



**RAILWAY RECRUITMENT CELL – WESTERN
RAILWAY WESTERN RAILWAY PARCEL
DEPOT,
ALIBHAI PREMJI MARG,GRANT ROAD (EAST), MUMBAI – 400 007.**

WEBSITE :www.rrc-wr.com

GDCE NOTIFICATION NO.01/2021: POST - TECHNICIAN-III-TMC

NOTICE

SYLLABUS FOR CBT OF TECHNICIAN Grade –III,/TMC

Ref : Notice dated 16-1-2024.

1. In para 3 part B of annexure H of the GDCE Notification No 01/2021 dated 11-10-2021, it has been laid down that for Part B of Exam, candidates with ITI/ Trade Apprenticeship qualification will be required to appear in the section having questions from the relevant trade. The matter has been reviewed and it is noted that it is not practically possible to hold examination separately for each trade and therefore three (3) groups have been formed for holding the part B of the examination. The groups are as under:
i. Mechanical, ii. Electrical, iii. Electronics

The syllabus for each group is enclosed herewith for information. The syllabus for Part A of the examination is also enclosed.

2. Exam Group to each eligible employee is decided at RRC's level and details thereof will be made available shortly on the RRC-WR's website.
3. CBT consists of 2 parts , Part A & Part B .Details are as under:

Part A	a. No. of questions -100 b. Duration : 90 minutes c. The questions will be in the nature of MCQ and will cover subjects Mathematics, General Intelligence & Reasoning, Basic Science & Engineering, and General Awareness on current affairs. d. There shall be negative marking and 1/3 rd of allotted for each question shall be deducted for every wrong answer.
Part B	a. No. of question in each Exam group - 75 b. Duration - 60 minutes c. This part is qualifying in nature and shall have questions from the 3 exam groups i. Mechanical, ii. Electrical, iii. Electronics. d. This part is only qualifying in nature and there will no negative marking.

4. Employees who have been transferred to other Zonal Railways or resigned after date of issue of Notification are not eligible to appear for CBT even though they are declared as Eligible /Prov. Eligible in the Eligibility List.

Encl: as above

Date: 12 -02-2024

Digitally Signed by Manisha
Walavalkar
Date: 12-02-2024 18:08:31
Reason: Approved

Annexure : 1

EXAM GROUP : MECHANICAL

1	- Algebraic symbols, fundamental algebra operations, sign and symbols used in algebra, coefficient terms, and unlike terms. Algebraic addition, subtraction, multiplication and division.
2	- Atmospheric pressure, pressure gauge, gauge pressure and absolute pressure and their units.
3	- Simple problems on multiplication, division, power and root using calculator.
4	- Power and exponent. Laws of exponent.
5	- Relation between specific gravity and density simple experimental determination.
6	- Geometry: Fundamental geometrical definition- angles and properties of angles, triangles and properties of triangles.
7	- Pythagoras theorem, properties of similar triangles. - Revision.
8	- Rectangle, square, Rhombus, parallelogram and their properties.
9	- Circle and properties circle: regular polygons. - Application of geometrical to shop problems.
10	- Forces definition. Compressive, tensile, shear forces and simple problems.
11	- Temperature measuring instruments. Specific heats of solids & liquids, quantity of heat.
12	- Heat loss and heat gain, with simple problems.
13	- Mensuration: Plain figures-triangles, square, rectangle, parallelogram.
14	- Mensuration : Plain figures-segment and sector of circle, ellipse, fillets. - Plain figures. Trapezium, regular polygons, circle, hollow circles.
15	- Mensuration: Solid figures : Prism, cylinder, pyramid, cone. - Solid figures: frustum of a cone, sphere, spherical segment.
16	- Material weight and cost problems related to trade.
17	- Trigonometry: trigonometric ratios, use of trigonometric table.
18	- Area of triangle by trigonometry.
19	- Finding height and distance by trigonometry.
20	- Levers-definition, types and principles of levers.
21	- Mechanical Advantage, velocity ratio and mechanical efficiency.
22	- Centre of gravity, simple experimental determination, stable, unstable & neutral equilibrium, simple explanation

23	- Friction- co-efficient of friction. Simple problem related to friction.
24	- Magnetic substances- natural and artificial magnets.
25	- Method of magnetisation. Use of magnets.
26	- Electricity & its uses. Electric current-positive & negative terminals.
27	- Use of fuses and switches, conductors and insulators.
28	- Simple electric circuits, simple calculations.
29	- Simple calculation based on Ohm's law. - electrical insulating materials.
30	- Transmission of power by belt, pulleys & gear drive. - Calculation of Transmission of power by belt pulley and gear drive.

Sr No	Topics
1	internal & external combustion engines, Classification of IC Engines, Principle & working of 2&4-stroke diesel engine (Compression ignition Engine (C.I)), Principle of Spark Ignition Engine(SI), differentiate between 2-stroke and 4 stroke, C.I engine and S.I Engine, Direct injection and Indirect injection, Technical terms used in engine, Engine specification. Study of various gauges/instrument on a dash board of a vehicle- Speedometer, Tachometer, Odometer and Fuel gauge, and Indicators such as gearshift position.
2.	process and Tools required for Servicing of Cooling and Lubrication system, Servicing of /Replacement of Air Cleaner of diesel engine. Servicing of Intake and Exhaust System of diesel engine. Servicing of Diesel Fuel System. Diagnose and Troubleshoot Diesel Engines.
3	Heat & Temperature: Heat and temperature, their units, difference between heat and temperature, boiling point, melting point, scale of temperature, relation between different scale of temperature, Thermometer, pyrometer, transmission of heat, conduction, convection, radiation.
4	Basic Electricity: Introduction, use of electricity, how electricity is produced, Types of current AC, DC, their comparison, voltage, resistance, their units. Conductor, insulator, Types of connections – series, parallel, electric power, Horse power, energy, unit of electrical energy.
5	Levers and Simple Machines: levers and its types. Simple Machines, Effort and Load, Mechanical Advantage, Velocity Ratio, Efficiency of machine, Relationship between Efficiency, velocity ratio and Mechanical Advantage.
6	Unit: Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units
7	- Material Science : properties -Physical & Mechanical, Types –Ferrous & Non-Ferrous, difference between Ferrous and Non-Ferrous metals, introduction of Iron, Cast Iron, Wrought Iron, Steel, difference between Iron and Steel, Alloy steel, carbon steel, stainless steel, Non-Ferrous metals, Non-Ferrous Alloys.
8.	Mass, Weight and Density : Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density, specific gravity of metals.
9.	Speed and Velocity: Rest and motion, speed, velocity, difference between speed and velocity, acceleration, retardation, equations of motions, simple related problems.
10.	Work, Power and Energy: work, unit of work, power, unit of power, Horse power of engines, mechanical efficiency, energy, use of energy, potential and kinetic energy, examples of potential energy and kinetic energy.

SR NO	Topics
1	- Introduction to Iron and Steel. Differences in Iron & steel.
2	- Introduction to Property and uses of C.I. and wrought Iron. - Iron and steel properties and uses.
3	- Properties and uses of plain carbon steel and alloy steel.

4	- Properties and uses of non ferrous metals and alloys Fraction and decimal - conversion fraction decimal and vice-versa.
5	- Properties and uses of copper, zinc, lead, tin, aluminum.
6	- Composition, properties and uses of brass, bronze, solder, bearing material, timber,rubber etc.
7	- System of units, British, metric and SI units for length, area, volume capacity,weight, time, angle, their conversions. - Effect of alloying elements in the properties of C.I. & steel.
8	- Unit of temperature for & related problems. Standard & absolute temp.
9	- Mass, volume, density, weight, sp. Gravity & specific weight. S.I. M.K.S. and F.P.S. units of force, weight etc. their conversion to related problems.
10	- Inertia, rest and motion, velocity and acceleration.
11	- Types of forces, its units and Weight calculation.
12	Introduction to Planing M/c. parts, types, constructions, details of Driving mechanism of planer, quick return motion etc Cutting tools for Planer - their material andtypes. Templates, gauges, their fixtures and vices , Hydraulicmechanism of planer theiradvantages, disadvantages
13	Introduction to milling machine machine, importance of milling machine, types and specification of milling machine, driving and feed mechanism of milling machine
14	- Simple machines-principle, velocity ratio, mechanical advantage, efficiency,related problems.
15	- Heat and temperature, thermometric scales their conversions.
16	Simple machines like winch pulley and compounding axle etc.

1. **Basic Bench Working Skills** :

Measuring of lengths, angles etc. and checking of curves and surface finish, with the help of checking tools and instruments including precision instruments.

Marking for transfer of dimensions from Blue Prints to the jobs having flat and curved surfaces. Centre punching of marked lines, punching with number and letter punches.

Rough and smooth filing to accurate dimensions of flat and round surfaces.

Hack sawing metal pieces, profiles, different length with hacksaw frame in horizontal and vertical positions.

Chipping with flat chisel and grooving with cross-cut chisel. Cutting of sheet metal by chisel. Use of hand and power operated shear machines, Simple sheet metal work. Use of hand drilling and bench drilling machines, countersinking, counter boring and spot facing with bench drilling machine.

