



THE WEST BENGAL POWER DEVELOPMENT CORPORATION LIMITED

(A Government of West Bengal Enterprise)

Corporate Identity No. : U40104WB1985SGC039154

:Registered & Corporate Office:

"Bidyut Unnayan Bhavan", Plot No. 3/C, LA-Block, Sector-III, Bidhannagar, Kolkata-700 106

• Phone: No. (033) 2339-3200/2339-3300 • Fax: (033) 2339 3186 / 2339 3286 /2339 3197

• Website: www.wbpdcl.co.in

SYLLABUS FOR COMPUTER BASED TEST **ASSISTANT MANAGER (CIVIL) POSITIONS**

1. ENGINEERING MATHEMATICS:

Linear Algebra: Matrix algebra, systems of linear equations, eigenvalues and eigenvectors.

Calculus: Functions of single variable, limit, continuity and differentiability, mean value theorems, indeterminate forms; evaluation of definite and improper integrals; double and triple integrals; partial derivatives, total derivative, Taylor series (in one and two variables), maxima and minima, Fourier series; gradient, divergence and curl, vector identities, directional derivatives, line, surface and volume integrals, applications of Gauss, Stokes and Green's theorems.

Differential equations: First order equations (linear and nonlinear); higher order linear differential equations with constant coefficients; Euler-Cauchy equation; initial and boundary value problems; Laplace transforms; solutions of heat, wave and Laplace's equations.

Complex variables: Analytic functions; Cauchy-Riemann equations; Cauchy's integral theorem and integral formula; Taylor and Laurent series.

Probability and Statistics: Definitions of probability, sampling theorems, conditional probability; mean, median, mode and standard deviation; random variables, binomial, Poisson and normal distributions.

Numerical Methods: Numerical solutions of linear and non-linear algebraic equations; integration by trapezoidal and Simpson's rules; single and multi-step methods for differential equations.

2. STRUCTURAL ENGINEERING:

Engineering Mechanics: System of forces, free-body diagrams, equilibrium equations; Internal forces in structures; Friction and its applications; Kinematics of point mass and rigid body; Centre of mass; Euler's equations of motion; Impulse-momentum; Energy methods; Principles of virtual work.

Solid Mechanics: Bending moment and shear force in statically determinate beams; Simple stress and strain relationships; Theories of failures; Simple bending theory, flexural and shear stresses, shear centre; Uniform torsion, buckling of column, combined and direct bending stresses.

Structural Analysis: Statically determinate and indeterminate structures by force/ energy methods; Method of superposition; Analysis of trusses, arches, beams, cables and frames; Displacement methods: Slope deflection and moment distribution methods; Influence lines; Stiffness and flexibility methods of structural analysis.

Construction Materials and Management: Construction Materials: Structural steel - composition, material properties and behavior; Concrete - constituents, mix design, short-term and long-term properties; Bricks and mortar; Timber; Bitumen. Construction Management: Types of construction projects; Tendering and construction contracts; Rate analysis and standard specifications; Cost estimation; Project planning and network analysis - PERT and CPM.

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Concrete Structures: Working stress, Limit state and Ultimate load design concepts; Design of beams, slabs, columns; Bond and development length; Prestressed concrete; Analysis of beam sections at transfer and service loads.

Steel Structures: Working stress and Limit state design concepts; Design of tension and compression members, beams and beam- columns, column bases; Connections - simple and eccentric, beam-column connections, plate girders and trusses; Plastic analysis of beams and frames.

Geotechnical Engineering:

Soil Mechanics: Origin of soils, soil structure and fabric; Three-phase system and phase relationships, index properties; Unified and Indian standard soil classification system; Permeability - one dimensional flow, Darcy's law; Seepage through soils - two-dimensional flow, flow nets, uplift pressure, piping; Principle of effective stress, capillarity, seepage force and quicksand condition; Compaction in laboratory and field conditions; One-dimensional consolidation, time rate of consolidation; Mohr's circle, stress paths, effective and total shear strength parameters, characteristics of clays and sand.

Foundation Engineering: Sub-surface investigations - scope, drilling bore holes, sampling, plate load test, standard penetration and cone penetration tests; Earth pressure theories - Rankine and Coulomb; Stability of slopes - finite and infinite slopes, method of slices and Bishop's method; Stress distribution in soils - Boussinesq's and Westergaard's theories, pressure bulbs; Shallow foundations - Terzaghi's and Meyerhoff's bearing capacity theories, effect of water table; Combined footing and raft foundation; Contact pressure; Settlement analysis in sands and clays; Deep foundations - types of piles, dynamic and static formulae, load capacity of piles in sands and clays, pile load test, negative skin friction.

