

Maharashtra State Board of Vocational Examination, Mumbai 400 051.

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|----|---|--|--------------|--------------------|-----------|--------|-----------|-----|-----|-------|-----|
| 1 | Name of Course | DIPLOMA COURSE IN LINEMAN | | | | | | | | | |
| 2 | Course Code | 302404 | | | | | | | | | |
| 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 | 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 | TRANSMISSION & DISTRIBUTION | 30240006 | 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 | TRANSMISSION & DISTRIBUTION | 30240006 | 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. |

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| <p>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.</p> | <p>Description of marking & cutting tools such as snips shears punches & other tools like hammers, mallets etc. used by sheet metal workers. Types of soldering irons-their proper uses.</p> <p>Use of different bench tools used by sheet metal worker. Soldering materials, fluxes and process.</p> |
| <p>12. Definition of Engineering Drawing. Uses of Engineering Drawing.</p> | <p>Freehand sketching of straight lines, rectangles, squares, circle polygons etc.</p> |
| <p>13. Geometrical construction of Square, Rectangle, Triangle, Circle, Ellipse, Polygons, etc.</p> | <p>Practice on Geometrical construction of Square, Rectangle, Triangle, Circle, Ellipse, Polygons, etc.</p> |
| <p>14. Lettering</p> | <p>Lettering practice</p> |
| <p>15. Different types of line.</p> | <p>Drawing of different types of line</p> |
| <p>16. 1st angle projection, 3rd angle projection. Orthographic views, Isometric views.</p> | <p>Drawing of different blocks</p> |
| <p>17. Drawing of plan, elevation & side views from isometric views</p> | <p>Practice of different blocks</p> |

BASIC ELECTRICAL WORKSHOP PRACTICE – 2nd year
(Subject Code – 30240001)

| THEORY | PRACTICAL |
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| <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 points-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> | |
| <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.</p> | <p>Making of different types of wire joints, fixing of lugs.</p> |
| <p>11. Two-dimensional geometrical construction – conic sections, involutes and cycloids – Representation of three-dimensional objects – principles of projections – standard codes of principles.</p> | |

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| 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. |

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| 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 |
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| <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>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>11. Study of R.C. series circuit and measurement of impedance, power and power factor.</p> <p>12. Study of R.L.C. series circuit and measurement of impedance, power and power factor.</p> |
| <p>5. Capacitors:</p> <p>Capacitor units and capacity. Concept of charging and discharging of</p> <p>Capacitors. Types of capacitors and their use in circuits. Series and parallel</p> <p>Connection of capacitors Energy stored in a capacitance</p> | <p>13. Connections of Ammeter, Voltmeter and Wattmeter in an A.C. circuit of resistive load.</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>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>16. Controlling lamps from two or three places.</p> <p>17. Drawing schematic diagram of single phase supply to consumers.</p> |

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| <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>18. Drawing schematic diagram of three phase supply to consumers.</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</p> <p>Introduction to resistance, capacitance and induction. What is inductive?</p> <p>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> | |

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| <p>9. Electrical Wiring</p> <p>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.</p> <p>Types of earthing - Plate Earthing, and pipe Earthing, their procedure and application.</p> <p>Solar Electricity</p> <p>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.</p> | |
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FUNDAMENTALS OF ELECTRICAL ENGINEERING - 2nd year

| THEORY | PRACTICAL |
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| <p>1. D.C. Machines –</p> <p>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.</p> <p>- -Connection of compound Generator- Voltage measurement-cumulative and differential –</p> <p>No Load & Load characteristics of Series, Shunt & Compound Generator.</p> <p>Controlling and protecting DC Generator.</p> |
| <p>3. DC Motors –</p> <p>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.</p> <p>-Connection, starting, running, speed control of motors. Testing of D.C. motors.</p> |

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| 5. Types of speed control of DC motors in industry Word-Leonard control, Thyristor/electronic controls. | Study of Thyristor/electronic control of DC motor. -Routine maintenance. |
| 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 buckholtz relay, other protective devices cooling of transformer Transformer oil testing and Tap changing off load and on load. Transformer bushings and termination. | 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, |
| 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 |