Hand Grinding of different types of tools, e.g. chisel, drill, etc.

Reaming with hand reamers.

Threading by hand using taps and dies.

Cold rivetting of two components with different types of rivets.

Pipe cutting, pipe threading, pipe fitting etc.

Punching of holes with hollow punches on leather gaskets and other packing materials.

Scraping flat and curved surfaces with different types of scrapers including power scrapers.

2. Basic Machine Working Skills :

During this phase the trainees should be acquainted with the constructional features, working principles, different types of operations, care and maintenance of machine and the safety precautions to be observed in the use of different types of machine tools.

Lathe :

Constructional features and working principle. Holding of work pieces and tools using different devices. Plain stepped, taper and form turning, knurling etc. Drilling, boring, counterboring and reaming on lathe. Screw cutting – external and internal – different types. Grinding of turning tools. Care and maintenance of machine. Safety precautions to be observed while handling the machine.

Milling Machine :

Constructional features and working principle. Different methods of holding of work piece and cutters. Parallel milling, angular milling and grooving including use of end mills.

Simple indexing and gear cutting.

Care and maintenance of machine.

Safety precautions.

Shaping Machine :

Constructional features and working principle. Holding of work piece and tools.

Flat and angular shaping.

Grinding of tools.

Care and maintenance of machine.

Safety precautions.

Grinding Machine :

Constructional features and working principle. Holding of work piece.

External and Internal cylindrical grinding.

Surface grinding.

Care and maintenance of machine.

Safety precautions.

3. Basic Hot Working Skills :

Forging :

Bending of hot bars, drawing down of thicker sections.

Heating and forming popular sections.

Twisting, punching and drifting. Care and use of forging tools.

Heat Treatment :

Hardening and tempering of hand tools.

Annealing of hardened components.

Case hardening of mild steel components.

Gas & Electric Welding & Flame Cutting

:Simple gas welding and flame cutting.

Simple arc welding.

Care and use of welding equipment.

Metal deposition technique.

Soldering and Brazing :

Use of hard and soft solders.

Soldering of ferrous and non-ferrous metals.

Brazing of ferrous and non-ferrous metals.

Fitter hand tools, their uses and maintenance :

Jointing and fastening device :

Machines tools and operations ,Their care and maintenance.

Hot working tools and processes :

Hand forging – Care and maintenance of equipment, welding defects etc.

Engineering materials and their properties : Meaning of tenacity, elasticity, malleability, ductility, toughness etc.

Power Transmission and Drives : Common methods of power transmission and drives. Types and uses of keys and keyways –Chains and sprockets – types and uses, methods of fixings. Couplings – types and uses, solid, flexible, friction, universal etc. **Friction and Lubrication , Bearings , Mechanical handling of machines/equipments , Machine foundations and alignment :**

SR No	Trade Topics
----------	--------------

1	General discipline in the Institute Elementary First Aid. Importance of Welding in Industry Safety precautions in Shielded Metal Arc Welding, and Oxy-Acetylene Welding and Cutting.
2	Introduction and definition of welding. Arc and Gas Welding Equipments, tools and accessories. Various Welding Processes and its applications. Arc and Gas Welding terms and definitions.
3	- Pre heating & Post Weld Heat Treatment - Use of temperature indicating crayons

Sr No	syllabus
1	different types of tools can be made by forging. safety procedure require during forging as per standard
2	2. types of sheet metal Items. safety procedure to be followed during Soldering, brazing and sheet metal work as per standard norms
3	3. Join MS sheet by riveting : Tools & equipment required for riveting. different type of rivets and its use. safety procedure required to be during riveting as per standard norms.
4.	4. Join mechanical components/metal parts by Arc welding / Gas welding : equipment and tools required for welding safety/ precaution required during Arc welding/ gas welding
5.	process of making of different types of male/ female parts , mechanical components, assemblies, fastner etc.
6	process of Maing facing, plane turning, step turning, chamfering, grooving, knurling, drilling and boring
7	Tools and equipments required for Dismantling and assembling of valves and fittings in pipes.
8	Tools and equipments required for Repair and assemble of damaged mechanical components used for powertransmission
9	Drilling jig-constructional features, types and uses. Fixtures-Constructional features, types and uses.
10	Non-ferrous metals (copper, aluminum, tin,lead, zinc) properties and uses.
11	Cast Iron: manufacturing process by using (cupola furnace) types, properties and uses. Wrought iron- : manufacturing process (Fuddling and Astor process) properties anduses. Steel: manufacturing process plain carbonsteels, types, properties and uses.
12	Vernier micrometer, material, parts, graduation, use, care and maintenance. Calibration of measuring instruments Introduction to mechanical fasteners and itsuses. Screw thread micrometer: Construction, graduation and use.
13	Drill- material, types, (Taper shank, straight shank) parts and sizes. Drill angle-cutting anglefor different materials, cutting speed feed. R.P.M. for different materials. Drill holding devices- material, construction and their uses

Annexure : 2

EXAM GROUP : ELECTRICAL

1.	Unit: Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units	Engineering Drawing: Introduction and its importance <ul style="list-style-type: none">- Relationship to other technical drawing types- Conventions- Viewing of engineering drawing sheets.- Method of Folding of printed Drawing Sheet as per BIS SP:46-2003
2.	Fractions : Fractions, Decimal fraction, L.C.M., H.C.F., Multiplication and Division of Fractions and Decimals, conversion of Fraction to Decimal and vice versa. Simple problems using Scientific Calculator.	Drawing Instruments : their Standard and uses <ul style="list-style-type: none">- Drawing board, T-Square, Drafter (Drafting M/c), Set Squares, Protractor, Drawing Instrument Box (Compass, Dividers, Scale, Diagonal Scales etc.), Pencils of different Grades, Drawing pins / Clips.
3.	Square Root : Square and Square Root, method of finding out square roots, Simple problem using calculator.	Lines : <ul style="list-style-type: none">- Definition, types and applications in Drawings as per BIS SP:46-2003- Classification of lines (Hidden, centre, construction, Extension, Dimension, Section)- Drawing lines of given length (Straight, curved)- Drawing of parallel lines, perpendicular line- Methods of Division of line segment
4.	Ratio & Proportion : Simple calculation on related problems.	Drawing of Geometrical Figures: Definition, nomenclature and practice of <ul style="list-style-type: none">- Angle: Measurement and its types, method of bisecting.- Triangle -different types- Rectangle, Square, Rhombus, Parallelogram.- Circle and its elements.
5.	Percentage : Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa.	Lettering and Numbering as per BIS SP46-2003: <ul style="list-style-type: none">- Single Stroke, Double Stroke, inclined, Upper case and Lower case.

6.	<p>Material Science : properties - Physical & Mechanical, Types – Ferrous & Non-Ferrous, difference between Ferrous and Non-Ferrous metals, introduction of Iron, Cast Iron, Wrought Iron, Steel, difference between Iron and Steel, Alloy steel, carbon steel, stainless steel, Non-Ferrous metals, Non-Ferrous Alloys.</p>	<p>Dimensioning:</p> <ul style="list-style-type: none"> - Definition, types and methods of dimensioning (functional, non-functional and auxiliary) - Types of arrowhead - Leader Line with text
7.	<p>Mass, Weight and Density : Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density, specific gravity of metals.</p>	<p>Free hand drawing of</p> <ul style="list-style-type: none"> - Lines, polygons, ellipse, etc. - geometrical figures and blocks with dimension - Transferring measurement from the given object to the free hand sketches.
8.	<p>Speed and Velocity: Rest and motion, speed, velocity, difference between speed and velocity, acceleration, retardation, equations of motions, simple related problems.</p>	<p>Sizes and Layout of Drawing Sheets</p> <ul style="list-style-type: none"> - Basic principle of Sheet Size - Designation of sizes - Selection of sizes - Title Block, its position and content - Borders and Frames (Orientation marks and graduations) - Grid Reference - Item Reference on Drawing Sheet (Item List)
9.	<p>Work, Power and Energy: work, unit of work, power, unit of power, Horse power of engines, mechanical efficiency, energy, use of energy, potential and kinetic energy, examples of potential energy and kinetic energy.</p>	<p>Method of presentation of Engineering Drawing</p> <ul style="list-style-type: none"> - Pictorial View - Orthogonal View - Isometric view
1	<p>Algebra : Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables).</p>	<p>Construction of Scales and diagonal scale</p>

