

MAHARASHTRA STATE BOARD OF VOCATIONAL EDUCATION EXAMINATION, MUMBAI

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|--|--|---|--|--|---------------|-----|-----------|-----|-----|------------|------------|
| 1 | Name of Course | Diploma Course in Electrician | | | | | | | | | |
| 2 | Max no. of Students | 25 | Course Code - 302409 | | | | | | | | |
| 3 | Duration | 2 year | | | | | | | | | |
| 4 | Course Type | Full Time | | | | | | | | | |
| 5 | No. of Days per week | 6 days | | | | | | | | | |
| 6 | No. of hours per day | 7 Hrs | | | | | | | | | |
| 7 | Space require | Theory Class Room – 200 sqft Three Practical Lab – 500 sqft each | | | | | | | | | |
| 8 | Entry qualification | S.S.C. Pass | | | | | | | | | |
| 9 | Objective of syllabus | To understand basic of electricity, To understand and use various electrician hand tool, To perform various task related to Electric fitting of residential and commercial building | | | | | | | | | |
| 10 | Employment opportunities | work as electrician in electricity board, various industrial organizations, and commercial organizations, can start own electrician practice | | | | | | | | | |
| 11 | Teachers Qualification | For Vocational Subject -B. E. Electical or Equivalent and for Non Vocational Subject Master Degree in concern Subject. | | | | | | | | | |
| 12] Teaching Scheme – | | | | | | | | | | | |
| | Ppr | 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 Electricity and Measurement | 30240011 | 3 Hrs | 8 Hrs | 11 Hrs | | | | | | |
| 5 | Electrician Practice | 30240012 | 3 Hrs | 8 Hrs | 11 Hrs | | | | | | |
| 6 | Workshop Calculation, Science and Drawing | 30240013 | 3 Hrs | 8 Hrs | 11 Hrs | | | | | | |
| Total | | | | | 42 Hrs | | | | | | |
| 13 | Internship | Two Month Summer Internship from 1st May to 30th June is Compulsory. | | | | | | | | | |
| 14] Examination Scheme – Final Examination will be based on syllabus of both years. | | | | | | | | | | | |
| | P | 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 Electricity and Measurement | 30240011 | 3 Hrs | 100 | 35 | 3 Hrs | 100 | 50 | 200 | 85 |
| 5 | | Electrician Practice | 30240012 | 3 Hrs | 100 | 35 | 3 Hrs | 100 | 50 | 200 | 85 |
| 6 | | Workshop Calculation, Science and Drawing | 30240013 | 3 Hrs | 100 | 35 | 3 Hrs | 100 | 50 | 200 | 85 |
| Total | | | | | | | | | | 900 | 375 |
| 15 | Teachers – Three Teachers per batch for vocational component. For English, Elective-I & II guest faculty on clock hour basis. | | | | | | | | | | |
| 16 | Student have to choose any one subject for Elective-I and Elective-II from below given subjects | | | | | | | | | | |
| 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 | | | | | | | | | |

Subject – 1 - Basic Electricity and Measurement

(Subject Code – 30240011)

1. Conducting material

- 1.1 Conducting material-Properties, Classification,
- 1.2 Characteristics of good/Bad Conductors, Semi/Super Conductors and their Applications.
- 1.3 Bare Conductors, O.H. Conductors, ACSR, Copper Aluminum G. I. , winding wires Bus Bars ,
- 1.4 Wires & Cables, L.T.& H.T. Cables Conductors.
- 1.5 Requirements of Resistive Material.
- 1.6 Properties of Resistive material.
- 1.7 Types of Resistive Material.

2. Insulating material

- 2.1 Properties of Insulating material, Classifications,
- 2.2 Types w. r. t. Thermal sensitivity Insulating material & its Dielectric strength
(Solid, Liquid & Gas)
- 2.3 Insulation material Required for--Winding wires, Cables/ wires (HT & LT), O.H.
Insulators (Advance) HT & LT, Switch gear
- 2.4 Dielectric medium its properties. .

3. Semi Conductor material

- 3.1 Characteristics of semi conductors material.
Semi conductor alloys, oxides, sulphides & Halides etc.
- 3.2 Commonly used semi conductor material and their Application.

4. Magnetic material

- 4.1 Requirements of magnetic material Permanent Magnetic material,
- 4.2 Magnetic material used for cores (CRGO, Ferrites) Application.

5. Special Application of materials

- 5.1 Contact material- slip ring, force free spring, carbon brushes, Brush Holder, commutator, Switch
gear, Contacts
- 5.2 Thermocouple materials,
- 5.3 Bimetal materials,

5.4 Soldering materials, Fuse materials

6. Cell and Batteries

6.1 Requirements of Cell and Batteries materials

6.2 Primary Cells description, Classification

6.3 Secondary Cells , Classification Lead Acid Battery, Construction, Nicel Battery Maintenance free Battery

6.4 Maintenance, installation, applications, write off procedures.

7. Electrostatics

7.1 Voltage & Die-Electric Strength (concepts only)

7.2 Principle of Capacitor. Capacitance, Series / Parallel Combination Charging & Discharging of Capacitor.

8. Electric Current & Circuits

8.1 Concepts & Types of circuit., Ohm's Law, Factors Controlling the 'R' of material. Effect of Temp., Law of Resistance, Resistivity etc.

8.2 Polarity of 'IR' Drops. Internal Resistance, Potentiometer- Construction & Applications. Shunts- Applications.

9. Network Circuits

9.1 Kirchhoff's Laws (KCL, KVL), Simple problems, Wheatstone's Network, Meter Bridge & Applications.

9.2 Simple numerical Problems

10. Electro- Chemistry

10.1 Chemical effects of Electric current, Faraday's Laws of Electrolysis- E.C.E., Applications of Electrochemistry,

11. Thermo- Electricity

11.1. Heating effect of elect. Current, Joule's Law Thermocouple, See-back effect, & Application.

11.2 Simple Calculations on Joule's Law Electric Power, Energy, Calculations on Power & Energy (Elect. Bills).

12. Electro-magnetism.

12.1 Permeability, Laws of Magnetic Forces, Definitions Of Mag. Field strength, Flux density, Intensity of Magnetism,, MMF, Ampere-Turns, Reluctance. Etc. Comparison between Mag. Field & Elect. Field.

12.2 Ampere's Rule, Laplace's Law, Force on current carrying conductor in Mag. Field, Fleming's Left Hand Rule. Force between two parallel current carrying conductors,, Solenoid.

12.3 Faraday's Laws of Electromag. Induction. Magnitude of Dynamically & Statically induced EMF, Eddy current. Lenz's Law, Magnetic Losses-

13. A. C. Fundamentals

13.1 Generation & Equation of Alternating Voltages & Currents, Definitions of Phase, Phase Difference, Max. / Peak Value, R.M.S. Value.Average Value etc.