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| <p>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.</p> | <p>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.</p> |
| <p>10. Single phase induction motor- Working principle, different method of starting and running (capacitor start/capacitor run, shaded pole technique). FHP motors.</p> | <p>Connection of single phase motor, identification, testing, running, and reversing.</p> |
| <p>11. Universal motor-advantages Principle, characteristics, applications in domestic appliances and industry, Fault Location and Rectification.</p> | <p>Identification, connection, testing, running and reversing of universal motor. Practice of winding / rewinding.</p> |

TRANSMISSION & DISTRIBUTION - 1st Year

(Subject Code – 30240006)

| THEORY | PRACTICAL |
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| Line Supports – Wooden pole , Reinforced cement concrete , Pole , steel tower . O .H . Lines & U . G . Cables compare , Material for O .H . Lines & Properties . Line supports properties , Main components of overhead Lines --- Conductors , Supports , Insulators , Cross arms , danger plate , lightning arrestors , anti- climbing wires ect | To study the construction of M.C.B. To study the construction of O.C.B. Find out the all day efficiency of three phase transformer. Synchronizing of alternator by Bright lamp method. Synchronizing of alternator by Synchro scope method |
| Types of Power Generating Stations- Introduction , Working , Layout , Advantages & Disadvantages of ----- Diesel power station ., Hydro –Electric, Thermal Power station , Nuclear power station, Wind power station, Tide power station, Gas Turbine power station, Solar power station . | 1. Study the tools required for transmission line. 2. Western union joint of A.C.S.R. conductor. 3. Britaniya joint of A.C.S.R. conductor. 4. Installation of Pin type over head insulator. 5. Installation of Shakale type over head insulator. |
| Conversion from A .C . to D .C . - Necessary , Methods of conversion , Comparison of their advantages & disadvantages . Three phase rectifiers(mercury arc) | 6. Installation of Suspension type over head insulator. 7. Study the voltage grade of Transmission line. 8. Installation of service wire. 9. Installation of low and medium voltage transmission line. |
| Maintenance – Maintenance of Generator, Maintenance of Alternator Maintenance of Power station Maintenance of Battery Maintenance of Synchronous motor | 10. Safety measures while working on transmission line. 11. Installation of stay wire. 12. Practice of changing the D.O. 13. Study the major Transmission lines in maharashtra. |
| Tariff - Introduction , Define of Tariff , Types -- Define & their comparison --- simple, flat rate , two part –maximum demand ect . | 14. Study the layout of national grid. |

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| <p>I.E. Rules - I.E. Rules of pertaining to O.H. lines I.E. Rules of pertaining to ground clearance</p> <p>Sag and its affecting factors, conductor spacing</p> | |
| <p>Transmission voltage Transmission Lines –</p> <p>Low, medium, high, extra high voltages</p> <p>Two wire , Three wire , Four wire, Six wire, Seven wire.</p> | |
| <p>Tools and Accessories –</p> <p>Hand Glows. Gum Boot , Safety belt, ladder, Pulley, Crain</p> | |
| <p>Lay out of transmission line –</p> <p>Transmission line in maharastra.</p> <p>Transmission line of national grid</p> | |
| <p>Sub –stations -</p> <p>Introduction , A .C . substations types - pole –mounted , outdoor type , indoortype , one line diagram of generating station to distribution of supply , Ring mains system & Interconnected system of Distribution , Under ground Sub-station sketch & important points . Symbols for equipment in Sub-station - Bus- bar , Singal –break isolating switch , Double break switch , O .C .B . ,Arcing horn , etc . Bus –bar arrangement in Sub –stations sketches 1) Single (2) Duplicate</p> | |
| <p>Underground cable system –</p> <p>Introduction , Classification according to Voltage , Construction of Paper –insulated Lead Covered Cables , Types of 3 ph . Cables , Cable type De signation , Installation of Cable Lines – General , laying cables in Trenches – Laying Conduit – built & tier –by – method . , Undreground PVC Cables- construction , range selection current rating of Aluminium, power cable , short circuit rating , Bending ,radius , Load factor ,Cable jointing, Faults in the under ground cableMethod of locating faults.</p> | |