2.	<p>Mensuration : Area and perimeter of square, rectangle, parallelogram, triangle, circle, semi circle, Volume of solids – cube, cuboid, cylinder and Sphere. Surface area of solids – cube, cuboid, cylinder and Sphere.</p>	Practice of Lettering and Title Block
3.	<p>Trigonometry: Trigonometrical ratios, measurement of angles. Trigonometric tables</p>	<p>Dimensioning practice:</p> <ul style="list-style-type: none"> - Position of dimensioning (unidirectional, aligned, oblique as per BIS SP:46-2003) - Symbols preceding the value of dimension and dimensional tolerance. - Text of dimension of repeated features, equidistance elements, circumferential objects.
4.	<p>Heat & Temperature: Heat and temperature, their units, difference between heat and temperature, boiling point, melting point, scale of temperature, relation between</p>	<p>Construction of Geometrical Drawing Figures:</p> <ul style="list-style-type: none"> - Different Polygons and their values of included angles. Inscribed and Circumscribed polygons. - Conic Sections (Ellipse & Parabola)
	<p>different scale of temperature, Thermometer, pyrometer, transmission of heat, conduction, convection, radiation.</p>	
5.	<p>Basic Electricity: Introduction, use of electricity, how electricity is produced Types of current_ AC, DC, their comparison, voltage, resistance, their units. Conductor, insulator, Types of connections – series, parallel, electric power, Horse power, energy, unit of electrical energy</p>	<p>Drawing of Solid figures (Cube, Cuboids, Cone, Prism, Pyramid, Frustum of Cone and Pyramid.) with dimensions.</p>
6.	<p>Levers and Simple Machines: levers and its types. Simple Machines, Effort and Load, Mechanical Advantage, Velocity Ratio, Efficiency of machine, Relationship between Efficiency, velocity ratio and Mechanical Advantage.</p>	<p>Free Hand sketch of hand tools and measuring tools used in respective trades.</p>

1	<p>Elasticity: Stress, strain, Modulus of elasticity, elastic limit, Hooks law, young's modulus.</p>	<p><u>Sign & Symbol Trade related</u> Alternating Current Drawing of simple electrical circuit using electrical symbols. Drawing of sine square & triangular waves. Diagram of battery charging circuit. Practice in reading typical example of circuit containing R, L & C. Reading of electrical drawing.</p>
2.	<p>Material: Introduction, types and properties. Uses of Conducting, Semi-conducting and insulating materials.</p>	<p>Electronic components Symbols for electronic components. Diode, Transistor, Zener diode, S.C.R., UJT, FET, I.C. Diac, Triac, Mosfet I.G.B.T etc. Drawing of half wave, Full wave and Bridgerectifier circuit. Drawing circuit for a single stage Amplifiers and Multi stage Amplifies and types of signals. Drawing of circuit containing UJT, FET & Simple power control circuits. Free hand drawing of Logic gates and circuits.</p>
3.	<p>Magnetism: Magnetic material, magnetic field, flux density, magnetic moment, m.m.f. Reluctance, permeability, susceptibility, electromagnet, solenoid and its practical applications.</p>	<p>Electric wirings & Earthing Detailed diagram of calling bell, & Buzzers etcFree hand sketching of Staircase wiring. Drawing the schematic diagram of plate and pipe earthing. Diagram for electroplating from A.C and D.C source.</p>
4.	<p>Pressure:- Pneumatic pressure, PSI, bar, atmospheric pressure, pressure gauge and absolute pressure, Heat treatment process.</p>	<p>DC machines Graphic symbols for Rotating machines. Sketching of brush and brush gear of D.C. machines. Sketching of D.C. 3-point and 4-point starter . Layout arrangement of D.C. Generators & motors, control panel. Exercises on connection to motors through Ammeter, voltmeter & K.W. meters of electrical wiring diagram. Drawing the schematic diagram of D.C. motor speed control by Thyristor / DC Drive.</p>

5.	<p>Indices: Laws of indices related problems.</p> <p>Quadratic Equation: Introduction, solution of simple Quadratic equation and related problems.</p>	<p>Transformer</p> <p>Graphic symbols for Transformers. Free hand sketching of transformer and auxiliary parts and sectional views. Sketching a breather. Drawing the diagram of typical marking plate of a distribution transformer.</p>
6.	<p>Solution of simple A.C. circuit with R.L.C. Calculation of power factor etc.</p>	<p>Illumination</p> <p>Free hand sketching of Mercury vapour lamp, sodium vapour lamp, Fluorescent tube (Single & Twine), MHL lamp and their connection.</p>

1	<p>Friction: - Laws of friction, coefficient of friction, angle of friction, simple problems related to friction. Lubrication</p> <p>Concept on terms like pressure, atmospheric pressure, gauge pressure.</p> <p>Heat treatment necessity difference methods.</p>	<p>Three phase Induction motor</p> <p>Free hand sketching of Slip-ring and Squirrel cage Induction motor. Typical wiring diagram for drum controller operation of A.C. wound rotor motor. Drawing the schematic diagram of Autotransformer starter, DOL starter and StarDelta Starter. Drawing the schematic diagram of A.C. motor speed control by SCR /AC Drive.</p>
2.	<p>Forces: - Resolution and composition of forces. Representation of force by vectors, simple problems on lifting tackles like jib wall, crane-Solution of problems with the aid of vectors.</p> <p>General condition of equilibriums for series of forces on a body. Law of parallelogram, Triangle Law, Lami's theorem.</p>	<p>Alternator</p> <p>Tracing of panel wiring diagram of an alternator. Drawing the schematic diagram of automatic voltage regulators of A.C. generators.</p>
3.	<p>Centre of gravity:- Centre of gravity concept and C.G. of different lamina. Equilibrium different kinds stable, unstable and neutral. Law of parallelogram force. Triangle law, Lami's theorem stable, unstable and neutral equilibrium.</p>	<p>Winding</p> <p>Drawing the development diagram for D.C. Simplex Lap & Wave winding with brush position. Drawing the development diagram of A.C 3 – Phase, 4 Pole 24 slots single layer winding.</p>

4.	<p>Number system:- decimal and binary, Octal Hexa decimal. BCD code, conversion from decimal to binary and vice-versa, all other conversions. Practice on conversions.</p>	<p>Control Panel</p> <p>Practice in reading panel diagram. Local & Remote control of Induction motor with inching. Forward & Reverse operation of Induction motor Automatic Star Delta Starter Automatic star delta starter with change of direction of rotation Sequential control of three motors.</p>
5.	<p>Estimation & costing:- Simple estimation of the requirement of materials etc. as applicable to the trade. Problems on estimation and costing.</p> <p>Further Mensuration:-</p> <p>Volumes of frustums including conical frustums.</p> <p>Graph- Basics, abscissa, co-ordinate etc.</p> <p>$Y = mx$ and $Y = mx + c$ graph</p>	<p>Distribution of Power</p> <p>Types of insulator used in over head line. (Half sectional views) Different type of distribution systems and methods of connections. Layout diagram of a substation. Single line diagram of substation feeders.</p>
6.	<p>Simple Problems on Profit & Loss.</p> <p>Simple and compound interest.</p>	<p>-----</p>

SR NO	Trade Theory
1.	<p>Ohm's Law - Simple electrical circuits and problems. Reading of simple Electrical Layout.</p> <p>Resistors -Law of Resistance. Series and parallel circuits.</p> <p>Kirchoff's Laws and applications. Wheatstone bridge principle And its applications. Effect of variation of temperature on resistance. Different methods of measuring the values of resistance</p>
2.	<p>Common Electrical Accessories, their specifications in line with NEC 2011-Explanation of switches lamp holders, plugs and sockets. Developments of domestic circuits, Alarm & switches, with individual switches, Two way switch .Security surveillance, Fire alarm, MCB, ELCB, MCCB.</p>
3	<p>Chemical effect of electric current-Principle of electrolysis. Faraday's Law of electrolysis. Basic principles of Electro-plating and Electro chemical equivalents. Explanation of Anodes and cathodes. Lead acid cell-description, methods of charging- Precautions to be taken & testing equipment, Ni-cadmium & Lithium cell, Cathodic protection. Electroplating, Anodising. Different types of lead acid cells.</p>
4	<p>Rechargeable dry cell, description advantages and disadvantages. Care and maintenance of cells Grouping of cells of specified voltage & current, Sealed Maintenance free Batteries, Solar battery.</p>
5	<p>Inverter, Battery Charger, UPS-Principle of working. Lead Acid cell, general defects & remedies. Nickel Alkali Cell-description charging. Power & capacity of cells. Efficiency of cells.</p>
6	<p>Types of drills description & drilling machines, proper use, care and maintenance. Description of taps & dies, types in rivets & riveted joints. Use of thread gauge.</p>
7	<p>Magnetism - Classification of magnets, methods of magnetising, magnetic materials. Properties, care and maintenance. Para and Diamagnetism and Ferro magnetic materials. Principle of electro-magnetism, Maxwell's corkscrew rule, Fleming's left and right hand rules, Magnetic field of current carrying conductors, loop and solenoid. MMF, Flux density, reluctance. B.H. curve, Hysteresis, Eddy current. Principle of electro- magnetic Induction, Faraday's Law, Lenz's Law. Electrostatics: Capacitor- Different types, functions and uses.</p>