13.2 Vector algebra of A.C. Quantities. Characteristics of A.C. Circuit. Having Pure Resistance, Pure Inductance and Pure Capacitance

14. A. C. Circuits

14.1 A.C. Ckt. Having R, L & C in series, Power Factor, and P. F. improvement methods, Advantages/ Disadvantages.

14.2 A.C. Ckt. Having R, L & C in parallel, Vector & Admittance method. Series & Parallel Resonance Circuit and Its Characteristics.A.C. Bridges,

14.3 Poly-Phase Circuit. Generation & Phase Sequence Star / Delta Connection & its Characteristics. Power in 3 Ph. System for Balance & Unbalance load.

15. Electrical Measuring Instruments & Measurements

15.1 Absolute & Secondary Instruments. Principles of Operation of Instruments. Types of Torques for Instruments.

15.2 Classification of meters. M.I. meters, M.C. meters, Wattmeters Types, Explanation, Applications.

15.3 Energy meters- Types, Construction, Working, Errors in Energymeters, Applications. Digital Meters- Study, Advantages/ Disadvantages. Multimeters- Analog / Digital, merits-demerits.

15.4.Instrument Transformers- CT, PT, Characteristics, Applications, Testing Clip-On meter-construction, working, Megger, Earth Tester-Construction, Working & Applications.

PRACTICAL CONTENTS:

Engg Material -

01 To study the Construction of various types Cable

1.1 Construction of LT cable.

1.2 Construction of HT cable.

02 To study the various types of insulation material class wise

03 To find out the break down voltage of given transformer oil sample

3.1 To collect various samples of insulating oil.

3.2 To test the die elect. strength of samples.

04 To study LT & HT overhead lines insulator

05 To study characteristics of various types of special Resistive material

5.1 To study Temperature sensitive resistive material.

5.2 To study Light sensitive resistive material.

06 To study negative resistance characteristic of semi conductors

07 Collect any various magnetic materials e.g. Ferrite Core of Transformer & study.

08 Study characteristics of various types of thermocouple & its material

09 Study characteristics of Fuse material.

10 To prepare a chart of various types of batteries and troubleshooting

11 To study the Lead acid Battery material

12 To study related Indian Standard with Tech. Specifications, from related Web-sites of various engineering materials.

Electricity and Measurement

1 To Prepare a sheet of Atomic Structure.

2 To measure the Potential Diff. of a charged line.

3 To determine the Resistivity of a given material.

3.1 To measure the length of given wire.

3.2 To measure the diameter of wire & calculate cross section area

3.3 To measure the resistance of wire by ohmmeter/multi meter.

4 To measure the Internal Resistance of a Cell by Potentiometer.

- 4.1 To study the concept of internal resistance
- 4.2 To make connections as per ckt. diagram.
- 4.3 To calculate the internal resis. by using formula.
- 5** To Verify the characteristics of Kirchhoff's Laws.
- 5.1 To verify Kirchhoff's voltage and current law
- 5.2 To verify Thevenins, Nortons and Superposition's.
- 6** To Varyify the Faraday's Laws of Electrolysis& determine the E.C.E. of copper.
- 6.1 To understanding the process of electrolysis.
- 6.2 To know the concept of metal deposition through electricity passing
- 7** To determine the Joule's constant by electric method.
- 7.1 To understand the relations between current passing & heat generated.
- 7.2 To calculate the Joule's constant by formula.
- 8** To Verify the Fleming's Left hand Rule.
- 8.1 To find out the direction of mag. field around conductor.
- 8.2 To observe the direction of torque of conductor.
- 9** To verify the Faraday's Laws of Electromag. Induction.
- 9.1 To verify the Faraday's 1st law of elect. mag. induction.
- 9.2 To verify the Faraday's 2nd law of elect. mag. induction.
- 10** To trace out the sine wave of A.C. on C.R.O. & find out the various values of A.C. quantities.
- 10.1 To trace & measure the Peak value of A.C. sine wave.
- 10.2 To calculate the R.M.S. & Average value.
- 11** Verification of Improvement of P. F. by using Capacitors.
- 12** To verify the characteristics of Star & Delta connections.
- 12.1 To verify the characteristics of star connection.
- 12.2 To verify the characteristics of delta connection.
- 13** To measure the power of 3 ph. balance & unbalance load using two-wattmeter method & calculate the P.F. of load.
- 13.1 To measure the power of 3 ph balance load

13.2 To measure the power of 3 ph unbalance load

13.3 To calculate the P.F. of load using formula.

14 To calibrate the given 1 ph. Energy meter.

Title of Book Author Publication

A Text Book of Electrical Technology. Vol.-I B. L. Thereja, A. K. Thereja. S. Chand & Company Ltd, New Delhi.

Applied Physics B. G. Bhandarkar. Vrinda Publications.

Basic Electricity & Electronics-I S. K. Patel.A. D. Maydeo. Nirali Prakashan.

Electrical Measurements & Measuring Instruments. E. W. Golding. F. C. Widdis.

Wheeler Publishing, Allahabad.

Basic Electrical Engineering, Volume –I P. S. Dhogal. Tata McGraw-Hill.

Electrical Engineering Measurements A K Sawhny S Chand & Company Ltd,

1 Basic Electrical Engineering M. L. Anvani

2 Modern Electrical Engineer, volume-1 W. J. John

3 Electrical Engineering materials A. J. Dekker

4 Electrical Engineering materials Uppal / Arrora

5 Electrical Engineering materials Indulkar

6 Electrical Engineering materials Manchand

1 Plier Insulated combination 150 mm. -5

2 Long Nose Insulated Plier 150 mm -5

3 Punch Centre 150 mm x 9 mm.- 5

4 Wire Stripper 150mm- 5

5 Tweezer 100 mm Insulated -5

6 Neon Tester -5

7 Heat sink Plier -5

8 I.C. Tweezer / Puller -5

9 Screw Driver Set of 6 Nos. -5

10 Watch Maker Screw Driver -5

11 Adjustable Spanner / Slide Wrench (15 to 20 cis) -5

12 Electrician Screw Driver 250 mm thin Stem Insulated -5

13 Plier Side Cutting 150 mm -5

14 Allen Key set -5

1. 1 sq. mm PVC Copper flexible wire
2. Electric lamps 100 watt, 250 v.
3. Capacitors 400 v. assorted
4. Bare copper,allu, nichrome wire
5. Battery 6 volt
6. Testing Board
7. Assorted wires & cables
8. Latest Primary cells
9. Secondary Battery (Tubular plates)
10. Allu. soldering material & flux
11. Pin type Insulator Porcelain
12. Threaded Pin G.I
13. G.I.wire 10SWG
14. Sand Paper 0 Nos.
15. Cotton Waste
16. Neutral link
17. PVC Insulted single strand Aluminum cable 1.5 mm² ,250V grade
18. Flexible PVC insulated cable 14/0.2 250V grade
19. Bare copper wire 8SWG
20. Fuse wire 1,2,5,10,&25AMP
21. Insulation tape 20mm width 10m Coil
22. Tube light Choke 40W,240V
23. Copper Sleeves for 16mm² Cable
24. Copper Ferrule for 16mm² Cable
25. Copper Lug for 16 mm² Cable
26. Solder flux 25gm tin
27. Alca P Solder
28. Bearing Grease Shell Alrania or equivalent
29. Machine Screw 30mm long with nut & 2 Washers 25 nos
30. Emery Sheet No."00" 05 Sheet

