Syllabus for the Post of Junior Technician (Boiler) -Level A1

Essential Qualification: High school or Class X Equivalent Board Examination with Science and II class Boiler Attendants (oil / Gas fired) certificate

Part (A): General Mental Ability and Aptitude	20% (20 questions carrying 1 mark each)

General Mental Ability and Aptitude to test the following:

- Interpersonal Skills
- Logical reasoning/Analytical/Comprehension ability
- Basic Numeracy and Data Interpretation Skills
- General Awareness

Part (B): Subject/Domain Related	80 % (80 questions carrying 1 mark each)

1. Introduction of Trade and Importance of Safety and General Precautions observed in the workshop. Introduction of Steel Rule, Calipers types and uses.
2. Introduction of functions and types. Try square and functions & uses of scribing Block / Marking Block. Introduction of Files, Types of Filing – Details
3. Introduction of Hacksaw, types functions and Blade, specifications types & uses etc. types of Files, Special files, functions, uses.
4. Introduction of Chisels, types, Chipping & types of Hammers uses & functions. Safety Precautions.
5. Introduction of Drill bits in detail and types, functions and Types of Drilling Machines.
   Introduction of Taps & types and other related details – Tap drill size calculation
6. Introduction of precision instruments, vernier caliper, Micrometers, Vernier height gauge & other related instruments.
7. Introduction of Dyes, Types & Function, Safety Precautions during Dye operation. Introduction about combination set & its uses.
8. Introduction about nomenclature of screw threads – types. Introduction about Nuts & Bolts – types of spanners & studs.
9. Introduction about fasteners – keys – keyways – types – functions & other related details.
10. Introduction of Sheet Metal - cutting snips– different sheet metal tools – stakes & types – Hand shearing maching & its function – types of sheet metal joints.
11. Rivets – types & their uses, method of riveting – specification of rivet – safety precaution while riveting
12. Removing of broken tapes by various methods (stud extractors, Tap extractors) Safety precaution during blind hole tapping & drilling.
13. Introduction of gauges – types – uses & functions (ring gauges, snap gauges, plug gauge etc.)
14. Safety at work causes and types of fire. fire extinguishers types and uses General Safety precautions in Boiler house, different equipment and Instruments used for boiler. Electricity-electric safety Ohm's law, series & parallel connections; What is IBR and non IBR Boilers.
15. **PRESSURE:** Definition of pressure. Types of pressure & their units. Types of pressure sensing elements- bourdon tube, diaphragms, capsules, and bellows. Pressure switches types and applications. Types of manometers. Dead weight tester and comparators and applications. Importance of ID fan & FD fan in Boiler.
16. **Temperature measurement:** Definition, Units of Temperature, modes of heat transfer, Temperature gauges – bimetallic, liquid filled system thermometer working and application.

Temperature sensors, RTD, Thermocouple, Optical and radiation pyrometer working and application.

17. Basic properties of fluids, fluids in motion, getting fluids to flow, units of flow rate and quantity flow, factors affecting flow rate. Relation between flow rate and pressure, area, quantity. Head type flow meter types. Working and application of venturi and orifice flow meter. Rota meter working, application.
18. Gases - CO, CO_2, O_2., Cooling tower. Working, Application of I to P, and valve positioner, ON-OFF controller, P, PI, PD, PID control limitations and application.
19. Blower construction and operation.
20. Steam: Its heating and power properties: Principles of steam and application in Modern Boilers. Steam preventing, escape of heat, lagging, steam distribution, charging of steam and water line, steam quality, condensate handling, traps etc. Wet steam saturated steam, super heated steam and their properties. Boiling point, temperature and pressure relations, sensible heat, latest heat super heat, reheat and total heat. Use of steam table and entropy chart. boiling and condensation.
21. Construction, working and uses of various types of valves.
22. Construction, working and uses of various types of Pumps, Introduction /overview of thermodynamics Construction, working and uses of various types of heat exchangers, condenser & cooler
23. Water treatment: Object of feed water treatment – water analysis water of high Pressure boilers. Impurities in water and their harmful effects. Effects of other suspended matter such as Oil, alkalinity, hardness, etc. in feed water- Total dissolved solids – Methods of purification use of Deaerators –Priming and foaming scale formation and corrosion. Chemical cleaning of boiler, softening and de- mineralized Water Plant.
24. Types of boilers-fire tube and water tube boilers Forced circulation boilers. Pre- heater, Economizer, waste heat boiler. Boiler drum. Boiler mounting and fittings. Boiler accessories. IBR and non IBR Boiler, Knowledge of Indian Boilers Acts and Rules.
25. **WORKSHOP CALCULATION AND SCIENCE**
    a. **Unit**: Systems of unit- CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units
    Material Science: Properties -Physical & Mechanical, Types –Ferrous & Non- Ferrous, difference between Ferrous and non-Ferrous metals.
    b. **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.
    Mass ,Weight and Density : Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density, specific gravity of metals.
    c. **Ratio & Proportion** : Simple calculation on related problems.
    Speed and Velocity: Rest and motion, speed, velocity, difference between speed and velocity, acceleration, retardation.
    d. **Percentage**: Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa.
    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.
    e. **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 andSphere.

