DETAILEDSYLLABUS FOR THE POST OF TRAINING OFFICER {SCHEDULED TRIBE DEVELOPMENT DEPARTMENT

BASICS OF CIVIL & MECHANICAL ENGINEERING (30 marks) (Annexure-K (i))

Module 1 — (5 marks)

General Introduction to Civil Engineering: Relevance of Civil Engineering in the overall infrastructural development of the country. Responsibility of an engineer in ensuring the safety of built environment. Brief introduction to major disciplines of Civil Engineering like Transportation Engineering, Structural Engineering, Geo-technical Engineering, Water Resources Engineering and Environmental Engineering.

Introduction to buildings: Types of buildings, selection of site for buildings, components of a residential building and their functions.

Building rules and regulations: Relevance of NBC, KBR & CRZ norms (brief discussion only).

Building area: Plinth area, built up area, floor area, carpet area and floor area ratio for a building as per KBR.

Module 2 — (5 marks)

Surveying: Importance, objectives and principles.

Construction materials, Conventional construction materials: types, properties and uses of building materials; bricks, stones, cement, sand and timber

Cement concrete: Constituent materials, properties and types.

Steel: Steel sections and steel reinforcements, types and uses.

Modern construction materials:- Architectural glass, ceramics, Plastics, composite materials, thermal and acoustic insulating materials, decorative panels, waterproofing materials. Modern uses of gypsum, pre fabricated building components (brief discussion only).

Module 3 — (5 marks)

Building Construction: Foundations: Bearing capacity of soil (definition only), functions of foundations, types – shallow and deep (brief discussion only), Load bearing and framed structures (concept only).

Brick masonry: - Header and stretcher bond, English bond & Flemish bond random rubble masonry.

Roofs and floors: - Functions, types; flooring materials (brief discussion only).

Basic infrastructure services: MEP, HVAC, elevators, escalators and ramps (Civil Engineering aspects only), fire safety for buildings.

Green buildings:- Materials, energy systems, water management and environment for green buildings. (brief discussion only)

Module 4 (5 marks)

Analysis of thermodynamic cycles: Carnot, Otto, Diesel cycles. Derivation of efficiency of these cycles, Problems to calculate heat added, heat rejected, net work and efficiency. IC Engines: CI, SI, 2-Stroke, 4-Stroke engines. Listing the parts of different types of IC Engines. Efficiencies of IC Engines(Definitions only), Air, Fuel, cooling and lubricating systems in SI and CI Engines, CRDI, MPFI. Concept of hybrid engines.

Module 5 (5 marks)

Refrigeration: Unit of refrigeration, reversed Carnot cycle,COP, vapour compression cycle (only description and no problems): Definitions of dry, wet & dew point temperatures, specific humidity and relative humidity, Cooling and dehumidification, Layout of unit and central air conditioners.

Description about working with sketches of: Reciprocating pump, Centrifugal pump, Pelton turbine, Francis turbine and Kaplan turbine. Overall efficiency, Problems on calculation of input and output power of pumps and turbines (No velocity triangles)

Description about working with sketches of: Belt and Chain drives, Gear and Gear trains, Single plate clutches.

Module 6 (5 marks)

Manufacturing Process: Basic description of the manufacturing processes -- Sand Casting, Forging, Rolling, Extrusion and their applications.

Metal Joining Processes: List types of welding, Description with sketches of Arc Welding, Soldering and Brazing and their applications

Basic Machining operations: Turning, Drilling, Milling and Grinding.

Description about working with block diagram of: Lathe, Drilling machine, Milling machine, CNC Machine. Principle of CAD/CAM, Rapid and Additive manufacturing.

BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING (30marks) (Annexure-K(ii))

Module 1
Elementary Concepts of Electric Circuits (5 marks)

Elementary concepts of DC electric circuits: Basic Terminology including voltage, current, power, resistance, emf; Resistances in series and parallel; Current and Voltage Division Rules; Capacitors & Inductors: V-I relations and energy stored. Ohms Law and Kirchhoff's laws-Problems; Star-delta conversion (resistive networks only-derivation not required)-problems.