Subject - 2 - ELECTRICIAN PRACTICE

(Subject Code – 30240012)

| Trade theory | Trade practical |
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| <p>Familiarisation with Trade, Instructor, Supervisor, Foreman, Principal.</p> <p>Activities, of the institute, importance of the trade, future prospect etc. Duties and responsibilities of trainees, safety measures to be observed.</p> <p>Elementary first aid. concept of standard and standardization.</p> | <p>Visit to the different sections of the institute.</p> <p>Demonstration on elementary first aid. Artificial respiration.</p> |
| <p>Matter, Atoms-structure, importance of physics-basic principles-work, power, energy .</p> <p>Identification of trade, hand tools – specifications and uses. Care and maintenance of hand tools.</p> | <p>Demonstration on trade hand tools. Identification of simple types-screws, nuts and bolts, chasis, clamps, rivets etc.</p> |
| <p>Fundamental of electricity electron theory- solar system-elements, free electrons- fundamental terms, definitions, units & effects of electric current.</p> | <p>Practice in using steel rules, cutting pliers, screw drivers etc. skinning the cables, and joint practice on single strand.</p> <p>Demonstration & practice on bare conductors such as- Britania, straight, Tee, Western union.</p> |
| <p>Solders, flux and soldering technique. Resistors types of resistors & properties of resistors.</p> | <p>Practice in soldering</p> <p>-Measurement of 'R' and measurement of specific 'R'.</p> |
| <p>Expl. Definition and properties of conductors, insulators and semi-conductors.</p> <p>Types of wires & cables standard wire gauge.</p> <p>Classification of wires & cables-insulation and voltage grades</p> <p>-Low, medium and high voltage</p> <p>precautions in using various types of cables</p> | <p>Demonstration and identification of types of cables</p> <p>Demonstration & practice on standard wire gauge</p> <p>Safe use of cables and wires</p> <p>As per I.S 732-1963-APP-D.</p> <p>Practice in crimping Thimbles, lugs .</p> |

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| <p>Common electrical accessories, their specifications, Common insulating material as per B.I.S.</p> <p>Concept of ckts.-types of ckts as per property as per current flow</p> <p>Ohm's law, series and parallel ckts. Kirchhoff's Law Reading of Analogy digital Ammeter and voltmeters only use-of protective devices of ckts-Fuses & their types Earthing etc.</p> <p>-Simple problems on ckts.</p> <p>-Conception of developments of domestic ckts, Alarm & a switch, A lamp, A fan with individual switches etc./Two way switch</p> | <p>Demonstration and practice on fixing common electrical accessories.</p> <p>Building/Layout/assemble of small electrical ckts. with common electrical accessories-reading & ammeter voltmeters</p> <p>-Verification & Ohm's Law</p> <p>-do- of series ckt.</p> <p>-do- of parallel ckt</p> <p>Practice in testing and connecting domestic appliances</p> |
| <p>Chemicals effect of electric current-principles of electrolysis. Faraday's Law of electrolysis. Electro-chemical equivalents. Explanation of Anodes and cathodes.</p> | <p>Assembly of a Dry cell-Electrodes-Electrolytes.</p> <p>Grouping of dry cells for a specified voltage and current.</p> |
| <p>Rechargeable dry cell-description advantages and disadvantages</p> <p>Care and maintenance of cells.</p> <p>Grouping of cells of specified voltage and current. Lead acid cell-description methods of charging- precautions to be taken & testing equipment.</p> | <p>Preparation of battery charging</p> <p>-Testing of cells</p> |
| <p>Lead Acid cells general defects & remedies.</p> <p>Nickel Alkale cell-description charging. Power & capacity of cells. Efficiency of cells.</p> <p>Wheat stone bridge and its application.</p> | <p>-Charging of a lead acid ceall, filling of electrolytes – testing of charging checking of discharged and fully charged battery.</p> |
| <p>ALLIED TRADES</p> <p>Marking use of chisel and hacksaw on flats, sheet metal filling practice, filling true to line</p> | <p>Introduction of fitting trade</p> <p>safety precautions to be observed description of files hammers, chisel, hacksaw, frames & blades- their specification & grades. Care. Maintenance of steel rule try square and files.</p> |

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| Drilling practice in hand drilling & power drilling machines. Grinding of drill bits. | Marking tools description & use. Types of drills description & drilling machines, proper use, care and maintenance. |
| Practice in using tapes and dies, threading hexagonal and square nuts etc. cutting external threads on stud and on pipes riveting practice. | Description of taps and dies types in rivets and riveted joints. Use of thread gauge. |
| Sawing and planing practice. Practice in using firemer chisel and preparing simple half lap joint. | Description of carpenter's common hand tools such as saws planes, chisels mallet claw hammer, marking, dividing and holding tools their care and maintenance. |
| Practice in using snips, marking and cutting of straight and curved pieces in sheet metals. Bending the edges of sheets metals. Reviting practice in sheet metal. Practice in marking different joints in sheet metal in soldering the joints. | Description of marking & cutting tools such as snibs shear punches and other tools like hammers, mallets etc. used by sheet metal workers. Types of soldering irons-their proper uses. Use of different bench tools used by sheet metal worker. Soldering materials, fluxes and process. |
| Define-magnetism & classification of magnets. Properties, care and maintenance, methods of magnetising magnetic material and Ferro magnetic substances. | Tracing the magnetic Field of a needle & bar magnet. Practice in magnetising mg. Materials. |
| Principles of Electro-magnetism corkscrew rule, right and left hand rules. Mg. Field of current carrying conductors and loop. Earth magnetism, solenoid its property. Magnetic terms Principle of Electro-magnetic Induction, Faraday's Law, Lenz's law. | Tracing the magnetic field set up by a current carrying conductor and a loop. Tracing the field of an Electro-magnet and study the variation of field strength by varying current number of turns etc. Assembly/winding of a simple Electro magnet. |
| Expl. types of resitors used in electrical ckts. Factors controlling the 'R' of a material. Specific resistance variation of 'R' with change of temperature. | - - Expl. to demonstrate variation of 'R' of a metal with the change of temperature. Concept development Expl. on specific resistance of a metal. - - Connection of a calling bell. - - Assembly of a calling bell/buzzer and rewinding of its Electro magnets. - - Measure of 'R' by drop method. - - Series & shunt ckts.-use of Ohm meter. |