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| <p>Maintenance –</p> <p>Maintenance of Sub Station. Maintenance of Panel board. Testing of earthing . Protection of Trans. Buchholz Relay , Earth faults Relays etc . Sketch , Advantages & disadvantages .</p> | |
| <p>Relay –</p> <p>Introduction , Protective Relays –circuit Terms – Pick up current , Current setting , P .S .M . , Functional Relay Types – Sketchs of Induction Type- Overcurrent Relay , Directional power Relay , Impedance Relay , Current , Voltage Differential Relay .Types of Protection - Primary & Back – up</p> | |
| <p>Switchgear -</p> <p>Introduction , Define , Switchgear Equipment –1) Switches - Air-break , Isolator , Oil .2) Fuses 3) C .B . \$) Relays . Switchgear Accommodation – Outdoor type , Indoor type . Causes of Short –circuit Faults in Three phase System - Definition - Symmetrical & Unsymmetrical</p> | |

| TRANSMISSION & DISTRIBUTION - 2 nd Year | |
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| <p>1. System reliability: Introduction, definition of reliability, failure, probability, concepts, power quality variation, reliability measurements, power supply quality survey, reliability aids, and recent development.</p> | |
| <p>2. Reliability concepts: Measures of reliability rules for combining probabilities, Mathematical Expectation, Distributions, Reliability theory series and parallel systems, Markov processes. Static generating capacity reliability.</p> | <p>1. Maintenance of power Transformer.</p> <p>2. Perform parallel connection of Three phase transformer.</p> <p>3. Practice of changing the transformer oil.</p> <p>4. Installation of lightning Arrester.</p> |
| <p>3. Outage definition: Loss of load probability methods. Loss of energy probability method. Load forecast, System Design and planning, Strategies for generation, Transmission & Distribution networks. Transmission system reliability evaluation – Average interruption rate method. The frequency</p> | <p>5. Installation of panel board of low voltage distribution</p> <p>6. Repairing of panel board of low voltage distribution.</p> <p>7. Installation of panel board of medium voltage distribution</p> <p>8. Repairing of panel board of medium voltage distribution.</p> |

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| and duration method. | <p>9.Laying the Under ground cable normal condition.</p> <p>10.Laying the under ground cable across road.</p> <p>11.Fixing the gland to the cable.</p> <p>12.Fault finding of the under ground cable.</p> <p>13.Practice of jointing the under ground cable.</p> <p>14. Fault finding, repairing of circuit breaker.</p> <p>15.Replacement of transformer from sub-station</p> |
| <p>4. Interconnected system: Generating capacity reliability evaluation introduction. The loss of load approach, reliability evaluation in two and more than two interconnected systems, Interconnection benefits.</p> | |
| <p>5. Load forecasting: Necessity, short-term forecasting by preliminary analysis control, medium term forecasting by field survey method, long-time forecasting by statistical method. Regression analysis, Analysis of time series. Factors in power system loading.</p> | <p>1.To study the construction of cable.</p> <p>2. Installation of single phase energy meter for domestic purpose.</p> <p>3. Installation of Three phase energy meter for commercial purpose.</p> <p>4.To measure the power of single phase induction motor.</p> <p>5.To measure the frequency of given supply.</p> <p>6.To measure the power factor of given load.</p> <p>7.To measure the earth resistance by earth tester.</p> <p>8.To prepare plate earthing.</p> <p>9. To prepare pipe earthing.</p> <p>10. Calculate the voltage ratio of given single phase transformer.</p> <p>11. Calculate the current ratio of given single phase transformer.</p> <p>12.Find out the iron losses of given single phase transformer</p> <p>13.Find out the copper losses of given single phase transformer</p> <p>14.Find out the voltage regulation of given single phase transformer.</p> <p>15. Find out the all day efficiency of single phase transformer.</p> <p>16.To study the construction of M.C.B.</p> <p>17.To study the construction of O.C.B.</p> <p>18. Find out the all day efficiency of three phase transformer.</p> |