8	<p>Alternating Current -Comparison and Advantages D.C and A.C. Related terms frequency Instantaneous value, R.M.S. value Average value, Peak factor, form factor. Generation of sine wave, phase and phase difference. Inductive and Capacitive reactance Impedance (Z), power factor (p.f). Active and Reactive power, Simple problems on A.C. circuits, single Phase and three-phase system etc. Problems on A.C. circuits. Power consumption in series and parallel, P.F. etc. Concept three-phase Star and Delta connection. Line and phase voltage, current and power in a 3 phase circuits with balanced and unbalanced load.</p>
9.	<p>Earthing-Principle of different methods of earthing. i.e. Pipe, Plate, etc Importance of Earthing. Improving of earth resistance Earth Leakage circuit breaker (ELCB). In absence of latest revision in respective BIS provision for Earthing it is recommended to follow IEC guidelines.</p>
10	<p>Basic electronics- Semiconductor energy level, atomic structure 'P' type and 'N' type. Type of materials –P-N-junction. Classification of Diodes – Reverse and Forward Bias, Heat sink. Specification of Diode PIV rating. Explanation and importance of D.C. rectifier circuit. Half wave, Full wave and Bridge circuit. Filter circuits-passive filter.</p>
11	<p>principle and uses of an oscilloscope. Explanation of principle of working of a transistor & configuration. Types of transistors & its application. Specification and rating of transistors. Explanation of transistor Amplifiers, Amplifiers. – class A,B and C Power amplifier</p>
12	<p>oscillator-working principle, stages and types. Multivibrator applications. Introduction of basic concept of ICs, U.J.T., F.E.T. Basic concept of power electronics devices e.g. S.C.R., Diac, Triac, power MOSFET, G.T.O and I.G.B.T. Digital Electronics -Binary numbers, logic gates and combinational circuits,</p>
13	<p>Application of fuses, relay, MCB,ELCB. Armature, inter poles and their uses, connection of inter poles, Commutation. Losses & Efficiency of D.C. Generator, Parallel Operation of D.C. Generator. Application of D.C. generators. Care, Routine & preventive maintenance.</p>

14	<p>D.C. Machines - General concept of Electrical Machines.</p> <p>Principle of D.C. generator. Use of Armature, Field Coil, Polarity, Yoke, Cooling Fan, Commutator, slip ring Brushes, Laminated core.</p> <p>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>DC Motors - Terms used in D.C. motor-Torque, Brake Torque, speed, Back-e.m.f. etc. and their relations, Types of D.C. Motor.</p> <p>Starters used in D.C. motors Related problems</p> <p>Characteristics of D.C. Motor, Losses & Efficiency, Application of D.C. motors.</p> <p>Care, Routine & preventive maintenance.</p>
15	<p>Working principle of Transformer. classification C.T., P.T. Instrument and Auto Transformer (Variac), Construction, Single phase and Poly phase.</p> <p>E.M.F. equation, parallel operation of transformer, their connections.</p> <p>Regulation and efficiency.</p> <p>Type of Cooling for transformer. Protective devices.</p> <p>Specifications, simple problems on e.m.f. Equation, turn ratio, regulations and efficiency.</p> <p>Special transformers.</p> <p>Transformer –Classification of transformer. Components, Auxiliary parts i.e. breather, Conservator, buchholze relay, other protective devices. Transformer oil testing and Tap changer (off load and on load). Dry type transformer.</p> <p>Bushings and termination.</p>
16	<p>Working principle of Transformer. classification C.T., P.T. Instrument and Auto Transformer (Variac), Construction, Single phase and Poly phase.</p> <p>E.M.F. equation, parallel operation of transformer, their connections.</p> <p>Regulation and efficiency.</p> <p>Type of Cooling for transformer. Protective devices.</p> <p>Specifications, simple problems on e.m.f. Equation, turn ratio, regulations and efficiency.</p> <p>Special transformers.</p> <p>Transformer –Classification of transformer. Components, Auxiliary parts i.e. breather, Conservator, buchholze relay, other protective devices. Transformer oil testing and Tap changer (off load and on load). Dry type transformer.</p> <p>Bushings and termination.</p>
17	<p>Three phase Induction motor, Single phase induction motor, SYNCHRONOUS MOTOR -Control Elements: Isolator, pushbutton switches, Indicating lamps, MCB, Fuse, Contactor, Relays, Overload Relay, Timers, Rectifier, Limit switches, control transformers.</p> <p>Wiring Accessories: Race ways/ cable channel, DIN Rail, Terminal Connectors, Thimbles, Lugs, Ferrules, cable binding strap & buttons, nylon cable ties, sleeves, Gromats & clips.</p> <p>Electrical Measuring Instruments -</p> <p>-types, indicating types. Deflecting torque, Controlling torque and Damping torque ,</p> <p>PMMC & MI meter (Ammeter, Voltmeter)</p>

	-Range extension -Multimeter(Digital/Analog) -Wattmeter
18	Illumination, Laws of Illuminations, terminology used , Illumination factors, intensity of light – importance of light, human eye factor, , units. Types of illumination Type of lamps. Industrial wiring Domestic Appliances: Working principles and circuits of common domestic equipment and appliances. – Calling Bell, Buzzer, Alarms, Electric Iron, Heater, Light. Electric Kettle, Heater / Immersion Heater, Hot Plate, Oven, Geysers, Cooking range, Mixer, Washing machine, , Motor Pump set, etc. Concept of Neutral and Earth.

SR NO	Topics
1	Fundamental of electricity. Electron theory- free electron, Fundamental terms, definitions, units & effects of electric current
2	Solders, flux and soldering technique. Resistor types of resistors & properties of resistors.
3	Introduction of National Electrical Code 2011 Explanation, Definition and properties of conductors, insulators and semi-conductors. Voltage grading of different types of Insulators, Temp. Rise permissible Types of wires & cables standard wire gauge Specification of wires & Cables- insulation & voltage grades -Low , medium & high voltage Precautions in using various types of cables/ Ferrules
4	Ohm's Law - Simple electrical circuits and problems. Reading of simple Electrical Layout. Resistors -Law of Resistance. Series and parallel circuits. Kirchoff's Laws and applications. Wheatstone bridge principle And its applications. Effect of variation of temperature on resistance. Different methods of measuring the values of resistance

5	<p>Chemical effect of electric current-Principle of electrolysis. Faraday's Law of electrolysis. Basic principles of Electro-plating and Electro chemical equivalents. Explanation of Anodes and cathodes. Lead acid cell-description, methods of charging- Precautions to be taken & testing equipment, Ni-cadmium & Lithium cell, Cathodic protection.Electroplating, Anodising. Different types of lead acid cells.</p>
6	<p>Rechargeable dry cell, description advantages anddisadvantages. Care and maintenance of cells Grouping of cells of specified voltage & current,Sealed Maintenance free Batteries, Solar battery.</p>
7	<p>Magnetism - Classification of magnets, methods of magnetising, magnetic materials. Properties, care and maintenance. Para and Diamagnetism and Ferro magnetic materials. Principle of electro-magnetism, Maxwell's corkscrew rule, Fleming's left and right hand rules, Magnetic field of current carrying conductors, loop and solenoid. MMF, Flux density, reluctance. B.H. curve, Hysteresis, Eddy current. Principle of electro-magnetic Induction, Faraday's Law, Lenz's Law. Electrostatics: Capacitor- Different types, functions and uses.</p>
8	<p>Alternating Current -Comparison and Advantages D.C and A.C. Related terms frequency Instantaneous value, R.M.S. value Average value, Peak factor, form factor. Generation of sine wave, phase and phase difference. Inductive and Capacitive reactance Impedance (Z),power factor (p.f). Active and Reactive power, Simple problems on A.C.circuits, single Phase and three-phase system etc.Problems on A.C. circuits. Power consumption in series and parallel, P.F. etc.Concept three-phase Star and Delta connection. Line and phase voltage, current and power in a 3 phase circuits with balanced and unbalanced load.</p>
9	<p>Introduction and explanation of electrical wiring systems, cleat wiring, casing & Capping, CTS, Conduit and concealed etc., I. E. Rules. Related to wiring, National Building codes for house wiring, specification and types,rating & material.</p>
10	<p>Introduction of Illumination- Terms & definitions, laws of illumination, illumination factors, intensity of light -importance of light, colour available. Construction, working & applications of - Incandescent lamp, Fluorescent tube, CFL, Neon sign, Halogen, Mercury vapour and types, sodium vapour etc. Decoration lighting, Drum Switches etc.</p>

11	Connections of different types of motors used in industry, their normal methods of wiring, Control , starting and protection devices-their connections, layouts and earthing Code practice for earthing of Industrial Wiring. Wiring methods & types in workshop & factories.
12	LED , Diode, types of transistor, UJT, SCR, regulatorICs and Zener diode uses and its application
13	IC - voltage regulator pin configurations and applications.
14	Common Electrical Accessories, their specifications-Explanation of switches, lamp holders, plugs and sockets etc. Development of domestic circuits using switches, fuse, MCB, sockets, lamp, fan, calling bell/buzzer, Two wayswitch, I.C.T.P, I.C.D.P, MCCB, ELCB, RCCB etc. Importance of Neutral, effect of opening of neutral wire Soldering - Solders, flux and soldering techniques.Types of soldering irons-their proper use.
15	Introduction to D.C Generators and working principle, parts of D.C. Generator. Classification of Generators- Self excited and separately excited- their application in practical field.
16	Parts and construction of Alternators, principle of working, types of Alternators, EMF equation. Various applications and power rating of alternators. General idea of loading and regulation of Alternator. Parallel operation of Alternators, synchronising methods.
17	TRANSFORMERS – Power Transformer – Its construction, working, performance, parallel operation of transformer, their connections. Cooling of transformer, S.C. & O.C. tests. Regulation and efficiency, Specifications, problems on e.m.f. Equation, transformation ratio. Characteristics of ideal transformer. Construction of core, winding shielding, auxiliary parts breather, conservator. Buchholz's relay, other protective devices. Transformer oil testing and Tap changing off load and on load. Transformer bushings and termination. Autotransformer- Its construction, working, performance & uses.