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| Principle of D. C. generator. Fleming's right hand rules. Use of slip-ring & slit rings. Use of commutator. | Expl./Demonstration on Fleming's rule |
| Explanation of D.C. generator-function types-parts. E.M.F. equation-self excitation and separately excited Generators-practical uses. Use of Ohm meter and Megger. | Identification and testing of the parts of D.C. Generators. -Demonstration and use of Ohm meter. -Demonstration and use of Megger. |
| Types and characters of D.C. generators -Series Generators and types -Shunt Generators and types -Their applications -Simple problems on generator types, capacity etc. | -Practice in dismantling the D.C. generators. -Study of parts of the D.G. generators -Voltage Building. -Connection with panel Board - - measurement of series. Shunt field resistance - - -Identification of terminals of D.C. Generators - - -testing by megger |
| Define and expl. armature reaction, interpoles and their uses, connection of interpoles, commutation. Electromagnetic drag. Fleming's left hand rule .Principle of D.C. motor | - - connection of shunt generators, Measurement of voltage. No load & character. - - -demonstration on field excitation - - -load character of series Gen. - - -connection of a compound Generator-Voltage measurement – commulative and differential – controlling and protecting equipment, No load & load ch. Of a compound Gen. |

2nd year

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| Terms used in D.C. motor Torque, speed , Back -e.m.f. etc. their relation practical application, Related problems | Demonstration and practice in identification and testing of D.C. motor parts & terminals. Running, speed control & reversing |
| Types , characters and practical application of D.C. motors Starting of D.C. MOTORS -3 point & 4 point starters | Study of the characters of D.C. Motors . -study of 3 point & 4 point starters -connection, starting, speed control of starters with motors |

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| Types of speed control , their advantages & disadvantages & industrial application | Use of tachometers revolution counters with stop watch Routine maintenance |
| Expl. of electrical wirings . importance. I.E.E. rules . Types of wiring both domestic & industrial Specification for wiring accessories – wires cables, buttons etc. IS 732 –1963/5 Principle of laying out in domestic wiring testing by meggar C.T.S. system P.V.C. concealed system Maintenance & Repairing data sheet preparation | Fixing of switches. Holder, plugs etc. the T.W. Board. Identification and use of wiring accessories Practice in C.T.S. wiring with minimum to more number of points Use of two way switches Testing of installation by meggar Fixing of calling bells/buzzers Making of test boards & extension boards IS 732-1963/61 Repairing and testing of domestic electrical appliances |
| Specification, standards for conduits & accessories. Earthing, laying diagram for industrial conduit wiring | Identification & demonstration on conduits and accessories & their uses cutting & threading laying earthing, use of flexible conduit & testing by meggar Measurement of earth resistance |
| Comparison D.C. & A.C. advantages of A.C. Alternating current & related terms frequency, Instantaneous value, R.M.S. value Average value, Peak factor, Load factor. Generation of sine wave, phase, in phase out phase. Obstruction of A.C. 'R' X_L & X_C Impedance , power factor, Average power, reactive power, Reactive power Simple problems of A.C. obstruction & T.P. A.P. etc. | Demonstration of sine wave, instantaneous values etc. Study of the behavior of R, X_L , & X_C in A.C. ckts, both in series and in parallel |
| Problems on A.C. ckts. Both series & parallel power consumption P.F. etc. Concept of poly-phase star & Delta Connection Line Voltage & phase voltage, current power in a3 ph. Ckt. | Explanation on poly phase ckts. Current, voltage & power measurement in poly-phase ckts. Measurement of energy in single & poly-phase ckts. |

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| Explanation of alternator prime/mover type advantages, parts, regulation, phase sequence, specification of alternators & practical places of uses | Demonstration on alternators parts voltage building , load character & regulation |
| Explanation & definition of transformer, classification C.T. , P.T. Instrument and auto/VARIAC construction, parts working E.M.F. equations efficiencies, parallel operation & poly phase types of their connection Cooling, protective devices . Specification simple problems on E.M.F. equation, turns ratio and efficiency. Special transformers | 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 |
| Explanation of A.C. motors , comparison with D.C. classification – pulsating field & split phasing. Working principle construction of 1-ph Motors characters | Identification of induction motors (I –ph-) squirrel cage type . -split phase type -capacitor type slip ring type starting of induction motor Reversing Dismantling Assembling |
| Single phase motors contd. Split capacitors, repulsion and series motor working principle –parts- characters starting- running & reversing. Stepper motor & Universal | -----do----- Demonstration of stepper & universal motor |
| Explanation of Electrical measuring instruments -types -forces necessary to work instruments -moving coil permanent magnet -moving iron -range extension Multi Meter- -wattmeter -energy meter -frequency meter -calibration | Demonstration on scales on meters -study of M.C.P.M. Meter -do-M.I. meter -do-Range extension - - -do-Wattmeter - - -do-Multi meter - - do-energy meter - - do-frequency meter - - do-calibration of meter |

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| <p>Explanation of light white lights-illumination factors, intensity of light –importance of light. Human eye factor units</p> <p>Types illumination & lamps</p> <p>-Neon sign halogen</p> <p>mercury vapour, sodium vapour, Flourescent tube.</p> <p>-characters watt ages, fixing places. Types of lighting Decoration lighting – Drum switches, Direct & indirect lighting –efficiency in lumens per watt, colour available Thumb rule calculation of lumens.</p> <p>Estimating placement of lights and fans and ratings Explanation of S.N. and R.N. LAMPS</p> | <p>Study of intensity of light</p> <p>-do---Neon sign</p> <p>-do-Mercury vapour (H.P. & L.P.)</p> <p>--do-Sodium vapour</p> <p>--do-Halogen lamps</p> <p>-do-Single tube</p> <p>Double tube</p> <p>Practice in Decoration lighting –do-S.N. & R.N. lamps</p> |
| <p>TECHNIQUES , Procedures of layout of conduit wiring as per IS 732 –1963. Use of flame proof and explosion proof. Installation of P.V.C.conduit switches. Types of Earthing –technique , their relative advantages</p> | <p>Installation of conduit pipe wiring for lighting and power circuits for both 230 V & 440 V Practice in Earthing</p> <p>-do-in P.V.C. conduit. Measurement of earth resistance & Insulation resistance.</p> |
| <p>A.C Winding terms, Armature winding terms, coil side, end coil & grouping of coils. Connection to adjacent poles, connected armature winding, alternate pole connection, armature winding – Lap & wave connected.</p> | <p>Making forma, coil insulation, slot insulation, Insertion of coils in slots, coil connection Practice, in single layer concentric winding.</p> |
| <p>D.C. Winding terms, pole pitch, coil pitch back pitch. Front pitch-Progressive & retrogressive winding.</p> | <p>Winding practice in distributed type, testing for faults, Growled testing-baking impregnating & varnishing.</p> |
| <p>Revision of A.C. ckts. & obstructions & their behaviour in series & in parallel ckts. Measurement of power and power factor & improvement of P.F. in 1-ph and in poly phases.</p> | <p>Expts.. On A.C. ckts. 1 ph and poly phase.</p> <p>Expts. On Improvement of P.F. Measuring of power & energy in 1-ph & poly phase. Building up of voltage in an alternator & to find out No-load & Load characteristics.</p> |
| <p>Transformer construction cores winding shielding, auxiliary parts-breather, conservator buchltz relay, other protective devices. Cooling of transformer. Transformer oil testing and top changing off load and on load. Transformer bushings and termination.</p> | <p>Cleaning & maintenance of transformer-changing of silicajel, Conducting No.-load & short ckt tests. Testing & 1-ph & poly ph. Transformers.</p> |

