

## 2: ELECTRICAL TECHNOLOGY (T4, T5, T6)

### Scheme of Examination

#### Std. XI

Paper	Title of the Paper	Theory		Practical		Term work	Project work	I.V.*	Total Marks
		Marks	Time (Hrs)	Marks	Time (Hrs)				
1	Electrical Wiring	80	3	80	3	20	10	10	200
2	Electrical Appliances	80	3	80	3	20	10	10	200
3	Electrical Machines	80	3	80	3	20	10	10	200

\* IV = Industrial Visits

\*\* OJT = On Job Training

#### Std. XII

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## Introduction

All India Council for Technical Education, (AICTE), the apex body for making and maintaining the norms of Technical Education in the country has framed a National Vocational Education Qualification Framework (NVEQF) for the polytechnics and Engineering Colleges.

NVEQF is introduced by Government in order to formally integrate vocational education together with its current conventional educational streams across school and higher education space and provide an opportunity and incentive to students to explore a large universe of opportunity.

It is important that a Vocational Educational Qualification Framework is in place that allow cross mobility of standards and their absorption in Industry with certain skill gained over a fixed period of time or their seamless integration into higher learning that enable them to acquire formal degree and higher skill so that they perform higher level jobs in industry.

The erstwhile Directorate of Vocational Education has gone for NVEQE based curriculum development.

Each curriculum provides a list of Job opportunities (both wage and self) and description of each job. The objective of the course, scheme of studies and examination pattern, syllabus are given.

The present competencies based curriculums on “Maintenance and Repair of Electrical Domestic Appliances - M.R.E.D.A.” and “Repair, Maintenance and Rewinding of Electrical Motors- R.M. & R.E.M. was implemented through Maharashtra State Board of Secondary and Higher Secondary Education, Pune after upgrading them since 2007-08. The two curriculums were falling short to fulfill the needs of Indian as well as foreign industries. To overcome this difficulty different group of expert worked to have a job and self employment generating opportunity by clubbing the two curriculums developed curriculum of Electrical technology vocational H.S.C. course likely to be equivalent to NVQEF level III and IV. The Group of Experts comprised of DVET officials, Experts from industries and Teachers and Instructors teaching to these two curriculums.

The suggestions by the various experts in the field of vocational education and industries will be greatly valued and will go a long way in bringing out a revised version after reviewing by them.

## Objectives

- To make students familiar with shop discipline, layout of electrical shop, safety practice.
- To acquire knowledge and skills about safety precautions while working.

- To acquire knowledge about function and use of various electrical tools, equipments and accessories.
- To acquire with properties and usage of different materials (conducting, insulating, wiring etc.)
- To know about electrical symbols of commonly used electrical parts.
- To develop knowledge about the wiring.
- To get introduced to electrical shop to classify different tools machines and equipments.
- To acquire skills for wiring methods.
- To develop knowledge about the wiring.
- To do any type of wiring such as house, industrial, commercial wiring.
- To know about planning layout, setting and up keeping of electrical Interactive Lecture, Workshop/Lab, Self-performed.
- To get knowledge about estimation, costing and billing of wiring.
- To ACQUIRE the detail knowledge of Electrical, Mechanical, cutting and holding tools various machines with their specific use handling and maintenance and precaution while handling.
- To UNDERSTAND how to work on electrical installation and shop floor safety precautions maintenance and upkeep
- To CREATE an awareness about all electrical domestic appliances
- To Develop technician skills in the field of dismantling, Servicing, Overhauling, Maintenance, testing and reassembling of electrical appliances.
- To ACQUIRE the skill in sales and marketing of the latest domestic appliances, equipment, spare parts and raw materials.
- To GAIN the knowledge and skill of motors transformer repairing, servicing and overhauling.
- To become a wire man / electrician with the details of installation, repairing and maintenance of commercial / industrial / house wiring.
- To obtain the detailed skills of reconditioning, repairing, charging and maintenance of various types of batteries, UPS, Invertors.
- To GROW UP as a first generation entrepreneur from non-business family.
- To participate in the development of country not as an employee but as an employer
- To RISE UP as a TECHNOCRAT with ability to take Higher Vocational Education.
- To make students familiar with winding shop discipline, layout of electrical winding shop, safety practice.
- To acquire knowledge and skills about safety precautions while winding.
- To acquire knowledge about function and use of various electrical machines, instrument equipments and accessories.
- To acquire with properties and usage of different materials (conducting, insulating, winding etc).
- To develop knowledge about the winding.

- To acquire skills for winding methods.
- To develop knowledge about the winding.
- To do any type of winding such as motor, transformer winding.

