Syllabus for All Post

Advertisement No. HRAQ/REC-WP-B/2023-66

Dated 28/03/2023

SYLLABUS: BLR12023

- General Safety precautions in Boiler house, different equipment and instruments used for boiler. Fire extinguishers types and uses. First aid, PPEs and Response to emergencies etc.
- Introduction, types, functions of Steel Rule, Calipers, Try square.
- Introduction, types, functions of scribing Block / Marking Block, Files.
- Introduction, types, functions of Hacksaw, Chisels, types, Drill bits.
- Introduction, types, functions of Taps, Dyes and precision instruments like Vernier caliper, Micrometers etc.
- Introduction, types, nomenclature of screw threads, Nuts & Bolts, spanners & studs.
- Introduction, types, functions of fasteners, keys, keyways, sheet metal, cutting snips, stakes, Hand shearing maching etc.
- Types, uses of Rivets, riveting, removing of broken tapes by various methods (stud extractors, Tap extractors).
- Introduction, types, functions of gauges (ring gauges, snap gauges, plug gauge etc.).
- Electricity- Ohm's law, series & parallel connections.
- Pressure: Definition, Types, units. Bourdon tube, diaphragms, capsules, and bellows.
- Temperature measurement: Definition, Units, modes of heat transfer, Temperature gauges, Temperature sensors, RTD, Thermocouple, Optical and radiation pyrometer working and application.
- Basic properties of fluids, fluids in motion. Relation between flow rate and pressure, area, quantity.
- Working and application of venturi and orifice flow meter
- Gases - CO, CO2, O2., Cooling tower. Working, Application of I to P, and valve positioner, ON-OFF controller, P, PI, PD, PID control limitations and application.
- Steam: Properties, Application in Modern Boilers. Use of steam table and entropy chart. boiling and condensation. Blower construction and operation.
- Construction, working and uses of various types of valves, pumps.
- Construction, working and uses of various types of heat exchangers, condenser & cooler.
- Water treatment: Objective, Analysis. Impurities in water and their harmful effects.
- Types of boilers-fire tube and water tube boilers. Forced circulation boilers. Preheater, Economizer, waste heat boiler. Knowledge of Indian Boilers Acts and Rules.

SYLLABUS: FTR12023

- Importance of safety and general precautions observed in the in the industry/shop floor - First aid, PPEs and Response to emergencies etc. Basics of Hot work, confined space work and material handling equipment.
- Bench Vice, Files – specification, types, uses, care & maintenance. Marking and measuring tools, Marking media, their special application, description.
- Physical & Mechanical properties of engineering metal. Types, properties and uses: Pig Iron, Cast Iron, Steel and Non-ferrous metals (Copper, Aluminium, Tin, Lead, Zinc).
- Power Saw, band saw, Circular saw machines used for metal cutting.
- Micrometer, Vernier calipers, Dial test indicator – principle, features, parts, reading, use and care.
- Drilling processes - Types, Drill- material, Drill angle, Drill holding devices, Drill troubles: causes and remedy.
- Sheet metal – sheet, sizes, types, uses as per BIS specifications. Shearing machine- description, parts and uses.
- Stakes- types, parts, their uses. Various types of metal joints, Wired edges. Solder and soldering: types of solder and flux.
- Counter sink, counter bore and spot facing-tools, Reamers, Screw threads.
- Tap and Dies, Grinding wheel: Abrasive, grade structures, bond, specification, use, mounting and dressing.
- Lathe specifications, and constructional features, main parts. Lathe cutting tools.
- Chucks and chucking. Lapping, Honing: Applications, materials.
- Turning operations- Types, Uses, Methods.
- Maintenance- Total productive maintenance,-Autonomous maintenance, Routine maintenance, Maintenance schedules.
- Screws: material, designation, specifications, Power tools, Nuts, Keys.
- Heat treatment, various heat treatment methods. Various coatings used to protect metals.
- Gauges, Bearings, Bearing materials and Pipes and pipe fittings.
- Vee belts, commercial belts, Couplings, Pulleys. Power transmission.
- Industrial hydraulic system, Applications, Pascal's Law. Pneumatic valves, Hydraulic oil, filters, cylinders motors and valves.
- Lubrication and lubricants- Types, Purpose, Use.