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| <p>Induction motor.</p> <p>Slip Squirrel Cage-Double Squirrel Cage Ind. Motor & their Chs. Slip-ring induction motor-Construction & Characters Starting & controlling devices.</p> | <p>Measuring the line & the ph. Voltage in connection. Study of Star-Delta Starter.</p> <p>-do- Automatic</p> <p>-do- Measurement of slip.</p> <p>-do- P.F. at various loads.</p> |
| <p>Earthing as per I.E. rules Testing & Inspections of Installations as per I.E. Rules. Improvement on earthing IS-3043-1966. Repulsion motor-advantages principle-characters, Fault Location & Rectification.</p> | <p>Testing of Insulation of motor with H Identification, connection, testing, reversing of repulsion motor.</p> |
| <p>Define-converter-inverter, M.G. Set-description-Characters, specifications-running & Maintenance.</p> | <p>Starting, running and building up voltage & loading of M.G. set. Maintenance of M.G. sets.</p> |
| <p>Working of thermo-couple and its uses, KVAR & max. demand indicator. Ferrant type DC energy meter, Ampere-hour meter 3 phds. Energy meters Specifications maintenance & repair.</p> | <p>Study of thermo Couple instruments.</p> <p>-do- KVAR meter</p> <p>-do- Max. demand indicator.</p> <p>-do- D.C. energy meter.</p> <p>-do- A.C. plan 3 ph. Energy meter.</p> <p>Connection of C.T. and P.T. with K.W. and energy meters.</p> |
| <p>Insulating materials, their classifications, and their uses in industries.</p> | <p>Development of sequence of operation in detecting electrical & mechanical troubles in motors and Generators. Overhauling of A.C. and D.C. m/cs.</p> |
| <p>Types, specifications, advantages of different types of circuit breakers construction and maintenance I.E.E. rules for over head service lines. Study of U.G. Cables and laying techniques.</p> <p>Working principle and construction of Domestic and agricultural appliances-their maintenance.</p> | <p>Study of different ckt. breakers.</p> <p>Study maintenance & repair of domestic & agricultural equipment.</p> <p>Electric kettle</p> <p>-do- heater/Immersion</p> <p>-do- hot plate</p> <p>-do- cooking range</p> <p>-do- Incubators</p> <p>-do- Furnaces etc.</p> <p>- Pump set.</p> |

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| Wiring of light & fan ckts. on rolling stock Installation Lighting arrestor/lighting conductor. | Practice of wiring of lights and fans on rolling stock. Practice of fixing lightening arrestors and lightening conductors. |
| Study of the arc controlling devices. Explanation and classification & uses of miniature relays & protector devices. Use of electro-magnetic clutches. Explanation and principle of operation. | Study of miniature relays. -do- Electro-mag. Clutches. -do- Mercury Arc 1 ph/Poly phase rectifier -do- Metal rectifier. |
| Introduction to electronics conductor-Insulator-semi conductor energy level atomic structure. 'P' & 'N' type of materials – P – N- junction. Diode-classification of Diodes-Reversed Bias and Forward Bias. | Identification of semiconductor. Diodes-symbol codes-Tests on Diodes. Characters of Diodes. I.S. 2032 of VIII 1965. |
| Expl. and importance of D.C. Rectifier ckt. – Half wave, Full wave and Bridge ckt. L.E.D. and Solar cells. Filter ckts-passive filter. Expl. and importance of oscilloscope working scope. | Study of Half wave rectifier ckt. -do- Full “ “ -do- Bridge “ “ -do- Filter ckts -do- Oscilloscope -do- Different wave shapes and their values. |
| Expl. of principle of working of a transistor-Types of Transistors, Characters of a transistors, Biasing of Transistors. Mode of use of transistor. | Study of a transistors-Identification of construction and terminals. -tests Study of the characters of transistors. |
| Expl. & Definition of Amplifiers. How a transistor Amplifiers. Signals-Pulse shapers cascade system | Assembly & testing of a single stage Amplifier and checking in an oscilloscope. Study of Types of wave shapes. -do- Cascade Amplifier. |
| Expl. and definition of oscillator-working principle Explanation of stages and types. | Study of oscillator ckt. Voltage measurement-current -do- And study wave shapes in scope. |

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| Expl. and working principle and practical applications of U.J.T., F.E.T., S.C.R. Diac & Triac. | Study of simple ckts. contain U.J.T. for triggering -do- FET as an amplifier -do- Power control ckts. by S.C.R. & Triac & Diac |
| Power Supply Stabilizer | Demonstration on power supply stabilizer |
| Complete House wiring Layout. Circuit splitting load wire. I.E.E. rules. Multistoried house wiring system. Fault finding & repair. Repairing of domestic electrical appliances. | Practice in wiring and in maintenance of institute & Hostel building. Layout & repairing of workshop electrical installation. |
| Fault finding techniques in Decoration lighting. -do- Commercial displays -do- Dynamos, Generators etc. | Fault finding practice |

List of Tools & Equipment for The Trade of Electrician

| SL. No. | Items | Quantity |
|---------|--|----------|
| | Tool Kit | |
| 1. | Rule wooden 4 fold 60 mm | 10 |
| 2. | Scriber 150 mm x 4 mm (Knurled centre position) | 10 |
| 3. | Pincer 150 mm | 10 |
| 4. | Plier insulated 150 mm | 10 |
| 5. | Screw driver 150 mm | 10 |
| 6. | Punch centre 150 mm x 9 mm | 10 |
| 7. | Knife double bladed electrician | 10 |
| 8. | Hammer, cross pein 115 grams with handle | 10 |
| 9. | Electrician connector, screw driver 100 mm insulated handle thin stem. | 10 |

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| 10. | Electrician testing pencil I Ineon Tester | 10 |
| 11. | Heavy duty screw driver 200 mm | 10 |
| 12. | Electrician screw driver 250 mm thin stem insulated handle | 10 |
| 13. | Rule steel 300 mm | 10 |
| 14. | Saw tenon 250 mm | 10 |
| 15. | Hammer ball pein 0.75 kg with handle | 10 |
| 16. | Firmer chisel wood 12 mm | 10 |
| 17. | Gimlet 6 mm | 10 |
| 18. | Bradawl | 10 |
| 19. | Plier sude cutting 150 mm | 10 |