Analysis of DC electric circuits: Mesh current method - Matrix representation - Solution of network equations. Node voltage methods-matrix representation-solution of network equations by matrix methods. Numerical problems.

Module 2
Elementary Concepts of Magnetic circuits, Electromagnetic Induction and AC fundamentals (5 marks)

Magnetic Circuits: Basic Terminology: MMF, field strength, flux density, reluctance - comparison between electric and magnetic circuits- Series and parallel magnetic circuits with composite materials,numerical-problems.

Electromagnetic Induction: Faraday's laws, problems, Lenz's law- statically induced and dynamically induced emfs - Self-inductance and mutual inductance, coefficient of coupling

Alternating Current fundamentals: Generation of alternating voltages-Representation of sinusoidal waveforms: frequency, period, Average, RMS values and form factor of waveforms-Numerical Problems.

Module 3
(5 marks)

AC Circuits: Phasor representation of sinusoidal quantities. Trignometric, Rectangular, Polar and complex forms.

Analysis of simple AC circuits: Purely resistive, inductive & capacitive circuits; Inductive and capacitive reactance, concept of impedance. Average Power Power factor. Analysis of RL, RC and RLC series circuits-active, reactive and apparent power. Simple numerical problems.

Three phase AC systems: Generation of three phase voltages; advantages of three phase systems, star and delta connections (balanced only), relation between line and phase voltages, line and phase currents- Numerical problems

Module 4
(5 marks)

Introduction to Semiconductor devices: Evolution of electronics – Vacuum tubes to nano electronics. Resistors, Capacitors and Inductors (constructional features not required): types, specifications. Standard values, color coding. PN Junction diode: Principle of operation, V-I characteristics, principle of avalanche breakdown. Bipolar Junction Transistors: PNP and NPN structures, Principle of operation, relation between current gains in CE, CB and CC, input and output characteristics of common emitter configuration.

Module 5 (5 marks)

Basic electronic circuits and instrumentation: Rectifiers and power supplies: Block diagram description of a dc power supply. Working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator. Amplifiers: Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response, Concept of voltage divider biasing. **Electronic Instrumentation**: Block diagram of an electronic instrumentation system.

Module 6 (5 marks)

Introduction to Communication Systems: Evolution of communication systems – Telegraphy to 5G.

Radio communication: principle of AM & FM, frequency bands used for various communication systems, block diagram of super heterodyne receiver, Principle of antenna – radiation from accelerated charge. **Mobile communication**: basic principles of cellular communications, principle and block diagram of GSM.

PROGRAMING IN C (15 marks) (Annexure-K(iii))

Module 1 *(5 Marks)*

Basics of Computer Hardware and Software

Basics of Computer Architecture: processor, Memory, Input& Output devices

Application Software & System software: Compilers, interpreters, High level and low level languages Introduction to structured approach to programming, Flow chart Algorithms, Pseudo code (bubble sort, linear search - algorithms and pseudocode)

Module 2 *(5 Marks)*

Program Basics

Basic structure of C program: Character set, Tokens, Identifiers in C, Variables and Data Types ,Constants, Console IO Operations, printf and scanf

Operators and Expressions: Expressions and Arithmetic Operators, Relational and Logical Operators, Conditional operator, size of operator, Assignment operators and Bitwise Operators. Operators Precedence

Control Flow Statements: If Statement, Switch Statement, Unconditional Branching using goto statement, While Loop, Do While Loop, For Loop, Break and Continue statements.(Simple programs covering control flow)

Module 3 *(5 Marks)*

Arrays and strings

Arrays Declaration and Initialization, 1-Dimensional Array, 2-Dimensional Array

String processing: In built String handling functions (strlen, strcpy, strcat and strcmp, puts, gets) Linear search program, bubble sort program, simple programs covering arrays and strings

PHYSICS

Module I

Unit I (1 mark)

Basic Mechanics : Newton's laws of motion, definition of force, concept of inertia, momentum and impulse, law of conservation of momentum, Work, Power and Energy, its concept, units and dimensions, kinetic energy, potential energy and their mathematical relation, principle of conservation of energy.