18	<p>GENERATION, TRANSMISSION AND DISTRIBUTION OF ELECTRICAL POWER</p> <p>Generation of Electricity and their types. General idea about overhead transmission, distribution (LV,MV& HV) and their types of accessories used. General arrangement and maintenance of outdoor type of substation.</p> <p>Explanation of overhead bus bar, side by bar. Bus trunking and rising mains.</p> <p>I.E. rules regarding panel erection, bus bar, spacing bus bar chamber, danger boards.</p> <p>Connection of high voltage metering equipment used with bus bar.</p>
19	Types of Distribution, Explanation of line protecting devices and their general principle. Brief description of connection of places of use.
20	<p>SUBSTATION EQUIPMENTS</p> <p>Switchgear-CBs – ACB, VCB, SF6, OCB etc. protection schemes, CT/PT-Protective relays, lightning arrestors,</p> <p>Explanation of different types of switches and switches gears multi Range switches, rotary switches, cooker control panels, power circuit switches, thermostat, mercury switches etc.</p>
21	<p>TYPES OF SUBSTATIONS - INDOOR, OUTDOOR & POLE MOUNTING</p> <p>Substation construction:</p> <p>i. Outdoor and Indoor substation.</p> <p>ii. E.H.T. substation</p> <p>iii. H.T. substation</p> <p>iv. Medium & low voltage substation (Pole mounting type)</p>
22	<p>U.G. CABLE</p> <p>Construction of cable, Types , Application & methods of jointing UG cable & testing</p> <p>General idea of laying method and jointing precautions to be observed and different accessories used for medium voltage termination.</p>
24	Control Panel elements, types and specifications. Layout and installation of panel board , Panel board wiring methods, colour coding of cables for

1. Electro- mechanical Assembly
2. Coil winding and insulation
3. Conductors
4. Impregnation
5. Balancing

SR No	Topics
1	<p><u>FITTING</u> different types of Fitting, hand tools, power tools, precision measuring instruments & their use. Equipments used in fittings like drilling machines, grinding machines, types, specifications and care and maintenance.</p>
2	<p><u>ELECTRICAL</u> Electrical terms such as AC and DC supply, Voltage, Current, Resistance, Power, Energy, Frequency etc. Safety precautions to be observed while working on electricity. Conductors and Insulators, Materials used as conductors. Measuring Instruments such as voltmeter, ammeter, ohm meter, watt meter, energy meter and frequency meter. Earthing and its importance. Earth resistance. Insulation and continuity test</p>
3	<p>Inductors and capacitors. Effects of inductor and capacitors in an AC circuit. Line voltage, Line current, Phase voltage and Phase current. Methods of improving power factor.</p>
7	<p>AC motors and their types. Advantages of AC motor over DC motor. Revolving field theory. Phase splitting theory.</p>
8	<p>Capacitor start capacitor run motor, working principle and construction. Starting capacitor and running capacitor Shaded pole motors, working principle and construction. Torque comparison among various single phase AC motors. Common faults, causes and remedies in motors.</p>
9	<p><u>ELECTRONICS</u> Introduction to Electronics. Basic Principles of semiconductors, Principles and application of Diodes</p>
10	<p>Rectification, Zener diode as voltage regulator – transistors parameters- CB, CE, CC, configuration, amplification. SCR</p>
11	<p>Photo diodes, photo transistors, multi – vibrator, CR & LR circuit. SCRs, UJTs, ICs.</p>
12	<p><u>WELDING</u> Introduction to basic principles of commonly used Welding processes, Arc welding, oxy fuel gas welding / cutting, brazing & soldering. Welding tools and equipment type specification and use.</p>
13	<p><u>BASIC REFRIGERATION</u> Study the function, working, use, specifications of refrigeration tools, instruments and equipment. Fundamentals of Refrigeration, units and measurements, Pressure & its Measurements. Thermodynamics law.</p>

14	Science related to refrigeration, work, power, energy, force, Heat and Temperature, Different temperature scales, Thermometers, Units of heat, sensible heat, latent heat, super heating and sub-cooling, saturation temperature, pressure, types, units.
15	Types of Refrigeration systems, Ton of Refrigeration, Study the construction and working of vapor compression cycle, low side & high side of vapour compression system. Applications of vapour compression cycle.
16	COMPRESSOR Function, construction, working, application of compressor like, Reciprocating, rotary, scroll type. Study the construction & working of centrifugal compressor, wobble & swash plate compressor. Compressor efficiency factors, wet compression, oil, properties, lubrication methods.
17	MOTORS Motors used in refrigeration And Air conditioning system, types, construction, working & their starting methods. Function of Starting relay, Capacitors, OLP's. Production of rotating magnetic field by three phase AC supply. Working principle of three phase induction motor. Terms such as torque, slip, rotor frequency and their relation.
18	CONDENSER/ DRIER Function of condenser/ drier, types, Construction of air cooled condenser. Effect of choked condenser. Advantages, de scaling of air cooled condenser. Types of air cooled condenser, application, and advantages. Liquid receiver, pump down, application, types, function and working.
19	EXPANSION VALVE Expansion valve used in domestic refrigeration and air conditioning systems. Capillaries, Automatic and Thermostatic Ex. Valves.
20	EVAPORATOR Working principle, Function, types of evaporators used in refrigerator, water coolers, bottle coolers, window and split A.C, Super heating in evaporators, Function of accumulator and types. Methods of defrosting, heat exchanger.
21	REFRIGERANT Classification of refrigerants, Properties, Chemical name and formulas, HFC, CFC. Ozone rule, substitute of CFC, Montreal protocol & India's CFC/HFC phase out schedules. Ozone rules 2000.

13	THERMAL INSULATION Function, types, thermodynamic properties of heat insulation materials used in refrigeration and Air Conditioning systems.
14	Fundamentals of Central Air Conditioning, requirements of comfort A.C, study of psychometric terms, DBT, WBT, RH, enthalpy, dew point, and specific humidity. Types of Central air conditioning (Direct and indirect system) Construction, working, components, faults, care and maintenance. Description of blowers & fans, function and types, static and velocity pressure measurements

Annexure : 3

EXAM GROUP : ELECTRONICS

1.	Unit: Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units	Engineering Drawing: Introduction and its importance <ul style="list-style-type: none">- Relationship to other technical drawing types- Conventions- Viewing of engineering drawing sheets.- Method of Folding of printed Drawing Sheet as per BIS SP:46-2003
2.	Fractions : Fractions, Decimal fraction, L.C.M., H.C.F., Multiplication and Division of Fractions and Decimals, conversion of Fraction to Decimal and vice versa. Simple problems using Scientific Calculator.	Drawing Instruments : their Standard and uses <ul style="list-style-type: none">- Drawing board, T-Square, Drafter (Drafting M/c), Set Squares, Protractor, Drawing Instrument Box (Compass, Dividers, Scale, Diagonal Scales etc.), Pencils of different Grades, Drawing pins / Clips.
3.	Square Root : Square and Square Root, method of finding out square roots, Simple problem using calculator.	Lines : <ul style="list-style-type: none">- Definition, types and applications in Drawings as per BIS SP:46-2003- Classification of lines (Hidden, centre, construction, Extension, Dimension, Section)- Drawing lines of given length (Straight, curved)- Drawing of parallel lines, perpendicular line- Methods of Division of line segment
4.	Ratio & Proportion : Simple calculation on related problems.	Drawing of Geometrical Figures: Definition, nomenclature and practice of <ul style="list-style-type: none">- Angle: Measurement and its types, method of bisecting.- Triangle - different types- Rectangle, Square, Rhombus, Parallelogram.- Circle and its elements.
5.	Percentage : Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa.	Lettering and Numbering as per BIS SP46-2003: <ul style="list-style-type: none">- Single Stroke, Double Stroke, inclined, Upper case and Lower case.