3. WATER RESOURCES ENGINEERING:

Fluid Mechanics: Properties of fluids, fluid statics; Continuity, momentum, energy and corresponding equations; Potential flow, applications of momentum and energy equations; Laminar and turbulent flow; Flow in pipes, pipe networks; Concept of boundary layer and its growth.

Hydraulics: Forces on immersed bodies; Flow measurement in channels and pipes; Dimensional analysis and hydraulic similitude; Kinematics of flow, velocity triangles; Basics of hydraulic machines, specific speed of pumps and turbines; Channel Hydraulics - Energy-depth relationships, specific energy, critical flow, slope profile, hydraulic jump, uniform flow and gradually varied flow

Hydrology: Hydrologic cycle, precipitation, evaporation, evapo-transpiration, watershed, infiltration, unit hydrographs, hydrograph analysis, flood estimation and routing, reservoir capacity, reservoir and channel routing, surface run-off models, ground water hydrology - steady state well hydraulics and aquifers; Application of Darcy's law.

Irrigation: Duty, delta, estimation of evapo-transpiration; Crop water requirements; Design of lined and unlined canals, head works, gravity dams and spillways; Design of weirs on permeable foundation; Types of irrigation systems, irrigation methods; Water logging and drainage; Canal regulatory works, cross-drainage structures, outlets and escapes; Design of Small Dams.

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4. ENVIRONMENTAL ENGINEERING:

Water and Waste Water: Quality standards, basic unit processes and operations for water treatment. Drinking water standards, water requirements, basic unit operations and unit processes for surface water treatment, distribution of water. Sewage and sewerage treatment, quantity and characteristics of wastewater. Primary, secondary and tertiary treatment of wastewater, effluent discharge standards. Domestic wastewater treatment, quantity of characteristics of domestic wastewater, primary and secondary treatment. Unit operations and unit processes of domestic wastewater, sludge disposal.

Air Pollution: Types of pollutants, their sources and impacts, air pollution meteorology, air pollution control, air quality standards and limits; Fog harvesting.

Municipal Solid Wastes: Characteristics, generation, collection and transportation of solid wastes, engineered systems for solid waste management (reuse/ recycle, energy recovery, treatment and disposal).

Noise Pollution: Impacts of noise, permissible limits of noise pollution, measurement of noise and control of noise pollution.

5. TRANSPORTATION ENGINEERING:

Transportation Infrastructure: Highway alignment and engineering surveys; Geometric design of highways - cross-sectional elements, sight distances, horizontal and vertical alignments; Geometric design of railway track; Airport runway length, taxiway and exit taxiway design.

Highway Pavements: Highway materials - desirable properties and quality control tests; Design of bituminous paving mixes; Design factors for flexible and rigid pavements; Design of flexible pavement using IRC: 37-2012; Design of rigid pavements using IRC: 58-2011; Distresses in concrete pavements.

Traffic Engineering: Traffic studies on flow, speed, travel time - delay and O-D study, PCU, peak hour factor, parking study, accident study and analysis, statistical analysis of traffic data; Microscopic and macroscopic parameters of traffic flow, fundamental relationships; Control devices, signal design by Webster's method; Types of intersections and channelization; Highway capacity and level of service of rural highways and urban roads.

6. GEOMATICS ENGINEERING:

Principles of surveying; Errors and their adjustment; Maps - scale, coordinate system; Distance and angle measurement - Levelling and trigonometric levelling; Traversing and triangulation survey; Total station; Horizontal and vertical curves.

Photogrammetry: scale, flying height; Remote sensing - basics, platform and sensors, visual image interpretation; Basics of Geographical information system (GIS) and Geographical Positioning system (GPS).

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Unit 1- Management Theories and Functions

- Principles and Practices of Management: Development of management Thought,
- Contributions of Taylor, Fayol, Mayo, Mary Parker Follett and C.I. Barnard.
- Behavioural Approach,
- Systems Approach,
- Quantitative Approach and
- Contingency Approach.
- Function of Management: Planning and Decision Making, Organising, Staffing, Directing, Controlling, Coordinating.

Unit 2- HRM

- Human Resource Management: Conceptual framework,
- Human Resource Planning, Job Analysis,
- Recruitment, Selection,
- Placement, Induction,
- Training and Development,
- Performance Management,
- Job Evaluation,
- Compensation Management,
- Employee Benefits and Incentives,
- Managing Career.
- New Trends in HRM: Changing environment of HRM and ontemporary challenges, Emerging HRM Concepts.