Unit II (1 mark)

Properties of Fluids : Surface Tension & Surface Energy, Cohesive & Adhesive Force, Angle of Contact, Capillarity & Expression for Surface Tension, Streamline & Turbulent Flow, Reynold Number, Viscosity & Coefficient of Viscosity, Stoke's law & Terminal Velocity.

Unit III (1 mark)

Lasers: Laser characteristics, spontaneous and stimulated emission, population inversion, pumping methods, optical feedback, engineering and medical applications of lasers.

Module II

Unit I (2 marks)

Electrostatics and Current Electricity : Coulomb's Law, Intensity of Electric Field, Intensity due to a Point Charge, Electric Lines of Forces and Electric Flux, Electric Potential, Electric Potential due to a Point Charge. Electric Current and its units, Direct and alternating current, Resistance and its units, Specific resistance, Conductance, Specific conductance, Series and parallel combination of resistances, Kirchhoff's laws, Wheatstone bridge and its applications.

Unit II (2 marks)

Magnetism : Biot - Savart law, magnetic field due to a current carrying conductor, magnetic field of an infinite linear conductor, magnetic field due to circular loop, field strength inside a solenoid, force on a current carrying conductor in magnetic field, force between two parallel linear conductors, hysteresis loop and eddy current loss.

Module III

Unit I (1 mark)

Heat and Thermodynamics: Concept of heat and temperature, modes of heat transfer (conduction, convection and radiation with examples), specific heats, scales of temperature and their relationship, Thermal Conductivity, Coefficient of Thermal Conductivity, Black Body, Newton's Law of Cooling.

Unit II (1 mark)

Semiconductor Physics: Energy bands in solids, classification of materials, intrinsic and extrinsic semiconductors, p-n junction, junction diode and V-I characteristics. Transistor; description and three terminals, Transistor types- npn and pnp, some electronic applications.

Unit III (1 mark)

Fiber Optics: Introduction to optical fibres, total internal reflection, light propagation through fibre, acceptance angle and numerical aperture, fibre types, applications in telecommunication.

(Total 10 Marks)

Mathematics (15 Marks)

MODULE 1: (3 Marks)

LINEAR ALGEBRA

Determinants and Matrices - Order - Different types of matrices.-Equality, Addition, Subtraction and multiplication of matrices- transpose– Symmetric and skew symmetric matrices – Inverse of a matrix.

MODULE 2: (3 Marks)

TRIGONOMETRY

Degree and Radian - Trigonometric ratios-Trigonometric identities- Trigonometric ratios of standard angles- T-Ratios of Allied angles -Compound Angles- T-Ratios of multiple and Sub-multiple Angles - Product formulae (Transformation of product to sum/difference and vice versa).

MODULE 3: (3 Marks)

VECTOR ALGEBRA

Scalar and Vector quantities- Different types of vectors- Addition and Subtraction of vectors- Position vector- Orthogonal Cartesian axes- Unit vectors- Scalar (dot) product - Vector (cross) product- application of scalar product and vector product.

MODULE 4: (3 Marks)

DIFFERENTIAL CALCULUS

Limit of functions – Differentiation - Rules of differentiation - Differentiation of function of a function- Differentiation of implicit functions and parametric equations- Successive differentiation – Increasing and decreasing functions- Maxima and minima of a function.

MODULE 5: (3 Marks)

INTEGRAL CALCULUS

Integration- Standard results - Different methods of integration - Definite Integral -Applications of integration for evaluation of Area and Volume- Differential equations -Order – Degree – variable separable method – linear differential equation.