ANNEXURE-I

Indicative Syllabus for Computer Based Test (CBT) for various disciplines (Junior Engineers & Mine Surveyor)

I. Salient Points

a. **Pattern of question paper**: The question paper will be bilingual i.e. both in **English and Hindi**, **except the test of English knowledge(objective)**. All the questions will be objective type and shall have 4 options of which one option will be correct.
b. **Duration of the computer-based test** – Total duration would be **2 hours** comprising of the General Aptitude Test (GAT) and Technical Knowledge Test (TKT)
c. **No. of questions in each part i.e. in General Aptitude Test (GAT) and Technical Knowledge Test (TKT) -** There will be 30 numbers of General Aptitude Test (GAT) and 70 numbers of questions in Technical Knowledge Test (TKT) and. Thus, there will be **100 numbers** of questions.
d. **Marks of each question and total marks of the question paper** – Each question would carry **1 mark** and the total marks of the paper (General Aptitude and Technical Knowledge) would be **100.**
e. **Negative marking -** There will be a negative marking of **0.25 mark** for each wrong answer**.** However, no mark will be deducted for not attempting the question by candidate.

II. Indicative Syllabus for Computer Based Test (CBT) for various Disciplines.

Syllabus for General Aptitude Test (GAT)

A. General Intelligence & Reasoning: The Syllabus for General Intelligence would include questions of both verbal and non-verbal type. The test may include questions on analogies, similarities, differences, space visualization, problem solving, analysis, judgment, decision making, visual memory, discrimination, observation, relationship concepts, arithmetical reasoning, verbal and figure classification, arithmetical number series, etc. The test will also include questions designed to test the candidate's abilities to deal with abstract ideas and symbols and their relationships, arithmetical computations, and other analytical functions.

B. General Awareness: Questions will be aimed at testing the candidate's general awareness of the environment around him/ her and its application to society. Questions will also be designed to test knowledge of current events and of such matters of everyday observations and experience in their scientific aspect as may be expected of any educated person. The test will also include questions relating to India and its neighboring countries especially pertaining to History, Culture, Geography, Economic Scene, General Polity and Scientific Research, etc.These questions will be such that they do not require a special study of any discipline.

C. General English: English Language & English Grammar. Narration, Voice, Basic Sentence Patterns. Transformation of Sentences, Determiners and Preposition, Tenses, Prefix, Suffix, Parts Of Speech-Common errors (Noun, Pronoun, Articles, Adverb, Punctuation, Preposition etc.) , Modals, Phrases, Idioms, Vocabulary

Syllabus for Technical Knowledge Test (TKT)

1. Syllabus for Technical Knowledge Test (TKT) for **Mechanical**

A. Fundamentals & basics

- Mechanical drawing
- Measurement & error
- Pipe & fittings
- Refrigeration and air conditioning
- Material inspection methods

B. Power Plant Engineering

- Steam Power Plant
- Rankine Cycle
- Carnot cycle
- Efficiency of Steam Power Plant
- Otto Cycle, Diesel Cycle & Brayton Cycle
- Fans & Pumps
- Coal and its analysis
- Steam Generator basic
- Steam Turbine basic & Nozzles
- Hydroelectric Power Plant
- Advantage & Disadvantage of Hydel power
- Hydrographs
- Hydro Turbines
- Cavitation
- Performance of Turbine
- Cooling Tower and Condenser basics

C. Basic Thermodynamics

- Open System, Closed System and Isolated System
- Quasi static process
- Point Function and Path function
- 1st Law, 2nd Law and Zeroth Law of thermodynamics
- Kelvin Planck Statement and clausius statement
- Dead state
- Joule-Thomson Co-efficient basic
- Concept of Heat engine and Heat Pumps
- Refrigeration cycle (i) Vapour compression cycle (ii) Vapour absorption cycle
- Name of refrigerant and their nomenclature
- Mollier diagram

D. Fluid Mechanics

- Properties of Fluid
- Pressure measuring devices
- Hydrostatic Force
- Buoyancy and stability
- Bernoulli's Energy Equation
- Compressible Flow and Incompressible Flow
- Basic of Turbomachinery