Unit 3- HRD and International HRM

- Human Resource Development (HRD): Concepts, Assumptions, Values,
- HRD Mechanisms, Action – research Model,
- HRD Culture and Climate, HRD Interventions,
- HR Accounting and Audit,
- Consultant – client relationship,
- Knowledge Management,
- Human Resource Information System.
- International Human Resource Management (IHRM): Organisational context of IHRM,
- IHRM and Sustainable Business,
- Functions of IHRM,
- Cross – Cultural Studies, Cultural Diversity,
- Transnational Organisations,
- IHRM models.

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Unit 4– Organizational Behaviour

- Organisational Behaviour: Concept, Scope, Nature of human behavior,
- Personality,
- Perception,
- Learning,
- Attitude,
- Motivation,
- Interpersonal Behaviour,
- Group Dynamics,
- Leadership,
- Communication,
- Power and Authority,
- Stress,
- Organisational Change and Development.

Unit 5– Industrial Relations and Trade Unions

- Industrial Relations: Concept, Scope, Evolution, Approaches, Actors and Models,
- Conflict and cooperation, Bi-partitism, Tri-partitism,
- Collective Bargaining,
- Workers' Participation in Management,
- Grievance Handling and Disciplinary Action, Code of Conduct,
- Industrial Relations in changing scenario,
- Employers' organisations.
- Trade Unions: Concepts, Evolution,
- Problems of trade unions in India, Recognition,
- The Trade Unions Act, 1926.
- Emerging role of trade unions in India.

Unit 6– Industrial Disputes

- Industrial Disputes: Factors, Forms, Trends,
- Prevention and Settlement, Role of State and Central Labour Administration,
- Strikes and Lockouts.
- The Industrial Employment (Standing Orders) Act, 1946.
- The Industrial Disputes Act, 1947.

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Unit 7– Labour Laws

- Labour Legislation: Objectives, Principles, Classification and Evolution.
- International Labour Organisation,
- Social Justice and Labour Legislation,
- Indian Constitution and Labour Laws.
- The Factories Act, 1948.
- The Mines Act, 1952.
- The Inter-state Migrant Workmen (Regulation of employment and conditions of service) Act, 1979.
- The Contract Labour (Regulation and Abolition) Act, 1970.
- The Building and other Construction workers (Regulation of employment and conditions of service) Act, 1996.
- The Child Labour (Prohibition and Regulation) Act, 1986.

Unit 8– Labour Laws regarding Wages

- Wages: Concept, Types, Factors influencing wages, Wage Theories and Wage Differentials
- The Minimum Wages Act, 1948.
- The Payment of Wages Act, 1936.
- The Payment of Bonus Act, 1965.
- The Equal Remuneration Act, 1976.
- The Payment of Gratuity Act, 1972.
- The Employees' Provident Fund and Miscellaneous Provisions Act, 1952.

Unit 9– Labour Welfare

- Labour Welfare: Concept, Scope, Types, Theories and Principles,
- Industrial Health and Hygiene,
- Industrial Accidents and safety,
- Occupational Diseases
- Social Security: Concept and Scope, Social Assistance and Social assurance.

Unit 10– Labour Market

- Labour Market: Features,
- Demand and Supply of Labour,
- Nature and Composition of Indian Labour Force,
- Unemployment and Underemployment,
- Types of Labour Market,
- Characteristics of Indian Labour Market,
- New Dynamics of Labour Market in India,
- Economic Systems and Labor Market,
- Problems of Labour in India.

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SYLLABUS FOR COMPUTER BASED TEST ASSISTANT MANAGER (IT) POSITIONS

1. DIGITAL LOGIC:

Boolean algebra. Combinational and sequential circuits. Minimization. Number representations and computer arithmetic (fixed and floating point).

2. COMPUTER ORGANIZATION AND ARCHITECTURE:

Machine instructions and addressing modes. ALU, data path and control unit. Instruction pipelining. Memory hierarchy: cache, main memory and secondary storage; I/O interface (interrupt and DMA mode).

3. PROGRAMMING AND DATA STRUCTURES:

Programming in C. Recursion. Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs.

4. ALGORITHMS:

Searching, sorting, hashing. Asymptotic worst case time and space complexity. Algorithm design techniques: greedy, dynamic programming and divide and conquer. Graph search, minimum spanning trees, shortest paths.

5. THEORY OF COMPUTATION:

Regular expressions and finite automata. Context-free grammars and push-down automata. Regular and context free languages, pumping lemma. Turing machines and undecidability.

6. COMPILER DESIGN:

Lexical analysis, parsing, syntax-directed translation. Runtime environments. Intermediate code generation.