Shop tools, Instruments & Machinery

| | | |
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| 1. | C. Clamps 200 mm, 150 mm, 100 mm | 2 |
| 2. | Spanner 150 mm adjustable 15 degree as cly-burns | 2 |
| 3. | Blow lamp 0.5 litre | 2 |
| 4. | Melting pot | 1 |
| 5. | Ladder | 2 |
| 6. | Chisel cold flat 12 mm x 200 mm | 2 |
| 7. | Chisel wood firmer 25 mm and 6 mm | 4 |
| 8. | Drill machine hand 0 to 6 mm capacity | 2 |
| 9. | Electric drill machine portable 6 mm capacity | 1 |
| 10. | Pillar electric drill machine 12 mm capacity | 1 |
| 11. | Allen key | 1 Set |
| 12. | Oil can 0.12 litre | 2 |
| 13. | Grease gun | 1 |
| 14. | Out side micrometer 0 to 25 mm | 1 |
| 15. | Bench grinder motorized | 1 |
| 16. | Rawl plug tool and bit | 2 Set |
| 17. | Pullypuller | 1 |
| 18. | Bearing puller | 1 |
| 19. | Multi meter 0 to 1000 M Ohms 2.5 to 5000 volts | 1 |
| 20. | Ammeter 1 MA to 500 MA | 1 |
| 21. | Ammeter 0 to 1 amp. D.C. | 1 |
| 22. | K.W. meter 0 to 1 K.W. capacity with C.T. 1:2 | 1 |
| 23. | Single phase power factor meter | 1 |
| 24. | Frequency meter | 1 |
| 25. | Tong tester (Clipon meter) | 1 |
| 26. | Mill Voltmeter centre zero 100-0-100 m volt | 1 |
| 27. | Spring balance 0 to 15 kg. And 0 to 2.5 kg. | 2 Set |
| 28. | Stop watch | 1 |
| 29. | Techno-meter or revolution counter with stop watch | 1 |
| 30. | Scissors blade 150 mm | 4 |
| 31. | Crimping tool | 1 Set |
| 32. | Screw driver 100 mm | 4 |

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| 33. | Chisel cold flat 12 mm | 4 |
| 34. | Mallet hard wood 0.50 kg. | 4 |
| 35. | Hammer exetor type 0.40 kg. With handle | 3 |
| 36. | Hacksaw frame 200 mm, 300 mm adjustable | 4 (2 each) |
| 37. | Square try 150 mm blade | 4 |
| 38. | Divider 150 mm, outside & inside calliper | 3 (each) |
| 39. | Plier flat nose 100 mm | 4 |
| 40. | Plier Gas round nose 100 mm | 4 |
| 41. | Plier Gas 150 mm | 4 |
| 42. | Tweezer 100 mm | 4 |
| 43. | Snip straight 150 mm | 2 |
| 44. | Snip bent 150 mm | 2 |
| 45. | Spanner D.E.W./W standard set | 2 |
| 46. | Drill hand brace 0 to 100 mm | 4 |
| 47. | Drill S.s. Twist block 3 mm, 5 mm, 6 mm set of 3 | 4 |
| 48. | Lane, smoothing cutters, 50 mm | 4 |
| 49. | Gauge, wire imperial | 2 |
| 50. | File flat 200 mm 2 nd cut | 3 |
| 51. | File half round 200 mm 2 nd cut | 4 |
| 52. | File half round 200 mm smooth | 4 |
| 53. | File round 200 mm 2 nd cut | 4 |
| 54. | File round 100 mm 2 nd cut | 4 |
| 55. | File flat 150 rough | 4 |
| 56. | File flat 250 mm smooth | 4 |
| 57. | File flat 250 mm rough | 4 |
| 58. | File flat 250 mm bastard | 4 |
| 59. | Rasp, half round 200 bastard | 4 |
| 60. | Iron, soldering 225 grams 125 watt | 4 |
| 61. | Vice hand 50 mm jaw | 4 |
| 62. | Stock and dies conduit | 1 |
| 63. | Ammeter M.C. 0-25 A.D.C. | 1 |
| 64. | Ammeter M.c. 0-5 A.D.c. | 1 |
| 65. | D.C. energy meter 220 V 5 A W/H or A/H type | 1 |
| 66. | A.C. voltmeter M.I. 0-500 V | 1 |
| 67. | A.C. Ammeter M.I. 0-25 A | 1 |
| 68. | A.c. Ammeter M.I. 0-5 A | 1 |
| 69. | A.C. Energy meter (single phase 5 amp. 230 V) | 1 |
| 70. | Megger 500 volts | 1 |
| 71. | Wheat stone bridge complete with galvanometer and battery | 1 |
| 72. | Fan A.C. 230 vlt 1200 mm | 2 |
| 73. | Fan D.C. 220 volt 1200 mm | 2 |
| 74. | Bath impregnating | 1 |
| 75. | Oven stoving | 2 |
| 76. | Vice, table jaw 100 mm | 3 |
| 77. | Lockers with 3 drawers (Standard size) | 2 |
| 78. | Bench working 2.5x1.20x0.75 meters | 4 |
| 79. | Almirah 2.5x1.20x0.50 meter. | 1 |
| 80. | Instructor's table | 1 |
| 81. | Instructor's chair | 2 |
| 82. | Fire extinguisher | 2 |
| 83. | Fire buckets | 4 |

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| 84. | Metal rack 180x150x45 cm | 4 |
| 85. | Wire stripper 20 cm | 1 |
| 86. | Copper bit soldering iron 0.25 kg. | 4 |
| 87. | Domestic appliances : | 2 |
| | (a) Electric hot plate 1500 watt. 220 V with temperature control | |
| | (b) Electric kettle, 100 watts, 230 V | 2 |
| | (c) Electric iron 1200 watts, 230 V with temperature control | 2 |
| | (d) Immersion heater 750/1000/1500 W-230 V | 2 |
| | (e) Geyser 25 litre 240 V (Storage type) | |
| | (f) B.A. taps and dies 0-2-4-6-8 sizes | 1 Set |
| 88. | Spring balance 0-1 kg. | 1 |
| 89. | Laboratory type induction coil 6 volt to 800-10,000 volt | 1 |
| 90. | Series type Ohm meter 0-2000 approximate | 1 |
| 91. | Shunt type Ohm meter 0-25 approximate | 1 |
| 92. | 3-point D.C. starters | 1 |
| 93. | 4-point D.C. starters | 1 |
| 94. | Pipe cutter to cut pipes upto 5 cm dia | 4 |
| 95. | Pipe cutter to cut pipes upto 5 cm dia | 1 |
| 96. | Cut out, reverse current, over load voltage relays | 1 each |
| 97. | Stock and die set for 20 mm to 50 mm G.I. pipe | 1 Set |
| 98. | Starters for 3-phase, 400 V, 50 cycles, 2 to 5 H.P. A.C. motors | |
| | (a) (a) Auto transformer type starter | 1 |
| | (b) (b) Star delta starter with manual, Semi-auto & Automatic | 1 |
| | (c) (c) Direct on line starter | 1 |
| 99. | Motor A.C. series type 230 V, 50 cycles, ¼ HP with starter and switch | 1 |
| 100. | Electrical machine trainer Suitable for demonstrating the construction and functioning of different types of DC machines and AC machines (single phase and three phase). Should be complete with friction brake dynamo meter, instrument panel and power supply units. | 1 per institute |
| 101. | Scientific Calculator | 2 Nos. |
| 102. | Multi meter | 2 Nos. (Large size) |
| 103. | Motor generator set consisting of : Motor induction squirrel cage, 7 HP 400 volts, 50-cycles, 3-phase with star delta starter and switch directly coupled to DC shunt generator 5 KW 440 volts, and switch board mounted with regulator, air circuit breaker, ammeter, voltmeter knife blade switches and fuses, set complete with case iron and plate, fixing bolts, foundation bolts and flexible coupling. | 1 |
| 104. | Motor generator set consisting of : Motor shunt 5 HP, 440 Volts with starting compensator and switch directly coupled to generator AC 3.5 KVA, 400/230 volts, 3-phase, 4 wire, 0.3 PF 50 cycles with exciter and 1 switch board mounted with regulator, circuit breaker, ammeter, voltmeter frequency meter, knife blade switch and fuses etc. Set complete with cast iron bed plate, fixing bolts, foundation bolts, 7 flexible coupling. | 1 |
| 105. | Motor series DC, 220 volts, 0.5 to 2 HP 0.5 to 2 HP. | 1 |
| 106. | Motor shunt DC 220 volt 2 to 3 HP | 2 |
| 107. | Motor of AC squirrel cage, 3-phase, 400 volt, 50 cycles, 2 to 3 HP with star delta starter & triple pole iron clad switch fuse. | 1 |