E. Heat Transfer

- Heat and Importance of Heat transfer
- Modes of heat transfer
- Fourier's law of heat conduction
- Heat transfer by convection- basic
- Heat transfer by Radiation
- Absorptivity
- Reflectivity
- Transmissivity
- Black Body
- Stefan-Boltzmann Law
- Type of Heat Exchanger
- LMTD

F. Material Science

- Normal Stress and Strain
- Stress-Strain diagram
- Elasticity and Plasticity
- Hook's Law
- Shear Stress and Strain
- Shear Force and Bending Moment

G. Manufacturing Science

- Metals and Alloys
- Heat Treatment
- Dry sand mould casting
- Die Casting
- Rolling, Forging and Drawing forming process
- Advantage and Disadvantage of cold rolling & Hot Rolling
- Arc welding, Gas welding and Thermit welding
- Cutting Tools
- Different measuring Tools

2. Syllabus for Technical Knowledge Test (TKT) for **Electrical**

A. Basic Electrical Engineering concepts: -

- Concept of Potential difference. Current and resistance. Ohm's law, insulation resistance. Kirchhoff's law,
- A.C. Fundamentals: Sinusoidal voltage and currents., concept of cycle period, frequency, instantaneous, peak, average, r.m.s. values, peak factor, and form factor, phase difference, lagging, leading and phasor representation.
- A.C circuits of pure resistance, inductance and capacitance and corresponding voltage-current phasor diagrams. Basics of series and parallel R-L, R-C, R-L-C circuits.
- Concept of active and reactive power and power factor.
- Polyphase AC circuits: Concept of three-phase supply and phase sequence. Balanced and unbalanced loads

B. Electrical Machines under Powerhouse: -

- Generator (basic principle & philosophy)
- Motor (basic principle & philosophy)
- Basic Electrical Protection of Generators and Motors
- Testing of Generators & Motors
- Switchgears

C. Transmission & Distribution System: -

- Transformers
- Circuit Breakers
- Other switchyard equipment (CT, PT, CVT, LA, Wave Trap, Isolators, Insulators, BusBar, Conductor etc.)
- Basic Testing of transformers, Circuit breakers, CT PT etc.
- DC System including Battery Bank
- Basic Electrical Protection philosophy of Transmission Line & Equipment such as Transformer etc.

D. Metering System

- Energy Meter (Basic principle of single and 3-phase energy meter)
- ABT meter

3. Syllabus for Technical Knowledge Test (TKT) for **C&I**

A. Basics & Fundamentals.

B. Basics of Measurements, Transducer, Transmitters, Indicators, Gauges

- Basics of measurement philosophy of different parameter like Pressure, Temperature, Level, Flow, Position etc.
- Measurement of Pressure i) Absolute, ii) Gauge and iii) Differential pressure
- Principles of electronic pressure measurement.
- Measurement of Temperature, Basic types of temperature measuring devices, i) Mechanical devices (liquid/gas-in-glass thermometers, bimetallic strips, bulb & capillary, pressure type etc.) ii) thermocouples iii) RTDs and thermistors iv) infrared and optical pyrometers, etc.
- Thermocouples principle of operation and Major types of Thermocouples
- Resistance Temperature Detector (RTD) principle of operation, Major Types of RTD.
- Measurement of Level: Level Transmitter Types i) Capacitance ii) Ultrasonic iii) Radar iv) Displacer Type v) By measurement of Pressure vi) Differential Pressure (DP) Type., etc.
- Level Switch Types i) Conductive ii) Float iii) Capacitive iv) Resistive, etc.
- Measurement of Flow i) DP (Differential Pressure) Type ii) Ultrasonic iii) Turbine Type iv) Mass Flow v) Target Type vi) Electromagnetic vii) turbine viii) open channel flow meters, etc.
- Types of Flow Element for DP Type Flow Transmitter i) Orifice ii) Flow Nozzle iii) Pitot Tube iv) Aerofoil, etc.
- Measurement of Vibration: Displacement, Velocity, Acceleration, Vibration Measurement Probes Types
- Measurement of Position: LVDT, Eddy, Capacitive, Optical, Ultrasonic etc.
- Measurement of Speed: Hall, Eddy etc.
- Gas and Liquid Analysers, Air Pollution monitoring, Oxygen Analyzer, SWAS, pH and conductivity measurement etc.
- Field Instruments for measuring Process parameter

C. Pneumatic Actuator, Power cylinder, Pneumatic Positioner, Pneumatic Smart Positioner, I/P Converter, Solenoid Valve, Servo Valve, Proportional Valve.