SYLLABUS: MDL12023

- Importance of safety and general precautions observed in the in the industry/shop floor - First aid, PPEs and Response to emergencies etc. Knowledge of fire and fire extinguishers.
- Hand & Power Tools: Marking scheme, marking material, Cleaning tools. Description, care and use of Surface plates, steel rule, measuring tape, try square. Callipers, Punches, Screw, driver, hammer, spanners, pliers.
- Systems of measurement: Description, Least Count calculation, care & use of – Micrometers, Vernier Calliper, and various gauges.
- Different types of metal joint (Permanent, Temporary), methods of Bolting, Riveting, Soldering, Brazing, Seaming etc. Fasteners, Cutting tools, Limits, Fits & Tolerances.
- Drilling machine, Description, different types, drill holding devices, Drill bits, Taps and Dies, Hand Reamers.
- Sheet metal: various common metal Sheets used, Shearing, bending, Drawing, Squeezing Sheet metal joints, Hem & Seam Joints Fastening Methods.
- Ohm's law, Voltage, Current, Resistance, Power, Energy, Voltmeter, Ammeter, Ohmmeter, Fuses & circuit breakers.
- Description of Chemical effects, Batteries & cells, Magnetic effects.
- Welding processes, Heat Treatment Process: Introduction, Definition.
- Non-destructive Testing: Various Methods, Definition and their importance,
- Internal & External combustion engines. Principle & working of 2 & 4-stroke diesel engine and S.I Engine.
- Diesel Engine Components: Cylinder head, Combustion chambers, Engine Valves, Camshafts & drives.
- Description & functions of cylinder block, pistons, piston rings, crank shaft, camshaft, engine bearings.
- Description & functions of the fly wheel, vibration damper, clutch & coupling units attached to flywheel.
- Gas Turbine, Comparison of single and two stage turbine engine, Different between gas turbine and Diesel Engine.
- Cooling systems: Types, Need. Heat transfer method. Viscosity and its grade as per SAE, Lubrication system components
- Description of Diesel Induction & Exhaust systems, components and air compressor
- Fuel Feed System in IC Engine (Petrol & Diesel).
- Emission Control: Vehicle emissions, Standards- Euro and Bharat II, III, IV, V. Characteristics and Effect of Hydrocarbons.
- Troubleshooting: Causes and remedy for Engine Not starting Mechanical & Electrical causes, High fuel consumption, Engine overheating, Low Power Generation.

SYLLABUS: WLD12023
• Importance of safety and general precautions observed in the in the industry/shop floor - First aid, PPEs and Response to emergencies etc. Knowledge of fire and fire extinguishers. • Different process of metal joining methods: Bolting, riveting, soldering, brazing, seaming etc. • Arc welding power sources: Transformer, Motor Generator set, Rectifier and Inverter type welding machines and its care & maintenance. • Welding positions as per EN &ASME: flat, horizontal, vertical and over head position. • Arc length – types, effects of arc length. Arc blow – causes and methods of controlling. Polarity, Weld quality inspection, common welding mistakes. • Calcium carbide, Acetylene gas, Oxygen gas properties and uses. • Oxy acetylene gas welding Systems (Low pressure and High pressure). • Specification of pipes, various types of pipe joints, pipe welding all positions, and procedure. • Gas welding filler rods, specifications and sizes. Gas welding fluxes – types and functions. Gas Brazing & Soldering: principles, types fluxes & uses. Gas welding defects, causes and Remedies. • Electrode: types, functions of flux, coating factor, sizes of electrode, Coding of electrode. • Weldability of metals, importance of pre heating, post heating and maintenance of inter pass temperature. • Welding of low, medium and high carbon steel and alloy steels. Stainless steel types- weld decay and weldability. • Brass, Copper, Aluminium, Cast Iron – types – properties and welding methods. • Types of Inspection methods. Destructive and NDT methods. Welding economics and Cost estimation. • Gas Metal Arc Welding (GMAW) and Gas Tungsten Arc Welding (GTAW) – Introduction, Safety precautions, Wire feed system – types –care and maintenance. • Heat input and technique. Pre heating & Post Weld Heat Treatment. Metalizing– types, equipment, advantages and applications. • Plasma Arc Welding (PAW) -principles of operation, types, advantages and applications. • Resistance welding process-types, principles, power sources, welding parameters and applications. • Welding codes and standards. Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) • Hard facing/ surfacing necessity, surface preparation, various hard facing alloys and advantages of hard facing.

SYLLABUS: IMC12023

- Importance of safety and general precautions observed in the in the industry/shop floor - First aid, PPEs and Response to emergencies etc.
- Basic hand tools, types, classification. Measuring instruments, Marking tools, Fasteners & Fastening devices.
- Precision Measuring Instruments, gauge blocks, sine bar, dial indicators, vernier calipers, micrometers, bevel protractor, thickness gauges.
- Types of tubes, Tube cutter, Flaring tools, Swedging tools, pipe bending, straightening, thread cutting, method of installation.
- Ohm's law & Kirchhoff s laws. A.C & DC electricity, types of wave forms, time period and frequency, peak to peak values, RMS values, Average values.
- Multimeter. Resistor, Resistivity and colour code, soldering anddesoldering. Soft soldering. Types of soldering irons. Solder& flux.
- Batteries. {Liquid & dry). Maintenance free batteries construction-charging, efficiency-use, advantage.
- Switches and types. Magnet, magnetism, magnetic properties, Electro-magnetism. E.M. relays, Solenoids, Circuit breakers.
- A.C.-impedance, Inductive reactance, capacitive reactance.
- Introduction of AC and DC generators working principles,construction.
- Transformer, types, transformation ratio. Open circuit and short circuit test.
- Electrical measuring instruments - absolute and secondary instruments, DC instruments, AC instruments.
- Semiconductor, Covalent bond,Doping, Intrinsic and extrinsic semiconductor. Transistors, Rectifier, Voltage Regulators.
- Power Supply units. Introduction, purpose & use. UPS and SMPS, inverters and converters and their applications. Thyristor devices.
- Oscillator's oscillations,oscillation frequency, basicworking principle and working of Talk circuit, Crystal controlled oscillators, Phase shift oscillators, RC phase shift oscillators, Colpitt, Clapp, Hartley, and IC oscillators.
- Operational Amplifier. Differential amplifier, ideal op-amp. Op-amp with feedback, Advantages of feedback. Inverting and Non invertingand inverting amplifier.
- Number systems; binary, octal, decimal and hexadecimalnumber system. Boolean algebra, Logic Circuits. Basic gates, Special gates, Flip flops Counters and registers.
- A/D and D/A converters, Introduction, Types, Specification
- Digital meters: frequencymeter, phase measuring meter, and time measuringinstruments. Digital capacitance meter.
- CRO: introduction and applications. MultimediaSystem - CD ROMS, DVD ROMS, Sound Cards. Computer Hardware & Software, Microprocessormicrocomputers.