6.	Material Science : properties - Physical & Mechanical, Types – Ferrous & Non-Ferrous, difference between Ferrous and Non-Ferrous metals, introduction of Iron, Cast Iron, Wrought Iron, Steel, difference between Iron and Steel, Alloy steel, carbon steel, stainless steel, Non- Ferrous metals, Non-Ferrous Alloys.	Dimensioning: <ul style="list-style-type: none"> - Definition, types and methods of dimensioning (functional, non-functional and auxiliary) - Types of arrowhead - Leader Line with text
7.	Mass, Weight and Density : Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density, specific gravity of metals.	Free hand drawing of <ul style="list-style-type: none"> - Lines, polygons, ellipse, etc. - geometrical figures and blocks with dimension - Transferring measurement from the given object to the free hand sketches.
8.	Speed and Velocity : Rest and motion, speed, velocity, difference between speed and velocity, acceleration, retardation, equations of motions, simple related problems.	Sizes and Layout of Drawing Sheets <ul style="list-style-type: none"> - Basic principle of Sheet Size - Designation of sizes - Selection of sizes - Title Block, its position and content - Borders and Frames (Orientation marks and graduations) - Grid Reference - Item Reference on Drawing Sheet (Item List)
9.	Work, Power and Energy : work, unit of work, power, unit of power, Horse power of engines, mechanical efficiency, energy, use of energy, potential and kinetic energy, examples of potential energy and kinetic energy.	Method of presentation of Engineering Drawing <ul style="list-style-type: none"> - Pictorial View - Orthogonal View - Isometric view

1	Algebra : Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables).	Construction of Scales and diagonal scale
---	---	---

2.	<p>Mensuration : Area and perimeter of square, rectangle, parallelogram, triangle, circle, semi circle, Volume of solids – cube, cuboid, cylinder and Sphere. Surface area of solids – cube, cuboid, cylinder and Sphere.</p>	Practice of Lettering and Title Block
3.	<p>Trigonometry: Trigonometrical ratios, measurement of angles. Trigonometric tables</p>	<p>Dimensioning practice: - Position of dimensioning (unidirectional, aligned, oblique as per BIS SP:46-2003) - Symbols preceding the value of dimension and dimensional tolerance. - Text of dimension of repeated features, equidistance elements, circumferential objects.</p>
4.	<p>Heat & Temperature: Heat and temperature, their units, difference between heat and temperature, boiling point, melting point, scale of temperature, relation between different scale of temperature, Thermometer, pyrometer, transmission of heat, conduction, convection, radiation.</p>	<p>Construction of Geometrical Drawing Figures: - Different Polygons and their values of included angles. Inscribed and Circumscribed polygons. - Conic Sections (Ellipse & Parabola)</p>
5.	<p>Basic Electricity: Introduction, use of electricity, how electricity is produced Types of current_ AC, DC, their comparison, voltage, resistance, their units. Conductor, insulator, Types of connections – series, parallel, electric power, Horse power, energy, unit of electrical energy</p>	<p>Drawing of Solid figures (Cube, Cuboids, Cone, Prism, Pyramid, Frustum of Cone and Pyramid.) with dimensions.</p>
6.	<p>Levers and Simple Machines: levers and its types. Simple Machines, Effort and Load, Mechanical Advantage, Velocity Ratio, Efficiency of machine, Relationship between Efficiency, velocity ratio and Mechanical Advantage.</p>	<p>Free Hand sketch of hand tools and measuring tools used in respective trades.</p>

1	<p>Elasticity: Stress, strain, Modulus of elasticity, elastic limit, Hooks law, young's modulus.</p>	<p><u>Sign & Symbol Trade related</u> Alternating Current Drawing of simple electrical circuit using electrical symbols. Drawing of sine square & triangular waves. Diagram of battery charging circuit. Practice in reading typical example of circuit containing R, L & C. Reading of electrical drawing.</p>
2.	<p>Material: Introduction, types and properties. Uses of Conducting, Semi-conducting and insulating materials.</p>	<p>Electronic components Symbols for electronic components. Diode, Transistor, Zener diode, S.C.R., UJT, FET, I.C. Diac, Triac, Mosfet I.G.B.T etc. Drawing of half wave, Full wave and Bridgerectifier circuit. Drawing circuit for a single stage Amplifiers and Multi stage Amplifies and types of signals. Drawing of circuit containing UJT, FET & Simple power control circuits. Free hand drawing of Logic gates and circuits.</p>
3.	<p>Magnetism: Magnetic material, magnetic field, flux density, magnetic moment, m.m.f. Reluctance, permeability, susceptibility, electromagnet, solenoid and its practical applications.</p>	<p>Electric wirings & Earthing Detailed diagram of calling bell, & Buzzers etc Free hand sketching of Staircase wiring. Drawing the schematic diagram of plate and pipe earthing. Diagram for electroplating from A.C and D.C source.</p>
4.	<p>Pressure:- Pneumatic pressure, PSI, bar, atmospheric pressure, pressure gauge and absolute pressure, Heat treatment process.</p>	<p>DC machines Graphic symbols for Rotating machines. Sketching of brush and brush gear of D.C. machines. Sketching of D.C. 3-point and 4-point starter . Layout arrangement of D.C. Generators & motors, control panel. Exercises on connection to motors through Ammeter, voltmeter & K.W. meters of electrical wiring diagram. Drawing the schematic diagram of D.C. motor speed control by Thyristor / DC Drive.</p>
5.	<p>Indices: Laws of indices related problems.</p> <p>Quadratic Equation: Introduction, solution of simple Quadratic equation and related problems.</p>	<p>Transformer Graphic symbols for Transformers. Free hand sketching of transformer and auxiliary parts and sectional views. Sketching a breather. Drawing the diagram of typical marking plate of a distribution transformer.</p>

6.	Solution of simple A.C. circuit with R.L.C. Calculation of power factor etc.	Illumination Free hand sketching of Mercury vapour lamp, sodium vapour lamp, Fluorescent tube (Single & Twine), MHL lamp and their connection.
----	--	--

1	Friction: - Laws of friction, coefficient of friction, angle of friction, simple problems related to friction. Lubrication Concept on terms like pressure, atmospheric pressure, gauge pressure. Heat treatment necessity difference methods.	Three phase Induction motor Free hand sketching of Slip-ring and Squirrel cage Induction motor. Typical wiring diagram for drum controller operation of A.C. wound rotor motor. Drawing the schematic diagram of Autotransformer starter, DOL starter and StarDelta Starter. Drawing the schematic diagram of A.C. motor speed control by SCR /AC Drive.
2.	Forces: - Resolution and composition of forces. Representation of force by vectors, simple problems on lifting tackles like jib wall, crane-Solution of problems with the aid of vectors. General condition of equilibriums for series of forces on a body. Law of parallelogram, Triangle Law, Lami's theorem.	Alternator Tracing of panel wiring diagram of an alternator. Drawing the schematic diagram of automatic voltage regulators of A.C. generators.
3.	Centre of gravity:- Centre of gravity concept and C.G. of different lamina. Equilibrium different kinds stable, unstable and neutral. Law of parallelogram force. Triangle law, Lami's theorem stable, unstable and neutral equilibrium.	Winding Drawing the development diagram for D.C. Simplex Lap & Wave winding with brush position. Drawing the development diagram of A.C 3 – Phase, 4 Pole 24 slots single layer winding.

	Topics
1	<p>Introduction to NCVT and certification mechanism. Semester system and its flexibility for the trainee and to the institute. EM trade and its applicability in industries.</p> <p>Expectations of the industry from trainees after the completion of the trade. The skills to be acquired to become part of industry. Introduction to safety, safety signs, and measures to be taken to maintain the standards of safety of personal working and the equipments. Different first aid mechanisms to rescue the affected by electric shocks or any physical injuries.</p>
2	<p><u>Hand Tools and their uses</u></p> <p>Identification, specifications, uses and maintenance of commonly used hand tools. Riveting of tags and lugs, cutting and bending of sheet metals, chassis and cabinets.</p>
3	<p>Basics of AC and Electrical Cables Basic terms such as electric charges, Potential difference, Voltage, Current, Resistance. Basics of AC & DC. Terms such as +ve cycle, -ve cycle, Frequency, Time period, RMS, Peak, P-P, Instantaneous value. Single phase and Three phase supply. Terms like Line and Phase voltage/ currents. Insulators, conductors and semiconductor properties. Different type of electrical cables and their Specifications. Types of wires & cables, standard wire gauge (SWG). Classification of cables according to gauge (core size), number of conductors, material, insulation strength, flexibility etc.</p>
4	<p><u>Cells & Batteries</u></p> <p>Battery /Cells: construction, types of primary and secondary cells, materials used, Specification of cells and batteries. Charging process, efficiency, life of cell/battery. Selection of cells / Batteries etc. Use of Hydrometer. Types of electrolytes used in cells and batteries. Series / parallel connection of batteries and purpose of such connections.</p>
5	<p><u>Passive Components</u> Ohm's law and its variables. Resistor- definition, types of resistors, their construction & specific use, color-coding, power rating. Equivalent Resistance of series parallel circuits. Distribution of V & I in series parallel circuits. KVL & KCL with applications. Principles of induction, inductive reactance, Types of inductors, construction, specifications and applications (energy storage concept). Self and Mutual induction. Behavior of inductor at low and high frequencies. series and parallel combination, Q factor. Capacitance and Capacitive Reactance, Impedance. Types of capacitors, construction, specifications and applications.</p>