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| | <ol style="list-style-type: none"> 1. Study the tools required for transmission line. 2. Western union joint of A.C.S.R. conductor. 3. Britaniya joint of A.C.S.R. conductor. 4. Installation of Pin type over head insulator. 5. Installation of Shakale type over head insulator. 6. Installation of Suspension type over head insulator. 7. Study the voltage grade of Transmission line. 8. Installation of service wire. 9. Installation of low and medium voltage transmission line. 10. Safety measures while working on transmission line. 11. Installation of stay wire. 12. Practice of changing the D.O. 13. Study the major Transmission lines in maharashtra. 14. Study the layout of national grid. <ol style="list-style-type: none"> 1. Maintenance of power Transformer. 2. Perform parallel connection of Three phase transformer. 3. Practice of changing the transformer oil. 4. Installation of lightning Arrester. 5. Installation of panel board of low voltage distribution 6. Repairing of panel board of low voltage distribution. 7. Installation of panel board of medium voltage distribution 8. Repairing of panel board of medium voltage distribution. 9. Laying the Under ground cable normal condition. 10. Laying the under ground cable across road. 11. Fixing the gland to the cable. 12. Fault finding of the under ground cable. 13. Practice of jointing the under ground cable. 14. Fault finding, repairing of circuit breaker. 15. Replacement of transformer from sub-station. |
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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 | 4 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. | 2 no |
| 22 | Tube fitting | 4 no |
| 23 | Bell | 2 no |
| 24 | Buzzer | 2 no |
| 25 | Emergency light | 2 no |
| 26 | Lead acid battery | 2 no |
| 27 | Three phase main switch 16 amp. | 2 no |
| 28 | Three phase main switch 32 amp. | 2 no |
| 29 | Gum boot | 10 no |
| 30 | Rain coats | 10 no |
| 31 | Voltage Stabilizer | 2 no |
| 32 | Inverter | 1 no |
| 33 | Work Bench | 4 no |
| 34 | Bench vice | 4 no |
| 35 | Pipe vice | 2 no |
| 36 | Measuring Tape | 4 no |
| 37 | Steel rules | 4 no |
| 38 | Micrometer | 2 no |
| 39 | S.W.G. | 4 no |
| 40 | Filler gauge | 2 no |
| 41 | Multi meter | 4 no |
| 42 | Try square | 4 no |
| 43 | Pipe cutter | 4 no |
| 44 | Hacksaw with blade | 6 no |
| 45 | Hand Drill machine | 2 no |
| 46 | Chisel | 6 no |
| 47 | Spanner Set (Double Ended) | 2 no |
| 48 | Screw Driver | 20 no |
| 49 | Hammer | 10 no |
| 50 | Pocker | 8 no |
| 51 | Varnier calipers | 4 no |
| 52 | Files | 10 no |

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| 53 | Wire stripper | 10 no |
| 54 | Tester | 10 no |
| 55 | Pliers | 10 no |
| 56 | Electrician knife | 10 no |
| 57 | Mallet | 6 no |
| 58 | Tennon saw | 6 no |
| 59 | Firmer chisel | 10 no |
| 60 | Dial Gauge | 4 no |
| 61 | Ring spanner | 5 sets |
| 62 | Box spanner | 5 sets |
| 63 | Rope 5meter, 10meter, 15meter | 4 each |
| 64 | Ladder | 4 no |
| 65 | Hand Gloves | 10 no |
| 66 | Safety belts | 10 no |
| 67 | Fire fighting Extinguisher | 4 no |
| 68 | First aid box | 2 no |

REFERENCE BOOKS

| No | Name of the book | Author |
|----|--|---|
| 1 | Basic Electrical Engineering | M.L. Anwani |
| 2 | Basic Electrical Engineering | Sharma |
| 3 | Electrical wiring Estimating and costing | S.L. Uppal |
| 4 | Electrical Wiring Estimating and costing | J.B. Gupta |
| 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 | Electrical Technology | Edwardm Hughes |
| 11 | Electrical Technology | Bhatnager |
| 12 | Electrical Technology | B.L.Thareja |
| 13 | Fundamentals of Electrical Technology | V.K. Mehata |
| 14 | How to repair major appliances | Ernest Tricomi |
| 15 | Electrical Appliances: Installation and Maintenance (Second Edition) | E.Molloy |
| 16 | Basic Electronics | Berard Grob |
| 17 | Electrical Technology | H.Cotton |
| 18 | Elementary Electrical Engineering | M.L.Gupta |
| 19 | Principle of Generation System | Bhatia, |
| | 1. Roy Billinton & Ronald N. Allan –Reliability Evaluation of Power System, Volume –I 2. Roy Billinton & Ronald N. Allan –Reliability Evaluation of Power System, Volume –II 3. J. Endreny –Reliability Modeling in Electric Power System 4. A. S. Pabla –Electric Power Distribution | |