SYLLABUS: PCM12023

Physics: Electrostatics, Current Electricity, Magnetic Effects of Current and Magnetism, Electromagnetic Induction and Alternating Currents, Electromagnetic Waves, Optics, Dual Nature of Matter and Radiation, Atoms and Nuclei, Electronic Devices, Communication System

Chemistry: Solid State, Solutions, Electrochemistry, Chemical kinetics, Surface chemistry, General principles and processes of Isolation of Elements, p-Block, d and f Block Elements, Coordination Compounds, Haloalkanes and Haloarenes, Alcohols, Phenols and Ethers, Aldehydes, Ketones and Carboxylic acids, Organic Compounds containing Nitrogen, Biomolecules and Polymers

Mathematics: Relations and functions, Inverse trigonometric functions, Algebra: Matrices, Determinants, Calculus: continuity and differentiability, Integral Calculus, Differential Calculus, Vectors and three-dimensional geometry, Linear programming, Probability.

SYLLABUS: NTR12023

- Applied Anatomy: The Circulatory and Lymphatic system: Structure of blood components, blood vessels – Arterial and Venous system. The Nervous system: CNS, ANS and PNS (Central, autonomic and peripheral). The Musculoskeletal system: Bones – types, structure, growth and ossification, Joints – classification, major joints and structure, Types and structure of muscles.
- Applied Physiology: Respiratory system: Functions of respiratory organs, Endocrine system: Functions and hormones of Pineal Gland, Pituitary gland, Thyroid, Parathyroid, Thymus, Pancreas and Adrenal glands. The Reproductive system: Female reproductive system – Menstrual cycle, function and hormones of ovary, oogenesis, fertilization, implantation, Functions of breast, Male reproductive system – Spermatogenesis, hormones and its functions, semen.
- Nursing Foundation: Definition and Administration of Medication, Drug Nomenclature, Effects of Drugs, Pharmacodynamics and Pharmacokinetics, Medication dose calculation, First Aid Management of Wounds, Haemorrhage & Shock, Musculoskeletal Injuries – Fractures, Dislocation, Muscle injuries. Transportation of Injured persons, Respiratory Emergencies & Basic CPR.
- Applied Biochemistry: Digestion, absorption and metabolism of carbohydrates, Lipids, proteins and related disorders, regulation of blood glucose, Isoenzymes – Definition & properties, Enzymes of diagnostic importance in, Liver Diseases – ALT, AST, ALP, GGT, Acid -base maintenance: pH – definition, normal value, Regulation of blood pH.
- Nutrition: Protein energy malnutrition – magnitude of the problem, causes, classification, signs & symptoms, Severe acute malnutrition (SAM), management & prevention and nurses 'role, Vitamin deficiency disorders – vitamin A, B, C & D deficiency disorders –causes, signs & symptoms, management &prevention and nurses' role, Therapeutic diets: Definition, Objectives, Principles. Balanced diet across life cycle: Definition, principles, steps, Food guides – Basic Four Food Groups.
- Applied Microbiology: Pathogenic organisms: Micro-organisms: Cocci – gram positive and gram negative; Bacilli –gram positive and gram negative, Viruses, Fungi: Superficial and Deep mycoses, Parasites. Immunity, Immunity: Types, classification, Antigen and antibody reaction
- Medical Surgical Nursing: Nursing management of patients (adults including elderly) with respiratory problems, with blood and cardiovascular problems, with disorders of endocrine system.
- Pharmacology: Basic and applied pharmacology of commonly used, analgesics and anesthetics, hyponotics and sedatives, composition action dosage route indications contraindication drug interactions, side effects, adverse effects, toxicity and role of nurse. Drugs acting on g.i. System: antiemetics, emitics, purgatives, antacides, cholinergics, anticholinergics, fluid and electrolyte therapy.
- Pathology and Genetics: Various blood and bone marrow tests in assessment and monitoring of disease conditions: Hemoglobin, Rbc, wbc & platelet counts. Methods of collection of blood specimen for various clinical pathology, biochemistry, microbiology tests, inference and normal values. Examination of body cavity fluids, transudates and exudates, laboratories tests used in CSF analysis.
- Child Health Nursing: Appraisal of New-born, Nursing care of a normal new-born /essential new-born care, Neonatal resuscitation. Identification and Nursing management of congenital malformations, Congenital disorders of different body systems, Childhood emergencies: Accidents – causes and prevention, Poisoning, Foreign bodies, Haemorrhage, Burns and Drowning, PLS (AHA Guidelines).
- Midwifery and Gynaecological Nursing: Oogenesis, spermatogenesis, fertilization and implantation, Embryology and Fetal development, Placenta and membranes, Structure, Functions, Abnormalities, Liquor amni, Umbilical cord, Fetal skull, Structure, Diameters, Fontanels and sutures, Fetal circulation. Diagnosis of pregnancy, Antenatal care, Calculation of expected date ofdelivery, Causes and signs of onset of labour, setting up of the labour room including new-born corner. Management of complications duringpregnancy: Bleeding in pregnancy, Abortion, Gestational diabetes mellitus, Pre-eclampsia, Eclampsia, Monitoring of High risk pregnancy, Multiple pregnancy. Gynaecological disorders: Retroversion, retro flexion, Fistulas, Uterine displacement & prolapsemalformations, Cysts and fibroids.
- Community Health Nursing: Epidemiology and nursing management of common communicable diseases like respiratory infections, Small pox, Chickenpox , Measles, Influenza, Rubella, Ari's& pneumonia, Intestinal infections: Poliomyelitis, Viral hepatitis, Cholera, Diarrhoeal diseases, Typhoid fever, Food poisoning, Dengue, Malaria, Filariasis, Zoonoses, Viral, Rabies, Yellow fever, Japanese encephalitis, Surface infection, Trachoma, Leprosy, STD and RTI, Yaws, HIV/AIDS. Demography: Definition, concept and scope. Epidemiology: Definition, concept, aims, scope, uses and terminology used in epidemiology. National Health program like: National ARI program, Revised national tuberculosis control program (RNTCP), National anti-malaria program, National AIDS control program. Health Agencies: WHO, UNFPA, UNDP, Indian Red Cross, Indian Council for child