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| 108. | Motor AC phase-wound slip ring type 5 HP 400 volts, 3-phase, 50 cycles with starter and switch. | 1 |
| 109. | Motor DC compound-wound, 220 volt 2 to 3 HP with starter 7 switch | 2 |
| 110. | Motor AC single phase, 230, volt, 1 HP repulsion type complete with starter and switch. | 1 |
| 111. | Motor AC single phase 230 volt, 50 cycles series type with starter/switch 1 HP. | 1 |
| 112. | Motor AC single phase 230 volt, 50 cycles capacitor type with starter switch 1 HP. | 1 |
| 113. | Motor universal 230 volt, 50 cycles with starter/ switch 1 HP | 1 |
| 114. | Transformer single phase, 3 KVA, 230/115 volts, 50 cycles core type, air cooled with tapings for scd. Connection. | 3 |
| 115. | Transformer three phase, 5 KVA 400/230 volts, 50-cycles, delta and star, shell type oil cooled | 2 |
| 116. | Current transformer | 2 |
| 117. | Potential transformer | 2 |
| 118. | Used DC generators-series, shunt and compound type for overhauling practice | 1 each |
| 119. | D.C. shunt generator, 2.5 KW, 220 V with control panel | 1 |
| 120. | D.C. compound generator, 2.5 KW 250 V with control panel including field rheostat, voltmeter, ammeter and circuit breaker | 1 |
| 121. | Variable auto transformer 0-250 V, 5 amps | 2 |
| 122. | Diesel generator, 5 KVA, with change over switch, current circuit breaker, water cooled with armature, star-delta connections. | 1 |
| 123. | Oscilloscope | 1 |
| 124. | Function Generator | 1 |
| 125. | Oil testing Kit | 1 No. |
| 126. | Flux meter | 1 No. |
| 127. | Stepper motor | 1 No. |
| 128. | Earth leakage ckt. breaker | 1 No. |
| 129. | Desoldering gum | 4 Nos. |
| 130. | A.C.B. 5 KVA | 1 No. |
| 131. | O.C.B. 5 KVA | 1 No. |
| 132. | M.C.B. 5 KVA | 1 No. |
| 133. | V.C.B. 5 KVA | 1 No. |
| 134. | Thyrister drive 1 H.P. with techogenerator | 1 No. |
| 135. | Voltage Stabilizer manual and automatic | 1 No. each |

Note : No additional items except those under Trainees Kit are required to be provided for a second batch.

For the batch working in the second shifts, only the items under Tool Kit and lockers are required to be provided.

For the second batch the items under trainees are required to be provided.

Subject - 3 - Workshop Calculation, Science and Drawing

(Subject Code : 30240013)

| | W/S CAL. & SCIENCE |
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| 1. | Simple arithmetic addition, subtraction , Multiplication, Division of whole and partial number. Properties of metals and their importance in trade |
| 2. | Fraction & decimals , conversion of fraction to decimals and vice versa/ |
| 3. | Properties of C.I. & its types, uses. properties of Non –ferrous metals and how its identifications. |
| 4. | Properties of copper, Zinc , mild steel , aluminum etc. |
| 5. | Properties of Brass steel , bearing metals, timber etc. |
| 6. | Decimals, Division, multiplication |
| 7. | Logarithm and how to find out mantisa & characteristics. |
| 8. | Properties of C.I steel |
| 9. | Work , power , energy |
| 10. | Motion, velocity and problems. |
| 11. | Volume, mass, density applied problems. |
| 12. | Properties of metal and their applications |
| 13. | Square roots, power conversion of decimal to British & vice versa |
| 14. | Square roots, power conversion of decimal to British and Vice versa |
| 15. | Multiplication power root of a number |
| 16. | Problems on work , power & energy |
| 17. | Ratio & percentages and problems |
| 18. | Meaning to stress, strain, energy , elasticity |
| 19. | Meaning of stress, strain, energy , elasticity |
| 20. | Stress and its important factors example. |
| 21. | Ration and proportions, ratio, fining forms and ratio proportions direct and indirect proportions |
| 22. | Application of ratio and proportion to shop problems |

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| 23. | Mixed direct and indirect proportion problems |
| 24. | Machines – basic principles , velocity ratio. mechanical advantages , efficient simple problems. |
| 25. | Algebraic symbols & fundamental algebraic operations signs & symbols used in algebra, co-efficient , terms like terms and unlike terms |
| 26. | Addition and subtraction , multiplication and division |
| 27. | Logarithm and antilogarithms . Problems on logarithms |
| 28. | Simple machines like winch pulley & compound axel etc. with examples. |
| 29. | Factors and equation of algebraic formula. |
| 30. | Factors and equations-types of factorisations. |
| 31. | Heat treatment of steel-hardening, annealing, tempering, normalizing, case hardening-standard and measurements-equations-simple simultaneous quadratic. |
| 32. | Application construction and solution of problem by equations. |
| 33. | Atmospheric pressure. pressuregauge gauge pressure & absolute pressure. |
| 34. | Power & exponent & laws of exponent. |
| 35. | Arithmetical operations involving logarithms in the computations. |
| 36. | Problems related to trade using logarithm tables. |
| 37. | Density of solid and liquids simple experiments and determination. |
| 38. | Specific gravity principle of Archimedes. |
| 39. | Relation between specific gravity and density. Simple experimental determination. |
| 40. | Geometry- Fund-mental geometrical definitions angles and properties of angles, triangles and properties of triangles. |
| 41. | Pythagoras theorem, properties of similar triangles. |
| 42. | Revision of 1st year topics. |
| 43. | Revision of 1 st year topics. |
| 44. | Rectangle, square, rhombus, parallelograms etc. and their properties. |
| 45. | Circle and properties of circles Regular polygon. |
| 46. | application of geometry to shop problem |
| 47. | Heat & temp. thermometric scales their conversions. |