## **Job Opportunities**

### **Wage Employment**

- Technician in local government bodies Corporation, Star Hotels, Electricity Board, co-generation plants, factories, Industries, Townships.
- Wire Man
- Electrician
- Instructor in technical institution
- DG Set Operator
- Lift Operator
- Electrical Supervisor
- Technical writer
- Technician in Banks, IT Industries, General Industries
- Electrical domestic Appliances Assembler
- Electrical Domestic Appliances Tester
- Electrical domestic Appliances repairer
- Electrical Domestic Appliances Service Technician
- Electrical Domestic Appliances salesman
- Electrical Domestic Appliances Demonstrator
- Insurance Surveyor
- Lifts-hoists service Technician
- Pump Mechanic
- Motor rewinder
- Wireman Panel wiring
- Industrial Insurance Surveyor

### **Self-employment**

- Dealership and agency of MNC-EDA
- Owner of EDA Repair shop
- Owner of after sales shop
- Owner Assembly shop of o Electrical Appliances
- Proprietor Service centre for electrical appliances
- Proprietor Service centre for Electric motors
- Free-lance Service Technician
- Proprietor Installation and maintenance services of electrical Machines

- Contractor of domestic, industrial, hotels, banks, hospital, commercial shop, BPO, IT Company, Mobile Tower Maintenance
- Sales shop of electrical items, Batteries
- Owner Generator Set
- Servicing of UPS / Invertors / Batteries
- Owner Generator Set
- Servicing of UPS / Invertors / Batteries
- Licensed electrical Contractor

## Std. XI

### Paper I: Electrical Wiring (T4)

#### Objectives

To enable the students to

- 1) Acquire knowledge and skills about safety precautions while working.
- 2) Identify and to use different tools used in wiring.
- 3) All units with properties and usage of different materials.  
(Conducting Insulating, Magnetic, Instructural, Wiring etc)
- 4) Understand the general concept of Generation of electrical power.
- 5) Understand the general concept of different wires.
- 6) Know about electrical symbols used in electrical parts.
- 7) Know about electrical house wiring.

#### Theory

Sr. No.	Unit	Sub-Unit	No. of Periods
1.	Safety Precautions and shock treatment	Shop Discipline	10
		Electrical shocks and procedure for separating person from contact with live wire	
		First Aid different methods of artificial respiration	
		Electric fire	
		Fire Extinguishers	
2.	Electrical common tools	Electrical tools	10
		Pliers, Combination, side cutting, round nose, long nose,	

		Screw drivers, connectors, electrical knife	
		Neon tester, test lamp, series test lamp, pincer, line dori, plumb bob, steel rule, Tenor saw, Hacksaw, Hammer	
		Symbols uses in Electrical technology	
		Reading of electrical drawing	
3.	Current Electricity	Introduction, Generation of electricity, Types of electricity, Effect of electricity and appliances, Different energy sources, EMF, potential difference, current, voltage, resistance, conductance, power, energy, specific resistance, energy billing for a month, direct current and alternating current	10
4.	DC Circuits	Ohm's law, Series CKT, Parallel ckt, series and parallel combination, types of electrical ckt	10
5.	AC circuits	Introduction importance, star delta, capacitor, Fundamentals of AC circuits, Introduction of different ckt, power factor, classification of materials, cables, wires, and insulation low, medium, high voltage	22
6.	Fuse and soldering	Introduction, common fusing material, miniature circuit breaker, (MCB), molded case circuit breakers (MCCB), earth leakage ckt breaker (ELCB), Soldering equipments, precautions	10
7.	Common electrical wiring accessories	Wiring accessories, lamp holders, other accessories, distribution boards, types of wirings, types of wires	12
8.	Domestic wiring (house wiring)	Introduction and necessity of wiring, selection of wiring, types of wiring, I.E. rule of domestic wiring, testing and installation of domestic wiring. Earthing formats for electrical connections	24
9.	Illumination	Introduction, lighting and fixtures	12
<b>Total</b>			<b>120</b>

## Practical

Sr. No.	List of Practicals	Periods
1.	Safety measures to be observed followed in the electrical workshop	4
2.	Demonstration of elementary first aid	12
3.	Personal protection basic injury prevention basic first aid safety signs for danger, warning & caution	8
4.	Artificial respiration techniques of separating person in contact with & live wire	8