welfare, Family Planning association of India. Delivery of community health services: Planning, budgeting and material management of SCS, PHC and CHC.

- Communication & Education Technology: Principles and maxims of teaching, Formulating objective; general and specific, Lesson planning, Classroom management. Methods of teaching: Lecture, demonstration, group discussion, role play, Clinical teaching method, nursing round & reports, Criteria for selection of assessment techniques and methods.
- Mental Health Nursing: Etiological theories (genetics, biochemical, psychological etc), Classification of mental disorders, Psychopharmacology – Definition, classification of drugs, Psychosocial therapies – individual therapies, group therapy, behavior therapy. Types of Psychiatric emergencies: Over Active, under active patient, Violent behaviour, Suicide, adverse drug reactions, withdrawal symptoms, Acute psychosis etc.
- Management of Nursing Service and Education: Establishment of nursing Educational institution – INC Norms and guidelines, Planning: Importance, Types of planning, Principles of organization, Organization chart of hospital/ward/PHC/ Sub center, Staffing, Job description, Job specification, Staff development and staff, welfare, Directing, Co-ordination and control, Quality management, Budgeting.
- Management of Nursing Service and Education: Organizational behaviour and Human relations, Communication, Interpersonal relationships, human relations, Leadership styles, Collective bargaining.
- Applied Sociology & Psychology: Clinical sociology: Introduction to clinical sociology, Sociological strategies for developing services. Body mind relationship, Genetics and behaviour, Cognitive process: Attention, Perception, Intelligence, Learning – definition, types, determinants.

SYLLABUS: TBR12023

- General Safety precautions in Boiler house, different equipment and instruments used for boiler. Fire extinguishers types and uses. First aid, PPEs and Response to emergencies etc.
- Introduction, types, functions of scribing Block / Marking Block, Files.
- The significance of principal appliance in use for the prevention of smoke and principle on which they work, Principle mechanical strokes, pulverizers, gas, oil and pulverizer fuel systems in use.
- Introduction, types, nomenclature of screw threads, Nuts & Bolts, spanners & studs.
- The working and management of steam boilers, super heaters and economizer.
- Introduction, types, functions of fasteners, keys, keyways, sheet metal, cutting snips, stakes, Hand shearing maching etc.
- Types, uses of Rivets, riveting, removing of broken tapes by various methods (stud extractors, Tap extractors).
- Introduction, types, functions of gauges (ring gauges, snap gauges, plug gauge etc.).
- Electricity- Ohm's law, series & parallel connections.
- Pressure: Definition, Types, units. Bourdon tube, diaphragms, capsules, and bellows.
- Temperature measurement: Definition, Units, modes of heat transfer, Temperature gauges, Temperature sensors, RTD, Thermocouple, Optical and radiation pyrometer working and application.
- Basic properties of fluids, fluids in motion. Relation between flow rate and pressure, area, quantity.
- Need for periodical cleaning, methods used for prevention of scales or other deposits of heating surfaces and the necessity for maintaining a certain PH in feed water.
- Working and application of venturi and orifice flow meter
- Gases - CO, CO2, O2., Cooling tower. Working, Application of I to P, and valve positioner, ON-OFF controller, P, PI, PD, PID control limitations and application.
- Steam: Properties, Application in Modern Boilers. Use of steam table and entropy chart. boiling and condensation. Blower construction and operation.
- Construction, working and uses of various types of valves, pumps.
- Construction, working and uses of various types of heat exchangers, condenser & cooler.
- Water treatment: Objective, Analysis. Impurities in water and their harmful effects.
- Types of boilers-fire tube and water tube boilers. Forced circulation boilers. Preheater, Economizer, waste heat boiler. Knowledge of Indian Boilers Acts and Rules.