	<p>Dielectric constant. Significance of Series parallel connection of capacitors. Capacitor behavior with AC and DC. Concept of Time constant of a RC circuit. Concept of Resonance and its application in RC, RL& RLC series and parallel Types and circuit Properties of magnets and their materials, preparation of artificial magnets, significance of electro magnetism, types of cores.</p> <p>Electromagnetic Relays, types, construction, specifications- coil voltage and contact current capacity.</p>
6	<p><u>Transformers</u> Working principle of a Transformer,</p> <p>Transformer construction, Types of cores used. Specifications of a transformer, Step-up, Step down and isolation transformers with applications. Different type of losses in Transformers, Phase angle, phase relations, active and reactive power, power factor and its importance in the industry.</p>
7	<p><u>AC & DC measurements</u> Introduction to electrical measuring instruments, Importance of meter, classification of meters, forces necessary to work a meter. MC and MI meter, range extension, need of calibration, characteristics of meters and errors in meters. Multi meter, use of meters in different circuits. Care and maintenance of meters. Use of CRO, Function generator, LCR meter</p>
8	<p><u>Soldering & De-soldering and switches</u></p> <p>Different types of soldering guns, related to Temperature and wattages, types of tips. Solder materials and their grading. Use of flux and other materials. Selection of a soldering gun for specific requirement.</p> <p>Soldering and De-soldering stations and their specifications. Different switches and their specification, uses.</p>
9	<p><u>Rectifiers</u> Semiconductor component number coding for different electronic components such as Diodes, Zeners. PN Junction, Forward and Reverse biasing of diodes, Interpretation of diode specifications Forward current and Reverse voltage, packing styles of diodes. Diode Bridge Modules. Rectifier configurations, their efficiencies, Filter components and their role in reducing ripple. Working principles of Zener diode / specifications / applications, Varactor diode / Tunnel diode / specifications with applications.</p>
10	<p><u>IC Regulators</u> Regulated Power supply using 78XX series, 79XX series, Op-amp regulator, 723 regulator, (Transistorized & IC based) voltage regulation, error correction and amplification etc.</p>
11	<p><u>Computer Hardware. OS. MS office Networking</u> Basic blocks of a computer, Hardware and software, I/O devices, keyboard, types of mouse and their working, Different types of printers, their function and inter-connection and their advantages HDD, CDD, DVD. Various ports in the computer.</p>

	<p>POST Booting concept.Windows O.S. MS widows: Starting windows and its operation, file management using explorer, Display & sound properties, screen savers, font management, installation of program, setting and using of control panel., application of accessories, various IT tools and applications, Components of desk top Concept of word processing,: MS word</p> <p>- Menu bar, standard tool bar, saving, copying, deleting & retrieving files, page setting, editing, formatting, advance features i.e. highlighting, cut & paste, subscript & superscript drawing features, mail merging, Hyperlink, tables and borders, printing of documentetc. Excel - Worksheet basics, data entry and formulae. Moving data in worksheet using tool bars and menu bars, Formatting and calculations, printing worksheet, creating multiple work sheets, creating charts, changing chart types, Adding titles, legends and gridlines, colouring charts, printing charts, placing charts in a word file. Introduction to power point Basics of</p>
12	<p><u>Transistor</u></p> <p>Construction, Working of a PNP and NPN Transistors. Purpose of E, B & C Terminals.Flow of currents into and out of terminals ofPNP/ NPN Transistors and their relations. Significance of β of a Transistor Need for Biasing of Transistor junctions, Interpretationof main parameters of a Transistor.V_{BE}, V_{CB},V_{CE}, I_C, I_B, Junction Temperature, junction capacitance, Frequency of operation,Discuss a Transistor application as a switch. Discuss a Transistor application as an amplifier. Define input impedance and outputimpedances</p> <p>Transistor power ratings & packaging styles,use of different heat sinks.</p>
13	<p><u>Amplifier</u></p> <p>Transistor (CB, CE & CC) configurations andtheir characteristics and applications</p> <p>Transistor biasing circuits and stabilizationTechniques.</p>
14	<p>Classification of amplifiers according to frequency, mode of operation, methods of coupling, Voltage amplifiers- voltage gain, loading effect. Configuration of common emitter, common base, common collector transistor, their definition characteristics and applications. Single stage CE amplifier, (CC amplifier) emitter follower circuit and its advantages RC coupled amplifier, Distinguish between voltage and power amplifier, Push pull amplifier and class C tuned amplifier Alpha, beta, voltage gain, Concept of dB dBm. Feedback and its types.</p>
15	<p>Introduction to positive feedback and requisites of an oscillator, Study of Colpitts, Hartley, Crystal and RC oscillators.</p> <p>Types of multi vibrators and study of circuit diagrams</p>

16	<p style="text-align: center;"><u>Wave shaping circuits</u></p> <p>Diode shunt clipper circuits and Clamping /limiting circuits and their applications.Schmitt trigger circuits</p>
17	<p style="text-align: center;"><u>Power Electronic Components</u></p> <p>Construction of FET, differentiate it with BJT. Purpose of Gate, Drain and source terminals and voltage / current relations between them,</p> <p>Impedances between various terminals. Interpret the main parameters of the FET. Suitability of FET amplifiers in measuring device applications. Working of power electronic components such as SCR, TRIAC, DIAC and UJT.</p>
18	<p style="text-align: center;"><u>MOSFET & IGBT</u></p> <p>Working of MOSFET, Power MOSFET and IGBT - their types, characteristics, switching speed, power ratings and protection. Differentiate FET with MOSFET, differentiate a Transistor with IGBT</p>
19	<p style="text-align: center;"><u>Opto Electronics</u></p> <p>Working and application of LED, IR LEDs, Photo diode , photo transistor, its characteristics and application, optical sensor,opto-couplers, circuits with opto isolators, characteristics of LASER diodes</p>
20	<p>Introduction to SMD technology</p> <p>Identification of 2,3,4 terminal SMD components, advantages of SMD components over conventional lead components</p> <p>Introduction to solder paste and machine.</p> <p>Soldering of SM assemblies - Reflowsoldering</p> <p>Tips for selection of hardware, Inspection of SM</p>

21	<p><u>Basic Gates:</u></p> <p>Introduction to Digital Electronics.</p> <p>Difference between analog and digital signals, Logic families and their comparison, Logic levels of TTL and CMOS. Number systems (Decimal, binary, octal, Hexadecimal) BCD code, ASCII code and code conversions.</p> <p>Logic Gates and their truth tables, propagation delay, power dissipation and noise immunity</p>
22	<p><u>Combinational Circuits:</u></p> <p>Combinational logic circuits such as Half Adder, Full adder, Parallel Binary adders, 2-bit and four bit full adders. Magnitude comparators. Half adder, full adder ICs and their applications for implementing arithmetic operations</p> <p>Basic Binary Decoder and four bit binary decoders.. Concept of encoder and decoder, Need for multiplexing of data. 1:4 line Multiplexer /De-multiplexer.</p>
23	<p><u>Flip Flops:</u></p> <p>Introduction to Flip-Flop. S-R Latch, Gated S- R Latch, D- Latch. Flip-Flop: Basic RS Flip Flop, edge triggered D Flip Flop, JK Flip Flop, T Flip Flop, Master-Slave flip flops and Timing diagrams, Basic flip flop applications like data storage , data transfer and frequency division.</p>
24	<p><u>Electronic circuit simulation software</u></p> <p>Study the library components available in the circuit simulation software. Various resources of the software.</p>
25	<p><u>Counter & shift Registers</u></p> <p>Basics of Counters, types of counters, two bit and three bit Asynchronous binary counters and decade counters with the timing diagrams.</p> <p>3-bit Synchronous counters and synchronous decade counters.</p> <p>Types of seven segment display,</p> <p>BCD display, BCD to decimal decoder. BCD to 7 segment display circuits,</p> <p>Basics of Register, types and application of Registers.</p>
26	<p><u>Digital Storage Oscilloscope:</u></p> <p>Block diagram of DSO/CRO and applications of DSO/CRO application of digital CRO, block diagram of function generator. Differentiate a CRO with DSO. Advantages of DSO. Major features of DSO.</p>

27	<p><u>SMD Soldering and De-Soldering:</u></p> <p>Soldering / de-soldering of above components</p> <p>Identification of Programmable Gate Array(PGA) packages</p> <p>Soldering / De-soldering of above PGA components</p> <p>Cold/Continuity check of PCBs</p> <p>Identification of loose /dry solders, broken tracks on printed wiring assemblies</p>
28	<p><u>PCB Rework:</u></p> <p>ESD Control in Electronics</p> <p>Introduction to Static charges, Prevention of Static charges, Handling of static sensitive devices, Various standards for ESD</p> <p>Introduction to non soldering Inter connections</p> <p>Introduction to crimping, wire wrapping, Conductive adhesives, Chip on Board, Tape Automated bonding.</p> <p>Introduction to components, Printed Circuit Boards</p> <p>Introduction to components, Construction of Printed Circuit Boards(single, Double, multi-layer), Important tests for PCBs</p> <p>Soldering guns</p> <p>Different types of soldering guns, related to Temperature and wattages, types of tips.</p> <p>Solder materials and their grading. Selection of a soldering gun for specific requirement.</p> <p>Soldering and De-soldering stations and their specifications.</p> <p>Reliable Soldering Practices (Manual)</p> <p>Fundamentals of soldering technology, Materials selection like solder, flux and cleaning solvents, Usage of correct tools, Component mounting, Solderability testing, Process for soldering Inspection of solder joints, Defects of soldered joints</p> <p>Introduction to Surface Mount Technology (SMT)</p> <p>Introduction to surface mount technology – advantages Surface Mount components and packages, Introduction to solder paste (flux), Soldering of SM assemblies - Reflow soldering Tips for selection of hardware, Inspection of SM.</p> <p>Rework and Repair of Printed Circuit board assemblies</p> <p>Introduction to rework and repair concepts</p> <p>Types of conformal coating and its removal methods</p> <p>Rework of through hole and surface mount soldered joints</p>