D. Semiconductor and Diodes, Electronic Devices and Circuits, Integrated Circuits, Transistors, SCR DIAC & TRIAC, Amplifiers, Oscillators, Power Electronics, Analog Electronics, OPAMPS, Filters.

E. Number Systems & Boolean Algebra, Digital Electronics , Different number systems – Binary, Octal, Decimal, Hexadecimal ,Conversion from one number system to another, Boolean variables – Rules and laws of Boolean Algebra, Logic Gates – AND, OR, NOT, NAND, NOR , XOR, XNOR, Logic Circuits and Memory Device, Flip Flops, Analog to Digital and Digital to Analog Conversion, Microprocessors .

F. Principles of Communication and Network System, Amplitude- and frequency modulation, Pulse Code Modulation and Differential Pulse Code Modulation. Delta Modulation and Adaptive Delta modulation, Amplitude Shift Keying, Frequency Shift Keying, Phase Shift Keying, Time Division Multiplexing, Optical fiber and Ethernet, Basic Computer Networking system.

G. Control System: P-I-D Control, Feedforward Control, Lead Lag Control, Relays, Microcontrollers, Sequential control, PLC, DCS (Distributed Control System), SCADA.

4. **Syllabus for Technical Knowledge Test (TKT)** for **Civil**

A. Fundamental of Civil Engineering & knowledge of different materials

B. Concrete Technology –
- Concept of materials
- Concrete mix,
- Cement type - composition of cement,
- Different tests carried out & its requirement.
- Concrete Structures
- Reinforcement steel detailing – strength, detailing, types, precautions & requirement
- Basic knowledge of Concrete design & parameters of IS:456, IS-875

C. Construction material & its management

D. Structural Engineering-
- Type of structures
- Strength of materials
- Basic knowledge of Steel design & parameters of IS 800, IS 802
- Knowledge of different connections – weld, B&N

E. Soil Mechanics & Foundation Engineering-
- Type of foundations & its uses
- Settlement & precautionary measures
- Soil Investigation & its requirement, type of tests, instruments used etc.
- Knowledge about bearing capacity of soil

F. Highway & Railway engineering-
- Pavement type & its uses
- Knowledge of Railway embankment, sleepers, gauge, rail type etc.
- Material knowledge & different type of tests carried out
- Composition of rigid & flexible pavement, basic design

G. Water supply & sanitation
- STP & uses of treated sewage water
- Effluent Treatment Plant
- Wastewater management
- Rainwater harvesting – its requirement & uses

H. Surveying – its uses, requirements, types, instruments used etc.

I. Quality related issues -its uses, functions & necessity

J. Miscellaneous:
- Knowledge about estimate preparation & its uses
- Knowledge about Fly ash products & its uses
- Knowledge about activities related to site supervision, mode of measurement.
- Knowledge about different material used for repairing / water proofing etc.
- Technical specification
- Knowledge about different activity for construction of buildings, bridges, water retaining structures, embankments etc.

5. Technical Knowledge Test (TKT) for **Communication**

A. Basic Electricity Classification of materials into conductor, semiconductor, insulator. various types of relays, switches and connectors, **Concept of capacitance and capacitors**; Ohm's law, Power and Energy, KVL & KCL and their applications , Concept of alternating voltage & current; Cells and Batteries

B. Electronic Devices and Circuits Active and passive components; Semiconductor Diode; Bipolar transistor & their circuits; Transistor Biasing Stabilization of operating point: Single-stage transistor amplifier, field-effect transistor, MOSFET circuits applications. Thyristor and UJT. Regulated Power Supply, Multistage Transistor Amplifier, Feedback in Amplifier: Sinusoidal Oscillators; Opto Electronics Devices and their applications: Operational Amplifier. Wave shaping and switching Circuits.