SYLLABUS: CIV12023

- Importance of safety and precautions, housekeeping & good shop floor practices. PPEs, First Aid. Response to emergencies e.g. power failure, fire, and system failure. Occupational Safety & Health.
- Computer Architecture, Number System and codes, Introduction to Operating System, Computer Network and the Internet, Introduction to C programming.
- Electrical & Electronics Engineering: DC network, Generator & motor, AC fundamental, AC circuit, Transformer, Semiconductor, Transistor, House Wiring, Microprocessor.
- Building Materials and Construction: Stone& Bricks, Sand & Mortar, Timber & Miscellaneous materials, Painting & Varnishing, Foundation, Masonry, Doors & Windows, Damp proofing and floors, Plastering & pointing.
- Water Resource Engineering: Introduction, Water requirements of crops, Definition of common terms, Hydrological cycles, Watershed management, Head works & Weir section, Gravity dam, Canals, Cross drainage works, Water logging.
- Civil Engineering Drawing: Doors and Windows, Roof Truss, Planning of Building, Stair-Case, Building Drawing, Perspective View drawing.
- Surveying: Introduction and overview, Measurement of distances, Chain survey, Compass survey, Levelling, Plane table survey.
- Structural Mechanics: Simple stresses and strains, Shear force, bending moments, Stresses in beams, Slopes and deflection of beams, Column, struts, Analysis of truss, Dams and retaining walls.
- Hydraulics: Measurement of Pressure, Flow of fluids, Flow through Open Channel, Pumps.
- Estimating-I: Types of estimates, Method of building estimate, Different items of work, Sanitary and plumbing, Estimate of RCC items of works.
- Computer Aided Drafting & Drawing: Basic command to get started, Setting up a drawing, Developing drawing strategies, Using layers, Using Blocks and W blocking, Generating elevation, Working with hatches and fills, Controlling drawing texts, Dimensioning, External references, Getting families with proper shape, Printing an auto CAD drawing.
- Concrete Technology: Cement, Properties of concrete, Concrete mix design, Quality control of concrete, Extreme weather concreting & chemical Admixture in concrete, Properties of special concrete.
- Advanced Surveying: Contouring, Theodolite surveying, Curves, Tacheometry survey, Modern method of surveying.
- Transportation Engineering: Introduction, Investigation for road project, Geometric Design of Highway, Construction of Road Pavements and Materials, Traffic Engineering**,** Hill Roads, Drainage of roads, Maintenance and repair of roads, Introduction to Airport Engineering.
- Design of RCC Structures: Properties of Concrete and steel, Fundamentals of Limit State Method, General design considerations (IS:456-2000), Reinforced Concrete beams, Limit state of collapse – Shear and Bond, Reinforced Concrete Slabs (only simply supported), Reinforced Concrete Column (only short and axially loaded column), Design of footings, Basic concept of Pre stressed concrete.
- Geo-Technical & Foundation Engineering: Properties, Permeability, Seepage analysis, Shear strength, Bearing Capacity, Compaction, Stabilization, Site investigation, Sub Soil Exploration, Foundation Engineering.
- Advanced Building Construction & Earthquake resistant Technology: Excavation, Pile foundation, Building Planning & Orientation, Fire Protection & Building Acoustics, Earthquake, RCC building-Seismic Performance, Ductile detailing, Strengthening and retrofitting of existing structure.
- Estimating II: Earthwork, Roadwork, Rate analysis, Specification, Departmental works.
- Environmental Engineering & Pollution Control: Water Supply, Domestic Sewage, Industrial Waste, Environmental Pollution, Solid Wastes from Society, Environmental Sanitation
- Design of Steel Structures: Introduction to steel structure, Design considerations (IS:800-2007), Riveted Connections, Bolted Connections, Simple beam connections, Welded connections, Design of - tension members, compression members, beams, column bases.