5.	Demonstration of use of fire extinguishers	8
6.	Demonstration of trade hand tools	6
7.	Use of crimping tools	8
8.	Measurement of current voltage of power of a appliances	8
9.	Calculate the bill of electricity for one month domestic use	8
10.	Verification of Ohm's Law	8
11.	Measurements of power of a appliance / circuit	8
12.	Calculation of unknown resistance V.I Method & Multimeter method	8
13.	Connecting of lamp in series	4
14.	Connecting of lamps in parallel circuits study of Resistance inductance	8
15.	Practical on P.F improvement of power factor	4
16.	Demonstration and identification of different types of wires & cables	8
17.	Demonstration and practice of using standard wire gauge	4
18.	Demonstration of cable joining kit	4
19.	Skinning the cable and joint practice on single and multistrand wire (straight married and pigtail joint)	8
20.	Market survey of electrical accessories	8
21.	Identification and use of writing accessories	8
22.	Practice one installation of common electrical accessories such as switch, holder, plug on board	8
23.	Two lamps controlled by two independent single pole switch	12
24.	Practice of conduit and concealed on stair case wiring	
25.	Installation and wiring connection of ceiling fan exhaust fan, geyser, water purifier	12
26.	Measurement of insulation resistance of new house wiring by using megger	12
27.	Practice of pipe & plate earthing	12
28.	Practical on electrical tube connection & testing fault & repair	8
29.	Industrial visit	12
	<b>Total</b>	<b>240</b>

## Paper II: Electrical Appliances (T5)

### Objectives

To enable the students to

- 1) Understand the working principle and construction of common domestic appliances
- 2) Know the cause of faults in these appliances
- 3) Acquire skills of testing and repairs of appliances
- 4) Know the working and construction of cells of batteries
- 5) Know the students about manufacturing of different appliances.

## Theory

Sr. No.	Unit	Sub-Unit	No. of Periods
1.	Testing Equipments & basic control equipments	Switch, fuse, line tester, electronic line tester, series test lamp for single phase, parallel test lamp for single phase, series test lamp for three phase, parallel test lamp for 3 phase, thermostat, bimetallic relay, thermocouple, overload switch, electromagnetic relay, MCB	10
2.	Electric iron	types of electric irons, ordinary, automatic, steam, spray, laundry	8
3.	Tea/ coffee maker	Electric kettle, coffee percolator, electric coffee mug/stirrer,	6
4.	Electric induction cooker	Electric induction plate cooker, simple rice maker	8
5.	Electric toaster	Ordinary, sandwich, pop up automatic	6
6.	Oven and tandoor	Oven, tandoor maker, Micro wave oven	6
7.	Water purifier	UV/RO, UV light effect on bacteria, reverses osmosis membrane process.	8
8.	Rectifiers and filter ckt	Rectifier, P type N type, Half wave, full wave, bridge rectifier	8
9.	Filter ckts and voltage regulator	Filter ckt, T-L, Pie types, voltage regulator IC	8
10.	Emergency Torch	Miniature lamp type, Farmers torch	8
11.	Battery charger	Battery charger ckt and different components	8
12.	Water boilers and geysers	Types of water boilers and geysers, corner, vertical, horizontal, market survey	12
13.	Cells & batteries	Types of secondary cells, cell in series and parallel, lead acid battery,	16
14.	Project	Project of above appliances	8
<b>Total</b>			<b>120</b>

## Practical

Sr. No.	List of Practicals	Periods
1.	Study precautions testing & repair of line tester parallel & series test	4



	lamp Study of application of heat control equipment such as thermostat bi metallic relay thermocouple	4
2.	Study of and application of over load switch, MCB, ELCB, Electromagnetic relay	4
3.	Dismantling reassembling testing and repairs ordinary laundry iron	12
4.	Dismantling reassembling testing & repairs electric tea / coffee maker	12
5.	Dismantling reassembling testing & repairs electric toaster	12
6.	Dismantling reassembling testing & repairs electric oven and tan door maker	12
8.	Dismantling reassembling testing & repairs electrical microven oven electrical	16
9.	Installation dismantling reassembling testing & repairs of UV & RO	16
10.	Study types of diodes	12
11.	Assemble & test bridge type rectifier with & without filter circuit	16
12.	Dismantling , reassembling testing & repair of emergency former torch	16
13.	Dismantling reassembling testing & repairs of car battery charger	16
14.	Dismantling reassembling testing & repairs of water boilers vertical / horizontal	16
15.	Study construction maintenance of lead acid cell battery	20
16.	Comparative study of above application according to market survey	16
17.	Visit above domestic & commercial appliance services & repair shop	16
	<b>Total</b>	<b>240</b>

## Paper III: Electrical Machines (T6)

### Objectives

To enable the students to

1. Understand the student to use & principle of different measuring electrical Instruments
2. Know various magnet & electromagnet.
3. Know various D.C. Motors construction, working principle & its application.
4. Know various single phase transformer construction principle and transformer equation & small transformer rewinding.
5. Know various single phase motors, construction working principle, applications.
6. Know various speed controls of single phase motors.
7. Students able to rewinding the different single phase motors
8. Students able to estimating, coasting and Billing