	Repair of damaged track Repair of damaged pad Repair of Plated through hole Repair of solder mask
29	<p><u>Protection devices:</u></p> <p>Fuse ratings, types of Fuses, Fuse bases, single/three phase MCBs, single phase ELCBs.</p> <p>Types of Contactors, contactor coils and working voltages, contactor contact currents, protection to contactors and high current applications.</p>
30	<p><u>Electrical control circuits:</u></p> <p>Fundamentals of single phase Induction motors, synchronous speed, slip, rotor frequency, torque</p> <p>- speed characteristics, Starters used for Induction motors.</p>
31	<p><u>Electronic Cables & Connectors</u></p> <p>Cable signal diagram conventions</p> <p>Classification of electronic cables as per the application w.r.t. insulation, gauge, current capacity, flexibility etc. different types of connector & their terminations to the cables.</p>
	<p>Male / Female type DB connectors, Ethernet 10 Base cross over cables and pin out assignments, UTP and STP, SFTP Cables</p> <p>Cable trays.</p> <p>Different types of connectors Servo 0.1" connectors, FTP, RCA, BNC, HDMI</p> <p>Audio/video connectors like XLR, RCA (phono), 6.3mm PHONO, 3.5/2.5mm PHONO, BANTAM, SPEAKON, DIN, mini</p> <p>DIN, RF connectors, USB, Firewire, SATA Connectors, VGA, DVI connectors, MIDI etc</p>

32	<p><u>Communication electronics:</u></p> <p>Radio Wave Propagation – Principle, Fading,</p> <p>Need for Modulation, types of modulation. Demodulation techniques.</p> <p>Fundamentals of Antenna, various parameters, types of Antennas & application.</p> <p>Introduction to AM, FM & PM, SSB-SC & DSB-SC, block diagram of AM and FM transmitter.</p> <p>FM Generation & Detection</p> <p>Radio Receivers: Types, Super heterodyne receiver Blocks, Principle, characteristics, advantages and disadvantages, Block diagram of FM Receiver, RF, IF & AF Amplifier Sections, AM/FM RF Alignment.</p> <p>Digital modulation and demodulation techniques, sampling, quantization & encoding.</p> <p>Concept of multiplexing and demultiplexing of AM/FM/PAM/PPM/PWM signals.</p> <p><i><u>A simple block diagram approach to be adopted for explaining the above mod/demod techniques.</u></i></p>
33	<p><u>Microcontroller (8051)</u></p> <p>Introduction to 8051 Microcontroller, architecture, pin details & the bus system. Function of different ICs used in the</p> <p>Male / Female type DB connectors, Ethernet 10 Base cross over cables and pin out assignments, UTP and STP, SFTP Cables</p> <p>Cable trays.</p> <p>Different types of connectors Servo 0.1" connectors, FTP, RCA, BNC, HDMI</p> <p>Audio/video connectors like XLR, RCA (phono), 6.3mm PHONO, 3.5/2.5mm PHONO, BANTAM, SPEAKON, DIN, mini</p> <p>DIN, RF connectors, USB, Firewire, SATA Connectors, VGA, DVI connectors, MIDI etc</p>
	<p>Microcontroller Kit. Differentiate micro controller with microprocessor. Interfacing of memory to the microcontroller. Internal hardware resources of microcontroller. I/O port pin configuration. Different variants of 8051 & their resources. Register banks & their functioning. SFRs & their configuration for different applications. Utilization of on chip resources such as ADC. Availability of assembly software & compiler for 8051. Application of microcontroller in domestic, consumer & industries.</p> <p>Comparative study of 8051 with 8052.</p> <p>Introduction to PIC Architecture.</p>

34	<p><u>Sensors Transducers and Applications</u></p> <p>Basics of passive and active transducers.</p> <p>Role, selection and characteristics.</p> <p>Working principles of RTD, PT-100 Thermo couple, Sensor voltage and current formats.</p> <p>Thermistors – salient features –operating range,composition, advantages and disadvantages.</p> <p>Thermocouples – basic principle – commonly used combinations, operating range, advantagesand disadvantages.</p> <p>Strain gauges – principle, gauge factor, types ofstrain gauges.</p> <p>Load cell –definition, uses, working of straingauge load cell</p> <p>Principle of operation of capacitive transducers,-advantages and disadvantages</p> <p>Principle of operation of inductive transducers,-advantages and disadvantages</p> <p>Principle of operation of LVDT-its advantagesand disadvantages</p> <p>Proximity sensors – applications, workingprinciples of eddy current , capacitive and inductive proximity sensors</p>
35	<p><u>Analog IC Applications</u></p> <p>Discussion on the identified projects with respect to data of the concerned ICs, components used in the project</p>
36	<p><u>Digital IC Applications</u></p> <p>Discussion on the identified projects with respectto data of the concerned ICs, components used in the project</p>
37	<p><u>Fiber optic communication:</u></p> <p>Introduction to optical fiber as a transmission media, its advantages over other media, properties of optic fiber, testing, losses , types of fiber optic cables and specifications.</p> <p>Encoding of light.</p> <p>Fiber optic joints, splicing, testing and the related equipments/measuring tools, precautions to be takenlaying of cables, safety aspects while handling optical cables.</p>

38	<p style="text-align: center;"><u>Digital panel Meter:</u></p> <p>Different types of seven segment displays, decoders and driver IC s for them. Concept of multiplexing and its advantages.</p> <p>Block diagrams of 7106 and 7107 and their configuration for different measurements.</p> <p>Use of DPM (Digital Panel Meter) with seven segment displays to display different voltage & current signals.</p>
39	<p>Principles of working of LCD. Different sizes of LCDs. Decoder/Driver ICs used with LCDs and their pin-out diagrams.</p> <p>Scrolling displays and its design.</p> <p>Use of DPM (Digital Panel Meter) with LCD to display different voltage & current signals</p>
40	<p style="text-align: center;"><u>SMPS:</u></p> <p>Concept and block diagram of manual, automatic and servo voltage stabilizer, o/p voltage adjustment, voltage cutoff systems, study of different types of relays used in stabilizer. Block Diagram of Switch mode power supplies and their working principles</p> <p>Various types of chopper circuits step-up, step down, inverting types.</p> <p>Introduction to DC-DC Converters</p> <p>ICs used for converting DC- DC, block diagrams and their pin outs. Applications of DC-DC converters</p>
41	<p style="text-align: center;"><u>UPS</u></p> <p>Concept of UPS,</p> <p>Difference between Inverters and UPS. Basic block diagram of UPS & operating principle,- explanation of rectifier, battery, inverter, static transfer switch.</p> <p>Types of UPS : Off line UPS, On line UPS, Line interactive UPS & their comparison</p> <p>UPS specifications. Load power factor & types of indications & protections</p> <p>UPS circuit description and working - controlling circuits, Micro controller circuits, power circuits, charging circuits, alarm circuits, Indicator circuits.</p>
42	<p>Three phase UPS Circuits.</p> <p>Installation of single phase & three phase UPS</p> <p>Electrical wiring for Single phase and Three phase systems, Earthing and earth resistance measurement, calculation of load power and power factor of a power source.</p> <p>Protection circuits used in inverters- battery level, over load, over charging etc. Various faults and its rectification</p>

43	<p><u>Solar Power (Renewable EnergySystem)</u></p> <p>Need for renewable energy sources, Solar energy as a renewable resource. Materials used for solar cells.</p> <p>Principles of conversion of solar light into electricity. Basics of photovoltaic's cell. Types of solar cells. Mono crystalline and poly crystalline PV cells.</p> <p>Define Components like Solar cell, Module, panel and Arrays. Factors that influence the output of a PV module. SPV systems and the key benefits. Difference between SPV and conventional power. Define solar charge controller or regulator and its role.</p> <p>Safety precautions while working with solar systems.</p>
44	<p><u>Cell phones</u></p> <p>Introduction to mobile communication, concept cell site, hand off, frequency reuse, block diagram and working of cell phones, cell phone features, GSM and CDMA technology. Use IEMI number to trace lost/misplaced mobile phone.</p>
45	<p>LED Lights</p> <p>Types of LED panels used in various lighting applications.</p> <p>Stacking of LEDs. Driving of LED stacks.</p>
46	<p>LCD and LED TV</p> <p>Difference between a conventional CTV with LCD & LED TVs,</p> <p>Principle of LCD and LED TV and function of its different section. Basic principle and working of 3D TV.</p> <p>IPS panels and their features</p> <p>Different types of interfaces like HDMI, USB, RGB etc with latest TVs.</p> <p>TV Remote Control -Types, parts and functions, IR Code transmitter and IR Code Receiver, Working principle, operation of remote control. Different adjustments, general faults in Remote Control.</p>