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| 48. | Temp. measuring instruments. |
| 49. | quantity of specific heat of solids liquids & gases. |
| 50. | Heat loss and heat gain with simple problem |
| 51. | Mensurations, plain figures-triangles, square rectangles, parallelogram. |
| 52. | Plain figures-trapezium, regular polygons, circle, hollow circles. |
| 53. | Plain figures segment and sector of circle, ellipse fillets. |
| 54. | Solid figures- prism, cylinder, pyramid, cone. |
| 55. | Solid figures-frustum of cones sphere, spherical segment. |
| 56. | Material weight and cost problems related to trade. |
| 57. | Trigonometry, Trigonometrical ratios use of trigono table. |
| 58. | Finding height and distance trigonometrically |
| 59. | Area of triangle by trigonometry. |
| 60. | Application of trigonometry to shop problems. |
| 61. | Application of trigonometry to shop problems. |
| 62. | Triangle of forces. Parallelogram of forces. |
| 63. | Composition and resolution of forces. |
| 64. | Representation of forces by vectors. Simple problem on lifting tackles like jib cranes, wall crane and solution of problem with the aid of vectors. |
| 65. | Simple problems on strength and crank lever. |
| 66. | Center of gravity-simple experimental determination stable-unstable and neutral equilibrium simple explanation. |
| 67. | Friction-co-efficient of friction. |
| 68. | Simple problem related to friction. |
| 69. | Magnetic substances neutral and artificial magnets. |
| 70. | Bausch principle of electricity. Method of magnetization & uses of magnets,. |
| 71. | Basic principle of electricity. |
| 72. | Use of fuses, conductors switches, insulator etc. |
| 73. | Simple electric circuits. Simple calculations. |
| 74. | Ohm's law-simple calculations-electrical insulation materials. |

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| 75. | Graphs-Abscissa & ordinates, graphs of straight line, related to 2 sets of varying quantities. |
| 76. | Further practice on logarithm. |
| 77. | Shop problems on estimation of material, time taken for machining a job elementary time and motion study. |
| 78. | Shop problems on estimation of material, time taken for machining a job, elementary time and energy. |
| 79. | Transmission of power by belt pulley and gear drive. |

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| | ENGINEERING DRAWING |
| 1. | Reading of simple drawing , Engineering drawing & its importance and instruments used in drawing |
| 2. | <ul style="list-style-type: none"> i) Making of Title blocks as per IS 465 1988 ii) Various sizes of drawing sheets iii) Various types of pencils & sharpening methods. iv) Types of lines & their application as Per SP 46: 1988 |
| 3. | use of drawing tools simple geometrical construction |
| 4. | Geometrical construction regular polygone circles |
| 5. | Geometrical construction of polygon inscribed circles |
| 6. | Curves and types of curves & their application and method of drawing curves |
| 7. | Geometrical construction, cycloid, hyperbola parabola curves, ellipse. |
| 8. | Free hand sketch of lines, polygons , ellipse etc. |
| 9. | Free hand sketch of basic tools and simple geometrical const. cone, pyramid , frustum / prism etc. / sphere |
| 10. | Construction of scale diagram, division of odd parts of scale with drawing instruments by sketch |
| 11. | Letters and its types and drawing of letters |
| 12. | Methods of ellipse. How to draw by drawing the instruments . |
| 13. | Simple dimensions with technics and location of parts as per dimensions , angle , taper |
| 14. | Transforming of various measurement, linear , Angular , Circular etc. |

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| 15. | Pictorial drawing Isometric drawings of simple block |
| 16. | Oblique views of simple geometrical construction |
| 17. | Isometric drawing on simple blocks |
| 18. | Isometric drawing on completed jobs |
| 19. | Free hand sketches of trade related hand tools cutting tools, measuring tools |
| 20. | Free hand sketches of trades related hand tools m measuring tools |
| 21. | orthographic drawing application of both first angle and third angle methods in representing the drawing for simple & complex machine blocks given for exercise with dimensions |
| 22. | Orthographic drawings application of both first angle and third angle. Methods in representing the drawing for simple and complex machine blocks given for exercises with dimensions |
| 23. | Standard method of sectioning as per IS-696. Exorcises for different sectional views on the given orthographic drawing of machine parts, castings etc. |
| 24. | Standard method of sectioning as per IS 696. Exercise for different sectional views on the given orthographic drawing of machine parts, casting etc. |
| 25. | Inter conversion of Isometric to orthographic drawings and vice-versa. Related problems such as V blocks-simple stepped blocks, block oriented by various machining operations etc. |
| 26. | Interconversion of isometric, oblique drawings to orthographic drawings and vice-versa. Related problems such as V-blocks simple stepped blocks, block oriented by various machining operations etc. |
| 27. | Free hand sketch of sectional tools. |
| 28. | Interconversion of isometric, oblique drawing to orthographic drawings and vice-versa. Related problems such as V block simple stepped blocks, blocks oriented by various machining operations. |
| 29. | Surface development of simple geometrical solids like cube, rectangular block, cone, pyramid, cylinder, prism etc. |
| 30. | Interpenetrating of solids and conventional application of intersectional curves on drawings. |
| 31. | Screw thread their standard forms as per I.S. external and internal thread conventions on the feature for drawings as per I.S.I. |
| 32. | Sketches for bolts nuts screw and other screw screwed members |
| 33. | Standard rivet forms as per ISI |

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| 34. | Riveted joints. |
| 35. | Riveted joints butt |
| 36. | Sketches of keys, cutter & pin joint. |
| 37. | Sketches of keys, cotter and pin joints. |
| 38. | Sketches for simple pipe unions with simple pipe line drawings. |
| 39. | Concept of preparation of assembly drawing and detailing simple assembly and their details of trade related tools/jobs/exercises with dimensions from the given sample or model. Tool post for the lathe with screw and washer. |
| 40. | Concept of preparation of assembly drawing and dove tailing. Simple assemblies and their details of trade related tools /jobs the exercises with dimensions from the given sample or models. Tool post for the lathe with washer and screw. |
| 41. | Details and assembly of Vee block with clamps. |
| 42. | Detail assembly of shaft and pulleys |
| 43. | Details and assembly of vee blocks with clamps. |
| 44. | Details and assembly of bush bearing. |
| 45. | Types of curves. How to draw. |
| 46. | Details and assembly of simple coupling. |
| 47. | Details and assembly of a simple hand vice. |
| 48. | Blue print reading simple exercises related to missing lines. |
| 49. | Blue print reading simple exercises related to missing views. |
| 50. | Simple exercises related to missing symbols. |
| 51. | Simple exercises related to missing sections. |
| 52. | Simple exercises to missing dimensions. |
| 53. | Hand drawing for in-dictating switches, buttons control m/c. tool axis's quadrant point value. |