## Theory

Sr. No.	Unit	Sub-Unit	No. of Periods
1.	Measuring instruments	Introduction, types of measuring instruments, analog and digital, ammeter, voltmeter, wattmeter, multimeter, Ohm-meter, frequency meter, clip on meter, energy meter, tachometer, megger, earth resistance tester	9
2.	Electromagnetism	Introduction, types of magnets, basic magnetic terms, electromagnet, difference between permanent and electromagnet, magnetic rules, right hand rule, cork screw rule, end rule, dynamically, statically, mutual induction	12
3.	D.C. motor	Introduction of D.C. motor, working principle, construction, types of D.C. motors, necessity of starters, types of starters	15
4.	Single phase Transformer	Introduction, types of transformer, transformation ratio, rewinding, transformer testing	12
5.	Single phase A.C. motor	Introduction, working principles, types of single phase motor, construction, working principles, speed control and change of DOR, lubricants, testing of single phase motors, fault finding and trouble shooting, study of data sheet and up keeping of motor	15
6.	Single Phase A.C. motor winding	Introduction types of single phase motor winding, fundamental definitions, winding tools and equipments, winding materials	15
7.	Rewinding Procedure	Name plate data, inside data, method of removing burn coil and rewinding procedure, varnishing and baking methods, winding problems and developed diagram	30
8.	Estimation, costing and billing	Elements of estimation, elements of costing, billing	12
<b>Total</b>			<b>120</b>

## Practical

Sr. No.	List of Practicals	Periods
1.	Measure the power of single phase resistive load by V.I method	12
2.	To test single phase energy meter with the help of standard wattmeter & stopwatch	8

3.	Identical of magnetic & non – magnetic materials	8
4.	Verification of target & development in current carrying coil in a magnetic field	8
5.	Connection of D.C motor to suitable starter & measure current, voltage & speed	8
6.	Identical of terminal by measuring resistance of field & armature of D.C motor	12
7.	Practical on simple transformer test, continuity short circuit & earth of primary & secondary winding	12
8.	Practice on small / transformer rewinding & verify voltage and current ratio	16
9.	Measure the insulation resistance between winding to core of single-phase transformer	8
10.	Identification of starting and running winding of single phase motor by measuring resistance with the help of multimeter	8
11.	Measure the insulation resistance of single phase motor by using & megger	8
12.	To study the parts of single phase motor, test capacitor by screw driver & multimeter method	12
13.	To start run reverse capacitor start & capacitor run motor measure the current voltage & speed	8
14.	Dismantle and study of carbon brush, and commulotor of universal motor reassemble it, start run reverse universal motor measure the current voltage speed.	8
15.	Visit to rewinding shop & prepare detailed report	8
16.	Nothing data of burnt motor and remove burnt coils and clean the slot	8
17.	Insulate the slot and prepare new coils as per old coils test the rewinded motor & insert wedges in the slots	16
18.	Find out start and end terminals & tapping, binding shaping of coils	
19.	Inserting the coils and making connection as per developed diagram, varnishing & baking	16
20.	Assembling a motor and start it after rewinding	12
21.	Study concentric winding in split phase motor	12
22.	Market survey the cost size and specification of winding materials	12
23.	Estimation, costing & billing of single phase AC motor winding	12
24.	Visit to winding and repairing shop of motor	8
	<b>Total</b>	<b>240</b>

## Std. XII

### Paper I: Electrical Wiring (T4)

#### Objectives

To enable the students to

1. Acquire knowledge and skill about industrial and commercial wiring.
2. Identify and uses of different tools.
3. Understand planning, estimation and costing of industrial and commercial wiring.
4. Know about generation and transmission of electrical power.
5. Know about HT and LT substations
6. Know about different workshop tools and uses

#### Theory

Sr. No.	Unit	Sub-Unit	No. of Periods
1.	Industrial and commercial wiring	Introduction	24
		Study of Layouts and wiring diagram	
		Power circuit	
		Street light circuit	
		Control panel wiring	
		Protective Devices	
		Load Balancing of 3 phase supply	
		Troubleshooting and maintenance of wiring system of office	
		Maintenance & repair of commercial/Industrial wiring	
		IE rules	
		Testing of commercial/industrial wiring with megger	
		Earthing	
		Plate and rod type earthing	
		Pipe earthing	
2.	Planning estimation and costing of industrial and commercial wiring	Introduction	16
		Estimation, costing and bill	
		Elements of estimation	
		Proforma for estimation and costing	
		Elements of Costing	
		Material, Labour, Expenses, Methods of costing	
		Content of invoice proforma of invoice	
		Tenders	
3.	Generation and transmission	Importance of electrical power in day to day life	24