SYLLABUS: MEC12023

- Importance of safety and precautions, housekeeping & good shop floor practices. PPEs, First Aid. Response to emergencies e.g. power failure, fire, and system failure. Occupational Safety & Health.
- Computer Architecture, Number System and codes, Introduction to Operating System, Computer Network and the Internet, Introduction to C programming.
- Nature and scope of environmental problems, definition, Elements of Ecology, Environmental Pollution, Environmental Sanitation, Resource Conservation
- Fluid Mechanics & Fluid Machines: Physical Properties of Fluids, Fluid Statics, Fluid Kinematics, Fluid Measurements, Pipe & Open Channel Flow, Fluid Machines, Hydraulic Turbines, Pumps.
- Electrical & Electronics Engineering: DC network, Generator & motor, AC fundamental, AC circuit, Transformer, Semiconductor, Transistor, House Wiring, Microprocessor.
- Manufacturing Technology – I: Basic of Machine Tools, Metal Casting Process, Welding Processes, Press Work, Powder Metallurgy, Cutting Fluids and Coolants.
- Thermodynamics: Fundamentals and laws of Thermodynamics, Laws of perfect gases, Thermodynamic processes on gases, Fuels and Combustion, Air standard cycles, Properties of steam, Vapour Power cycle, Heat Transfer.
- Engineering Materials: Mechanical Properties of Materials, Structure of Solids, Ferrous Metals and its Alloys, Non- Ferrous Metals and Its Alloys, Plastic, Testing of Materials, Heat Treatment, Corrosion & Surface Engineering.
- Manufacturing Technology-II: Lathe, Drilling machine, Shaper, Planer & Slotter, Grinding & Surface finishing, Milling machine, Non-Traditional machining methods, Jigs and Fixtures.
- Theory of Machines: Definition of Theory of Machine (TOM), Basic kinematics of Machines, Friction, Transmission of Power, Cams, Balancing, Mechanical Vibrations, Governors.
- Strength of Materials: Simple Stresses and strains, Shear force and bending moments, Theory of simple bending and Deflection of beam, Stresses in beams, Torsion in circular shafts and springs, Columns and Struts, Rivets and riveted joints.
- Machine Drawing: Cutting geometric Solids with planes, Keys, Cotters Joints and Pin Joints, Pipes Drawings, Welded Joints, Shaft Coupling, Shaft Bearing and Brackets, Pulleys, Valves, Engine Parts, AutoCAD.
- Thermal Engineering-I: Steam generators, Steam nozzles, Steam turbine, Steam condensers and Cooling towers, Nuclear power plant, Heat transfer:
- Industrial Engineering: Work study, Job Evaluation & Merit Rating, Wage Systems, Inspection and Statistical quality control, Network Analysis.
- Plant Maintenance Engineering: Introduction of maintenance engineering, Power Plant maintenance, Preventive maintenance, Electrical maintenance.
- Advance Workshop Practice& CNC Machine: Introduction of the Shop Floor: Safety and security measures inside the Tool Room, Fundamentals of Cam, Manual Part Programming
- Non-Conventional Energy: Introduction to Non-Conventional Energy Sources, Solar Energy Engineering, Wind Energy Engineering, Ocean Energy Engineering, Geothermal Energy Engineering, Bio Energy Engineering, Direct Energy Conversion Systems, Chemical Energy Sources
- Thermal Engineering-II: Internal Combustion Engine, Air compressors, Gas turbine and propulsion, Refrigeration Cycle
- Drawing, Estimating & Costing: Jigs and Fixtures, Introduction to Estimation and costing, Elements of costs, Indirect expenses and depreciation, Mensuration and Estimation of material cost, Estimation of Machining Time, Estimation of Welding & Fabrication Time Sheet metal
- Metrology: Metrology concepts and standards, Basic Precise and Non Precise Measuring instruments, Limits, Fits, Tolerances and Gauges, Angular Measurements, Comparators, Screw Thread Measurement, Gear Measurement, Surface Finish Measurement, Machine tool metrology.

SYLLABUS: INS12023

- Elements Of Electrical Engineering: Conductor, Insulator, Current, Voltage, Resistance, Work, Power, Energy, Resistance and resistivity, Conductance and conductivity, Ohm's law, Kirchhoff's point law, Voltage law, Faraday's laws of electromagnetic induction, Fleming's right hand and left hand rule, D. C. Generator, D. C. motor, EMF equation, Lenz's law, A. C. through pure resistance, pure inductance and pure capacitance, A. C. through R—L, R—C and R—L – C series circuit, Phasor, Ideal transformer, Auto transformer, 3 phase induction motor. Importance of safety and precautions, housekeeping & good shop floor practices. PPEs, First Aid. Response to emergencies e.g. power failure, fire, and system failure. Occupational Safety & Health
- Analog Electronics-I: Semiconductor devices, Rectifier & Power Supply, Bipolar Junction Transistor, Transistor biasing, 0JFET, MOSFET AND UJT, Signal Stage Transistor Amplifiers, Multistage Amplifier, Class B Push Pull Amplifier, Noise in amplifier circuits.
- Digital Electronics: Logic levels, Logic Gates, Boolean Algebra, Combinational Logic Systems, Flip flops, Registers & Counters, Memory Devices, Converters.
- Electrical Measurement and Measuring Instruments-I: Unit, Dimension & Standards, Measurement and instrumentation system, Electromechanical instruments, Measurement of resistance, Potentiometer, AC Bridge, Measurement of current and voltage.
- Electrical Circuits &Networks: D. C Network Theorem (With dependent Source), D. C Network Theorem (With independent Source), A. C Network Theorem, Single phase AC parallel circuit, Three phase circuit, Transients.
- Analog Electronics-II: Tuned Amplifier, Feedback Amplifies, Operational Amplifier, Oscillators, Relaxation Oscillator, Sweep Circuits, Microelectronics.
- Instrumentation System-I: Measurements, Performance characteristics of measuring instruments, Signals & response of measuring systems, Sensors and transducers, Pneumatic transducer, Signal Conversion.
- Process Control-I: Introduction to Control systems: Laplace transformation, Dynamic system representation, Transfer function of physical system, Block diagram reduction, Control system analysis, Controller modes, Stability Analysis.
- Microprocessor: Introduction, 8-bit Microprocessor Architecture, Instructions and Programming, 16 bit Microprocessor 8086, Interfacing Peripherals.
- Electrical Measurements and Measuring Instruments-II Measurement of power, Measurement of energy, Instruments for special purpose, Electronics Instrument, Primary sensing element and transducer, Data transmission and telemetry, Microprocessor based Instrumentation system.
- Instrumentation System-II: Temperature measurements, Pressure measurements, Level measurements, Flow measurements, Telemetering.
- Process Control-II: Process dynamics and mathematical modelling, Control elements, Controllers, Special Control Schemes, Stability analysis, Process Instrumentation.
- Automatic Control System: Introduction, Block diagram and signal flow graph, Time domain analysis, Frequency domain analysis, State space model.
- Industrial Electronics: Power devices, Thyristors, Rectifiers, Inverters, Choppers, Cycloconverters, Power supply, Motor speed control, uninterruptible power supply.
- Data Communication & Networking: Introduction to Data Communication, Serial Data Communication, Computer Networks, Local Area Networks, Internetworking, ISDN and ATM.