C. Digital Electronics Number system (binary and hexadecimal): Logic Gates Multiplexers and Demultiplexers: Latches and Flip Flops: Counters; Shift Registers; Memories; A/D and D/A converters,

D. Communication AM, FM and PM Modulation /Demodulation ; Pulse modulation - TDM, PAM, PPM, PWM, Multiplexing, Principles and applications of PCM. Introduction of Basic block diagram of digital and data communication systems, Digital Modulation Techniques - ASK, ICW, FSK, PSK: Characteristics/working of data transmission circuits; UART, USART: Modems; Protocols and their functions, brief idea of ISDN interfaces, local areas Network.

6. Technical Knowledge Test (TKT) for **Mine surveyor Discipline.**

Subject Knowledge: Multiple Choice Questions (MCQs)		
Sl. no	**Subtopic**	**Detail Description**
1	**Linear measurement**:	Instruments for measuring distance ranging, chain surveying; errors in chaining and plotting; optical square.
2	**EDM**	Principles of measurements; types; correction and selection of instrument.
3	**Angular measurement**:	Prismatic compass; bearing of lines; local attraction; magnetic declination.
4	**Plan Table Surveying**:	Methods contouring using plane table and micro-optic alidade.
5	**Miners' dials and other compass instruments**	Dialling; loose and fast needle surveying.
6	**Theodolite:**	Modern micro-optic theodolites; measurement of horizontal and vertical angles; theodolite traversing; traverse calculation; computation of coordinates; adjustment of traverse; temporary and permanent adjustment.
7	**Total Stations:**	Surveying by Total stations, errors, adjustments and applications.
8	**Levelling:**	Levelling instrument types of levelling; booking and reduction methods; temporary and permanent adjustment of levels; geometrical, trigonometric and physical levelling; characteristics and uses of contours; methods of contouring; traverse; co-ordinates and levelling problems.
9	**Tachometry & Controlled surveys:**	Tachometry Triangulation; trilateration; application of GPS and Total Station in mine surveying. Use, care, testing, and adjustments of instruments.
10	**Field astronomy:**	Astronomical terms; determination of true bearing by equal altitude method; Gyro theodolite; principle and determination of Gyro north, astronomical triangle; conversion of time systems and precise determination of azimuth by astronomical methods.
11	**National grid:**	Map projection Cassini Lambert's polyconic and universal transfers Mercator; transformation of coordinates, vertical projections; mine models.
12	**Geodesy:**	Geod, spheroid and ellipsoid, geocentric, geodetic and astronomical coordinates, orthometric and dynamic heights.
13	**Photogrammetry:**	Introduction; scale of a vertical photograph; photographs versus maps; application of photogrammetry and remote sensing in mining.
14	**Theory of errors and adjustments**	Causes and classification of errors; inclines of precision; laws of weight propagation and adjustment of errors; adjustment of triangulation figures.
15	**Traversing**	along steep topography with or without auxiliary telescope.
16	**Area and volume calculation; different**	earth work and building estimation; laying out of rail and haul road curves; determination of azimuth latitude and longitude.

	methods and their limitations:	Borehole surveying and calculations, dip, strike, outcrop and fault problems.
		Types of plans for opencast workings, their preparation, care, storage and preservation: legislation concerning mine plans and sections; duties and responsibilities of surveyors.
		Geological map reading. Application of computers in mine surveying and preparation of mine plan, 3D laser profiling of surfaces and bench / slopes.
		Profiling of benches, highwall, dumps
		Dump / Highwall stability monitoring using different instruments like Laser Scanner / Continuous Real Time Monitor
		True North determination, Triangulation, Topographic survey, Tacheometry survey, Survey adjustments & theory of Errors Continuous Real Time Monitor, Contouring Underground Mine surveys & opencast Mine Surveys, Correlation of Underground & Surface Surveys Subsidence Survey, Surveys for construction and development purpose. Responsibilities of survey department at the mine construction phase etc. Dip, Strike and fault problems. Coal heap Measurement. Overburden measurements. Duties and responsibilities of a surveyor as per coal mines regulations 2017.plans, type of plans Statutorily as per coal mines act Total station DGPS, 3DTLS & drone Surveying in Open cast Mines. Application of Computers & software's Knowledge of remote sensing 7 GIS Geomatics.

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