		Methods of power generating	
		1) Hydroelectric power station	
		2) Thermal power station	
		3) Nuclear power station	
		4) Solar power generation	
		5) Wind power generation	
		Co- generation	
		Need of co- generation	
		Types of co-generation	
		Topping cycle	
		Bottoming cycle	
		Power system layout types of power transmission system	
		Transmission voltages	
		Types of insulators used in transmission line	
		Lighting arrestor	
4.	HT and LT substation	Introduction	24
		Protective Devices	
		Switch gears	
		Introduction to layout and maintenance schedule	
		Single line diagram	
5.	Illumination	Circuit study installation and application of illumination sources	16
		Mercury, Vapor lamp	
		Sodium Vapor lamp	
		Metal halide lamps	
		LED Based modern lighting fixtures	
		Decoration lighting	
6.	Electrical services interactive lecture workshop lab, self performed	Introduction	16
		Classification of tools	
		Electrical hand tools	
		Mechanical hand tools	
		Cutting and holding tools	
		Application of other tools	
		Application of machines	
		Application of instruments	
		List of equipments	
		Raw materials	
		Planning, Layout and setting of electrical lab self performed	
		Up keeping of electrical shop	
		Safety precaution and measures	
<b>Total</b>			<b>120</b>

## Practical

Sr. No.	List of Practicals	Periods
1.	Demonstration on wiring with pvc channel	8
2.	Practice and concealed wiring	8
3.	Practice on surface wiring	8
4.	Measurement of insulation resistance of wiring insulation by using megger	8
5.	Continuity and polarity test by using megger	8
6.	Bus bar MCBs, Elcbs, fuse and DB with cable, gland, fixing in wiring installation.	8
7.	3 phase load balancing	8
8.	3 phase energy meter installation	8
9.	Estimate the cost of material and labour charges required as per market rate.	12
10.	Site visit on installation of different wiring system for office/commercial complex/malls/bank/lodge/hospital.	12
11.	Study of protective device used in power supply and its function	8
12.	Practice on operation estimation and costing of materials and accessories as per layout of industrial wiring	8
13.	Preparation of project report of electrical workshop/lab self performed	8
14.	Installation of DTH wiring	8
15.	Installation of CCTV wiring	8
16.	Installation of different chaser lighting circuit	8
17.	Workout measurement of a building or a shop and prepare the list of item for wiring.	12
18.	Prepare the list of item required for wiring with specification	8
	Visit to generation station and prepare detailed report. Visit to 33kv/132kv substation & Prepare detailed report. Visit 11Kv.440v transformer (DP) and prepare detailed report	12
19.	Three Phase load balancing	8
20.	To study protective device in substation	8
21.	Circuit study installation and application of Illumination sources	8
22.	Circuit study installation and application of mercury vapor lamp, sodium vapour lamp and metal halide lamp	12
23.	Circuit study, installation and application of LED based modern lighting fixtures and decoration lighting	8
24.	Electrical interactive lecture workshop/lab self performed and one apartment and one commercial complex.	8
25.	Industrial visit (minimum Three visit)	12
	<b>Total</b>	<b>240</b>

## Paper II: Electrical Appliances (T5)

### Objectives

To enable the students to

1. Understand the principle and uses of different testing and control equipments.
2. Understand the working principle, construction, and uses of different electrical domestic electrical appliances.
3. Acquire skills, testing and repairing of electrical appliances.
4. Know the working principle and construction of stabilizer, mixer, inverters, Refrigerators, washing machines, room cooler, air conditioners etc.
5. Know the functioning of craft, crane and lift.

### Theory

Sr. No.	Unit	Sub-Unit	No. of Periods
1.	Testing of Equipment and basic control equipment	<b>Testing instruments</b>	16
		Tester, Continuity tester, Test lamp, growlers	
		<b>Measuring Instruments</b>	
		R, V, I, W, KWH, IR, HZ, COSΦ, KVA	
		Control equipments	
		Control Switch, Fuse, Thermostat overload Relay MCB, Timer, ELCB	
2.	Heat Convertor (Blower Type)	Introduction	4
		Construction	
		Working Principal	
		Overhauling & precaution	
3.	Electric Hand drill machine	Ordinary Hammer tone, controlled speed DOR	6
4.	Introduction to power tools	Electric cutter grinder Hammer-chippers	6
5.	Ordinary Blender Mixer/Food procedure	Lassi Maker, Food procedure, juicer Attachment, food procedure, mixer single speed three speed	8
6.	Domestic Vacuum Cleaner	Carpet cylindrical type wet type up right type	6
7.	Different types of electrical fans	Car fan/ cabin fan table fan, pedestal fan, wall mounting fan, Blow/sprinkler fan ceiling fan, exhaust fan, exhaust cum fresh air fan	18
8.	Domestic floor	Ordinary Hammer tone, controlled speed DOR	4