SYLLABUS: TCL12023

Maths

Differential Calculus: Limit and Continuity (ε- δ definition), Types of discontinuity, Differentiability of functions, Successive differentiation, Leibnitz's theorem, Partial differentiation, Euler's theorem on homogeneous functions.

Tangents and normals, Curvature, Asymptotes, Singular points, Tracing of curves. Parametric representation of curves and tracing of parametric curves, Polar coordinates and tracing of curves in polar coordinates.

Differential Equations: Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method.

Algebra: Definition and examples of groups, examples of abelian and non-abelian groups, the group Zn of integers under addition modulo n and the group U(n) of units under multiplication modulo n. Cyclic groups from number systems, complex roots of unity, circle group, the general linear group GLn (n,R), groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle, and (iv) a square, the permutation group symmetric groups, Group of quaternions.

Integral Calculus: Integration by Partial fractions, integration of rational and irrational functions. Properties of definite integrals. Reduction formulae for integrals of rational, trigonometric, exponential and logarithmic functions and of their combinations.

Theory of Equations: General properties of polynomials, Graphical representation of a polynomials, maximum and minimum values of a polynomials, General properties of equations, Descarte's rule of signs positive and negative rule, Relation between the roots and the coefficients of equations.

Physics

Elasticity: Hooke's law - Stress-strain diagram - Elastic moduli-Relation between elastic constants - Poisson's Ratio- Expression for Poisson's ratio in terms of elastic constants - Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder - Determination of Rigidity modulus by static torsion – Torsional pendulum-Determination of Rigidity modulus and moment of inertia - q, η and σ by Searles method.

Laws of Thermodynamics: Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law: General Relation between CP and CV, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Coefficient, Reversible and irreversible processes, Second law and Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero.

Kinetic Theory of Gases: Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases.

Chemistry

Atomic Structure: What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of Ψ and Ψ2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydrogenic wave functions (atomic orbitals) an d their variations for 1s, 2 s, 2 p, 3 s, 3 p and 3 d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers ml and ms. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, sp in quantum number (s) and magnetic spin quantum number (ms).

Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

Transition Series Elements (3d series): General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu. Lanthanoids and actinoids: Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion exchange method only).

Coordination Chemistry: Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordination numbers 4 and 6. Drawbacks of VBT. IUPAC (2005) system of nomenclature.

Organic Chemistry:
Fundamentals of Organic Chemistry: Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis.
Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.
Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.
Aliphatic Hydrocarbons
Alkanes: (Up to 5 Carbons):
Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.
Alkenes: (Up to 5 Carbons):
Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule). Reactions: cis-addition (alk. KMnO 4) and trans-addition (bromine), Addition of HX (Markownikoff's and anti Markownikoff's addition), Hydration, Ozonolysis.
Alkynes: (Up to 5 Carbons):
Preparation: Acetylene from CaC2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinaldihalides. Reactions: formation of metal acetylides, addition of bromine and alkaline KMnO4, ozonolysis and oxidation with hot alk. KMnO4.
Aromatic Hydrocarbons
Preparation: (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (up to 4 carbons on benzene). Side chain oxidation of alkyl benzenes (up to 4 carbons on benzene).
Alkyl and Aryl Halides
Alkyl Halides: (Up to 5 Carbons): Types of Nucleophilic Substitution (S N1, S N2 and S Ni) reactions. Preparation: from alkenes and alcohols. Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs substitution. Aryl Halides: Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions. Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH2/NH3 (or NaNH2/NH3). Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

Alcohols, Phenols and Ethers: (Up to 5 Carbons)
Alcohols: Preparation: Preparation of 1o, 2 o and 3 o alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. KMnO4, acidic dichromate, conc. HNO3). Diols: (Up to 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement. Phenols: (Phenol case): Preparation: Cumene hydroperoxide method, from diazonium salts.
Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer- Tiemann Reaction, Schotten – Baumann Reaction. Ethers (aliphatic and aromatic): Cleavage of ethers with HI. Aldehydes and ketones (aliphatic and aromatic): (Formaldehye, acetaldehyde, acetone and benzaldehyde): Preparation: from acid chlorides and from nitriles. Reactions – Reaction with HCN, ROH, NaHSO3, NH 2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's Reaction, Wittig Reaction, Benzoin Condensation. Clemensen Reduction and Wolff Kishner Reduction. Meerwein-Pondorff Verley Reduction.