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.

f. Archimedes's principle, principle of floatation hydrometers. Centre of gravity and Equilibrium condition. Definition - viscosity, flash point, fire point, flash points of standard lubricating oils, octane number.
g. Pressure, temperature, Boyle's law, Charles's law, Equation of perfect gas. Calculations. Newton's laws of motion unit of force, find out resultant force parallelogram law of forces,
h. Centre of Gravity, (C.G. Of square, rectangle, triangle, circle, semicircle, cone) & its calculations. Condition of equilibrium, kind of equilibrium, some examples of equilibrium in daily life,
i. **Flow of fluids-** Equation of continuity, Bernoulli's theorem. Advantages & Disadvantages of friction, Limiting friction, Laws of limiting friction, Coefficient of friction, angle of friction, Inclined plane, Force of friction
j. Flow measurement by orifice meter, venturi meter, Rota meter, U-tube manometer. Latent heat, sensible heat, saturated steam, wet steam, superheated steam. Reynolds's number, at different velocities.

26. **ENGINEERING DRAWING**

a. **Engineering Drawing**: Introduction and its importance
Drawing Instruments: their Standard and uses; 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.
Lines :
- Definition, types and applications in Drawing as per BISSP:46-2003
- Classification of lines (Hidden, centre, construction, Extension, Dimension, Section)
- Drawing lines of given length (Straight, curved); Drawing of parallel lines, perpendicular line

b. **Drawing of Geometrical Figures**: Definition, nomenclature and practice of - Angle: Measurement and its types, method of bisecting.
- Triangle –different types
- Rectangle, Square, Rhombus, Parallelogram, polygons.
- Circle and its elements.

Lettering and Numbering as per BIS SP46- 2003: Single Stroke, Double Stroke, inclined, Upper case and Lowercase

c. **Practice of Lettering and Title Block Dimensioning practice**:
- Position of dimensioning(unidirectional, aligned, oblique as per BISSP:46-2003)
- Symbols preceding the value of dimension and dimensional tolerance.

d. **Drawing of Solid figures:** (Cube, Cuboids, Cone, Prism, Pyramid, Frustum of Cone and Pyramid.) with dimensions.

Free Hand sketch of hand tools and measuring tools used in respective trades.

e. **Free-hand sketches** of Hand Tools, Screw drivers, Pliers, Spanner, Tweezer. Free-hand sketches of Vernier Caliper, micrometer, Depth Gauge, Dial Test Indicator, Bevel protractor

ISI symbols of Generator, Voltmeter, Ammeter, Watt- meter. Resister, inductor, Capacitor, Transformer, AC & DC motors.etc. Drawing of pressure control process line

f. **Drawing sketches of different types ofvalves**, such as gate valve, globe valve, ball valve, Plug Valve, check valve etc.
   Drawing of different types locking devices such as double nut, castle nut, pin etc.
g. **Symbolic representation of different types of valves**- gate valve, globe valve, butterfly valve, ball valve, diaphragm valve, control valve, non-return valve, and needle valve.
   Free hand sketches of Belt conveyor, Screw conveyer, Bucket elevator.
h. **Drawing of pressure, Level, flow and temperature control system.**
   Free hand sketches of crushers, ball mill, hammer mill and centrifuges
i. **Free hand sketches** of steam jet ejector, steam trap
   Diagram of distillation column with all accessories

   Free hand sketches of process instrument- such as temperature indicator, level indicator, LIC, TIC, PI, PIC, FI, FIC
j. Flow sheet / Block diagram of Sulphuric acid, Nitric acid, Ammonia, Urea , Ethanol

Note: The above syllabus is indicative and the questions in the test may include similar other topics pertaining to the level and content of essential qualification.