	mill		
9.	Transistor	as a switch type of configurations common emitter amplifier, introduction to basic component LED Photo diode bridge zener diode, PNP-NPN transistor SCR UJT DIAC, TRAIC, LDR POT, Electrolytic Cap, Resistance Colour code	8
10.	Hand Dryer	Sensor used different types of sensor	4
11.	Emergency Light	Led/CFL fluorescent tube type	4
12.	Refrigerator	Refrigerator Deep Freezers	4
13.	Washing Machine	Ordinary Semi auto, Agitor, Drum, Pulsator, Side loading, Timer & value	6
14.	Room Cooler	Pillar, Window mounting table mounting semi-auto	4
15.	Types of stabilizers inverter, Home protector, UPS, Online Offline	VA capacity, selection, connections, Installations, working with block diagram	6
16.	Air Conditioners	Functioning & Installation	4
17.	Craft, Crane, Lift	Functioning	4
18.	Project on above appliances		8
<b>Total</b>			<b>120</b>

## Practical

Sr. No.	List of Practicals	Periods
1.	Dismantling, resembling techniques of testing instruments	4
2.	Study, Precautions, testing and repair of line tester, parallel & series test lamp for single phase supply and three phase supply.	8
3.	Precautions while using measuring instruments R, V, I, W, KWH, IR, HZ, COS $\phi$ , KVA, O	4
4.	Study, Dismantling, reassembling, up keeping, testing and repair of heat convector.	8
5.	Study, reassembling, up keeping function owning precaution, testing and repairs of electric hand drill machine	8
6.	Study, reassembling, up keeping function owning precaution, testing and repairs of electric power tools cutter, grinder, hammer	8
7.	Survey of power tools such as hammer/cutter/grinder machines of different make as projects.	8
8.	Dismantling reassembling up keeping testing & repairs blender, juicer, grinder.	8
9.	Dismantling reassembling up keeping testing & repairs mixer/food processor (3/6 speed)	12
10.	Dismantling reassembling up keeping testing & repairs of domestic vacuum cleaner car/pot/cylinder/wet/up-right.	12



11.	Study, dismantling, reassembling, installation, testing and repairs car fan/cabinet fan	12
12.	Study, dismantling, reassembling, installation, testing and repairs car fan/pedestal fan	8
13.	Study, dismantling, reassembling, installation, testing and repairs ceiling fan/exhaust fan	8
14.	Installation techniques, precautions, dismantling, up keeping, reassembling, testing and repairs of domestic floor mill	8
15.	Study of transistor biasing PNP, NPN and transistor as a switch	8
16.	Study of basic components testing and symbols	8
17.	Study of transistor as amplifier in common emitter configuration	8
18.	Dismantling, reassembling, testing and repair of hand dryer	8
19.	Study, testing, repairs, assembling of emergency CFL light	8
20.	Study, testing, assembling of refrigerator/deep freezer	8
21.	Study, testing, repairs, assembling of washing machine ordinary / semi / automatic	12
22.	Dismantling, reassembling, up keeping, testing and repairs of room cooler window, table pillar	12
23.	Study, selection, testing & repairs, installation of UPS, Stabilizers	8
24.	Study, selection, testing & repairs, installation of inverters	8
25.	Study, functioning, up-keeping, testing & installation of air conditioner	12
26.	Study, functioning, up-keeping, testing of hoist, crane & lift	8
27.	Visit exhibition to market survey	8
28.	Study of advanced appliance and detailed report	8
	<b>Total</b>	<b>240</b>

## Paper III: Electrical Machines (T6)

### Objectives

To enable the students to

1. Understand the student about three phase transformer construction and working principle.
2. Know the construction working principle and various types' three phase AC motors.
3. Students should rewinding the three phase motors.
4. Know about electrical pumps maintenance and repairs.
5. Know about different starters and relay settings.