Physical Chemistry
Chemical Equilibrium: Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG^o, Le Chatelier's principle. Relationships between Kp, Kc and Kx for reactions involving ideal gases.
Solutions: Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperature composition curves of ideal and non-ideal solutions. Distillation of solutions. Azeotropes. Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solvent extraction.

Phase Equilibrium: Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic deviation. Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead –silver, FeCl3-H2O and Na-K only)

Electrochemistry: Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: ΔG, ΔH and ΔS from EMF data. Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge. PH determination using hydrogen electrode and quinhydrone electrode

Kinetic Theory of Gases: Gases: Kinetic Theory of Gases: Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation. Andrews isotherms of CO 2. Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance. Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Collision number and mean free path of molecules. Viscosity of gases, effect of temperature/pressure on coefficient of viscosity (qualitative treatment only).

Analytical Methods in Chemistry

UV-Visible and IR Spectrometry: Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.

UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument; Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method.

Infrared Spectrometry: Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques. Structural illustration through interpretation of data, effect and importance of isotope substitution.

Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.

Separation techniques: Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions.

Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and non-aqueous media.

Chromatography: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods.

Qualitative and quantitative aspects of chromatographic methods of analysis: TLC and HPLC.

Water Base Drilling Fluid: i) Newtonian and Non-Newtonian Fluids and their difference, ii) Definition of Drilling fluid / Mud, iii) Functions of Drilling Fluid / Mud, iv) Types of Drilling Fluid /Mud, v) Composition of Drilling Fluid / Mud, vi) Properties of Drilling Fluid / Mud, vii) Additives used in Drilling Fluid / Mud and their functions, viii) Rheology of Drilling Fluid and its significance, ix) Solid Control Equipment in Rig, their functions and significance, x) Drilling Fluid Contamination & its remedy, xi) Rig infrastructures for Drilling fluid storage, maintenance, treatment etc, xii) Volume / Capacity calculation of cylinder, rectangular tank or cuboidal tank, xiii) Role of Mud attendant / Mud Engineer during Cementing operation, xiv) Down hole problems encountered during drilling and their remedies.

Drilling Fluid Laboratory: i) Laboratory measurement of drilling fluid parameters like- Density, Marsh Funnel Viscosity, Apparent Viscosity, Plastic Viscosity, Yield Point, Gel Strength, pH, Salinity, Fluid Loss (API and HP-HT), Methylene Blue Test (MBT) / Cation Exchange Capacity, Sand Content determination, Oil/Solid determination by Retort, K+ ion concentration, ii) Unit of measurement of different mud parameters, iii) Laboratory equipment required for measuring different mud parameters.

Workover Fluid: i) What is Workover in oil/gas well why?, ii) Well Killing, iii) Importance of Workover fluid, iv) Types of work over fluids, v) Characteristics of Workover fluid, vi) Testing of workover fluid parameters in Laboratory like- Density, pH, Salinity, Turbidity, Carbonate content, Bicarbonate content, vii) Unit of measurement of different mud parameters, viii)Plug and squeeze cementing in oil/gas well.

Reservoir Section: i) Permeability, ii) Porosity, iii) Calculation of Hydrostatic head of a certain height of Fluid column of a certain density.

Cementing Laboratory: i) Properties of cement slurry for oil well cementing, ii) Determination of Cement slurry properties like Rheology, Thickening time, Setting time, API Fluid Loss, Free Water, Compressing Strength etc, iii) Different equipment used for cement slurry design and evaluation, iv) Additives used to tailor-made the properties of comment slurry.

Analytical and Environment Laboratory: i) Testing and analysis of water samples viz. Drinking water, Effluent water, ETP treated and Raw water, Complain water (Irrigation and Fish cultivation water samples), Sewage treatment plant water (both treated and untreated), Boiler/Cooling water etc.; ii) Significance of various parameters tested against a water samples for eg. BOD, COD, DO, Turbidity, Hardness, Salinity, pH, Mineral Oil, Alkali metals, heavy metals, toxic elements, organic, inorganic elements etc.; iii) Different standards for testing of water samples., iv) Principles of instruments used in Analytical and Environment Laboratory e.g, UV spectrophotometer (Beer Lambert's law); Dissolved Oxygen Meter, Oil Content Analyzer, BOD Analyzer, Spectrophotometer, Flame Photometer, Ion Chromatograph, COD analyzer, Turbidity meter, Conductivity meter, Autotitrator etc.; v) Acid-Base titrations; Redox titrations; Complexometric titrations etc.;

OIL Laboratory: i) Distillation of Crude Oil, ii) Classification of Crude Oil, iii) Analysis of Crude oil and other petroleum products like HSD, lube oil etc., iv) Measurement of different parameters of Crude oil and other petroleum products like water/oil content, specific gravity, Density, API gravity, Wax content, Asphaltene content, Resin content, Sulfur content, Rheology of crude oil, Pour Point, Flash point etc. v) Laboratory equipment required for measument of the above parameters and their principles. (e.g, Optidist, Dean & Stark apparatus, Stabinger Viscometer, Rheometer etc.

Natural Gas Analysis Laboratory: i) Composition of Natural Gas, ii) Chromatographic analysis of Natural Gas, iii) Principle of Gas Chromatograph.