### Theory

Sr. No.	Unit	Sub-Unit	No. of Periods
1.	Three phase Transformer	<b>Introduction</b>	20
		Working Principle construction of Transformer,	

		connections of transformer	
		<b>distribution and power transformer</b>	
		Transformer testing and maintenance	
2.	3phase AC MOTOR	Types of motor construction	22
		Working principle of poly phase motor (asynchronous motor )	
		Speed control of three phase motors	
		Testing and repairing	
		Installation and commissioning	
3.	Three phase AC motor winding	Fundamental winding terms	30
		Types of winding	
		Introduction of modern winding machine	
		Rewinding procedure of AC machines	
		Different types of winding data and its developed diagrams	
4.	Control circuits	Basic Controllers	16
		Some important definitions	
5.	Electric Pump	Working Principle	16
		Types of pumps	
		Maintenance & repairing of pumps	
6.	Motor starters and Relay setting	necessity of starter	16
		Procedure of relay setting in starter	
		Types of AC motor starter-Construction, working principle and uses of AC motor Starters 1) DOL starter 2) Fully automatic star-delta starter 3) Auto transformer starter 4) Rotor Resistance starter 5) Mobile remote control starter their ckt (connection) diagram.	
<b>Total</b>			<b>120</b>

## Practical

Sr. No.	List of Practicals	Periods
1.	Dismantling reassembling techniques of testing instruments	12
2.	To study of 3 phase transformer for its various connections i.e. star/star, star/delta, delta/star, scot	12
3.	Visit to transformer manufacturer	12
4.	Connect, start, run and reverse given 3 phase induction motor	12
5.	Measure starting and running current, voltage & speed of 3 phase induction motor	12
6.	Control the speed of 3 phase induction motor by various methods (by varying method by changing pole method)	12
7.	Dismantling the three phase motor	8
8.	Dismantling testing resembling and installation of three phase motor	12

9.	Noting data of burnt motor and remove the coils and clean the slot	12
10.	Insulate the slots, prepare new coils as per old could, in setting wedges in the slots, of rewound starter, tapping & binding & shaping of rewound starter coil	12
11.	Baking and varnishing of rewound starter	12
12.	Test the rewound motor, assemble the motor, test it and start and run	12
13.	Estimation, costing and billing of 3 phase induction motor rewind	8
14.	Find out start and end terminals by two voltmeter or two amp meter test the coil	8
15.	Study of control circuits accessories, preparation of simple circuits	12
16.	Dismantle the electric pump repairing and reassembling it	12
17.	Dismantle the submersible pump, repairing and reassemble it, study of float switch	12
18.	Study of relays, setting of relays	12
19.	Study of DOL starter and connect to three phase induction motor	12
20.	Study of fully automatic star delta starter and connect to 3 phase induction motor, replacement of faulty parts in starter	12
21.	Visit to rewinding shop and prepare detailed report	12
	<b>Total</b>	<b>240</b>

## Reference Books

1. Electrical Technology - Edward Hughes
2. Electrical Technology - H. Cotton
3. Study of Electrical Appliances and devices - K.B.Bhatia
4. Elements of Electrical Gadgets - K.B.Bhatia
5. Small Appliances Servicing - P.T. Brook Woll Jr.
6. How to repair small Appliances - Jack Darr
7. Electrical Wiring Estimating & Costing - J. D. Gupta
8. Audels Home appliances servicing - Edwin P. Anderson
9. Electrical Motor Repair - I. M. Anwani
10. Electrical Wiring Estimating & Costing - S. L. Uppal
11. Electrical Motor Winding & Repair - Anwani
12. Basic Electrical Engineering - A Kastkin
13. Basic Electricity (Hindi) - K. B. Bhist
14. Maintenance of Domestic Appliances - R. B. Lal
15. Audels Electrical Motor Guide - Edwin P. Anderson
16. House Wiring Practice - T. D. Bhise
17. Indian Electricity Rules - Nausheer Bharocha
18. Fundamental's of Electricity - Kernard C. Graham
19. Electrical Engineering - B. L. Theraja P - I, II, III, IV
20. Basic electronics - By V. K. Me
21. Basic Electricals - By B. L. Jheraja

## INFRASTRUCTURE

1. Classroom =400sf with charts, display board, black board, ohp, computer with internet facility
2. Workshop/lab =600sf with required appliances and wiring material, wiring boards at least two, charts, display board, black board, ohp, computer with internet facility
3. Electric power supply at least 5KW, 3 phase
4. Pure drinking water facility
5. Library may be common but separate store required

<b>List of Equipment</b>		
<b>Sr. No.</b>	<b>Description</b>	<b>Quantity</b>
1	Air conditioner functioning	1
2	Ammeter A.C. and D.C. analog	8
3	Ammeter multi range A.C. D.C.	8
4	Armature winding machine	1
5	Battery charger	2
6	Battery lead acid diff. types	2
7	Bi-metallic relay,	2
8	Blow lamp with 1ltr capacity	1
9	Wiring board	1
10	Centrifugal Pump	1
11	Ceiling fan winding machine	1
12	Centrifugal switch	1
13	clip on meter	2
14	Coil winding machine with counter clutch arrangement	1
15	Decorating night lamp for ceiling lamp	3
16	Digital energy meter single phase	1
17	Digital energy meter three phase	1
18	Digital panel mounted ammeter 0-20A	2
19	Digital panel mounted voltmeter 0- 500 V	2
20	Digital stop watch	1
21	Digital tachometer	1
22	Dimmer stat single phase	1
23	Dimmer stat 3 phase	1
24	Drawing oven with thermostat 230V single phase	1
25	Dummy new rewinded armature for universal motor	2
26	Dummy squirrel cage rotors of 1/3 phase	2
27	Dummy stators single phase/ three phase	2
28	Dummy transformer core/ stamping diff. sizes	2
29	Earth resistance testing set with spikes	1
30	Electric hand drill machine with bits	2
31	Electric microwave oven	1

32	Electric bell indicator	2
33	Electric blender/juicer	1
34	Electric blow fan	1
35	Electrical cabinet/cabin fan	1
36	Electrical ceiling fan	4
37	Electrical cutter/grinder	1
38	Electrical domestic floor mill	1
39	Electrical domestic vaccum cleaner	2
40	Electrical exhaust fan	2
41	Electrical food processor	1
42	Electrical hand drier	1
43	Electrical heat convector	2
44	Electrical induction cooker	2
45	Electrical invertors	1
46	Electrical iron ordinary, automatic, spray, laundry	4
47	Electrical room cooler	2
48	Electrical Soldering iron	4
49	electrical table fan	1
50	Electrical tea and coffee maker	1
51	electrical toaster	2
52	Electrical UV/RO Purifier	1
53	Electrical voltage stabilizer	1
54	Electrical washing machine Semi/ Automatic	2
55	Electrical water boiler	2
56	Electrical wind generator (model)	1
57	Electronic relay, electronic timer	2
58	Emergency torch/light	2
59	External growler	1
60	Fan regulator diff. types	4
61	Fluorescent tube with accessories	5
62	Frequency meter	1
63	Internal growler 250V	1
64	Mercury vapor lamp	1
65	Sodium vapor lamp	1
66	MCB's and ELCB's	2
67	Capacitor Motor	1
68	Capacitor start capacitor run motor	1
69	Sheded pole motor	1
70	Split phase motor	1
71	Squirrel cage induction motor 3 phase	1
72	Universal motor	2
73	Multi stage pump	1
74	Ohm-meter	1
75	Oil can	1
76	Phase sequence indicator	1

77	Starter auto transformer for 3 phases induction mot.	1
78	Starter automatic star/delta for squirrel cage induction 3 phase motor	1
79	Starter DOL for squirrel cage 3phase induction motor	1
80	Transformer C.T.	1
81	Transformer 230/6V 12V 2.5A	1
82	Power factor meter	1
83	Rectifier bridge, half wave, full wave	3
84	Refrigerator	1
	<b>Total</b>	<b>142</b>

<b>List of Tools</b>		
<b>Sr. No.</b>	<b>Description</b>	<b>Quantity</b>
1	Adjustable pipe wrench 350mm	2
2	Adjustable stator holder for rewinding work	2
3	Adjustable wrench	2
4	Allen key set (Metric)	2
5	Auto wire insulation stripper	5
6	Bearing puller suitable for 5HP motors	1
7	Bench vice 150mm, 200mm	2
8	Chisel cold 12mm, 300mm, 12mm 350 mm	8
9	Chisel firmer with handle	4
10	Crimping tools	1
11	De-soldering pump and wire	2
12	Dial gauge	1
13	Electrical knife with double blade	5
14	Electronic leak detector digital type	1
15	File set	1
16	Fire buckets 10 ltr	2
17	Fire extinguisher	1
18	Grease gun	2
19	Hack saw mini	5
20	Hammer ball pen	4
21	Hammer claw	2
22	Hammer straight pain	2
23	Hand drill machine with bit	1
24	Home protector	1
25	Hydrometer	1
26	Insulated side cutting pliers 10mm, 150mm	10
27	Mallet	2
28	Pincer	2

29	Pipe cutter	2
30	Pliers insulated combination flat nose, long nose	20
31	Spanner box set	1
32	Spanner set ring type	1
33	Spanner set box type	1
34	Spirit level	1
35	Standard wire gauge	2
36	Scissors	4
37	Screw driver set	5
38	Screw driver connector	5
39	Tube holder	4
40	Winding wire cutter	2
41	Wire pusher	1
42	Coil spreader	2
43	Electrical wrench diff. type	1
44	Tenon saw	2
45	Neon line tester	10
	<b>Total</b>	<b>138</b>