7. OPERATING SYSTEM:

Processes, threads, inter process communication, concurrency and synchronization. Deadlock. CPU scheduling. Memory management and virtual memory. File systems.

8. DATABASES:

ER model. Relational model: relational algebra, tuple calculus, SQL. Integrity constraints, normal forms. File organization, indexing (e.g., B and B+ trees). Transactions and concurrency control.

9. COMPUTER NETWORKS:

Concept of layering. LAN technologies (Ethernet). Flow and error control techniques, switching. IPv4/IPv6, routers and routing algorithms (distance vector, link state). TCP/UDP and sockets, congestion control. Application layer protocols (DNS, SMTP, POP, FTP, HTTP). WSN, Basics of Wi-

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Fi. Network security: authentication, basics of public key and private key cryptography, digital signatures and certificates, firewalls.

Information Systems and Software Engineering: Information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input / output design, process life cycle, planning and managing the project, design, coding, testing, implementation, maintenance.

Web technologies: HTML, XML, basic concepts of client-server computing.

10. DATA ARCHITECTURE:

- i. Data models
- ii. Data management blue print
- iii. Data security, performance and scalability

11. DATA ANALYTICS:

- i. Hypothesis formulation
- ii. Application of analytics in software programming.

12. CLOUD COMPUTING

Definition of Cloud Computing and its Basics, Use of Platforms in Cloud Computing, Cloud Management, Concepts of Services and Applications

13. OBJECT-ORIENTED PROGRAMMING (OOP) FUNDAMENTALS:

- i. Principles of OOP: Encapsulation, Inheritance, Polymorphism, Abstraction.
- ii. Classes and Objects: Defining classes, creating objects, object interaction.
- iii. Data Structures: Arrays, lists, trees, etc., and their role in object-oriented design.
- iv. Basic OOP languages: Introduction to Java or C++, focusing on syntax and basic constructs.
- v. Design Patterns: Understanding common design patterns like Singleton, Factory, Observer, etc.
- vi. Object-Oriented Analysis and Design: Applying OOP principles to analyze and design software systems.

14. ARTIFICIAL INTELLIGENCE

Explain Fuzzy sets and Fuzzy logic systems including relationship between the Classical Sets and Fuzzy Sets, Membership functions, fuzzification and defuzzification methods, Fuzzy Inference System and Applications of Fuzzy Logic.

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15. VISUAL PROGRAMMING AND WEB TECHNOLOGY

WEB APP DEVELOPMENT

Server Side:

Languages: [PHP, NodeJS]

MVC Framework: Laravel

API DEVELOPMENT INTEGRATION [server to server(api call) / server to client (ajax)]

ReST & SOAP

Webhook

CLIENT SIDE DEVELOPMENT

Languages: [JavaScript with ES6, TypeScript]

MVC Framework: Angular

Library: JQuery, React

UI/UX: HTML, CSS, SCSS, Material Design, Bootstrap, Tailwind

PWA DEVELOPMENT FOR COMPATIBILITY WITH MOBILE DEVICES

Angular, Material Design, React, Bootstrap

ERP

Working knowledge of ABAP and SAP functional modules.

INTERNET TECHNOLOGY

Overview, Network of Networks, Intranet, Extranet and Internet., World Wide Web: Domain and Sub domain, Address Resolution, DNS, Telnet, FTP, HTTP. Review of TCP/IP Features, Segment, Three-Way Handshaking, Flow Control, Error Control, Congestion control, IP Datagram, IPv4 and IPv6. IP Sub- netting and addressing: Classful and Classless Addressing, Sub-netting. NAT, IP masquerading, IP tables, Internet Routing Protocol .Routing -Intra and Inter Domain Routing, Unicast and Multicast Routing, Broadcast. Electronic Mail POP3, SMTP.

HTML, Image Maps, XML, CGI Scripts (9L): Introduction, Editors, Elements, Attributes, Heading, Paragraph. Formatting, Link, Head, Table, List, Block, Layout, CSS. Form, Iframe, Colors, Color name, Color value, map, area, attributes of image area. Extensible Markup Language, Introduction, Tree, Syntax, Elements, Attributes, Validation, Viewing. XHTML in brief. Introduction, Environment Variable, GET and POST Methods

Perl, JavaScript, Java applets Introduction, Variable, Condition, Loop, Array, Implementing data structure, Hash, String, Regular Expression, File handling, I/O handling. , Basics, Statements, comments, variable, comparison, condition, switch, loop, break. Object – string, array, Boolean, reg-ex. Function, Errors, Validation. Definition of cookies, Create and Store a cookie with example. Container Class, Components, Applet Life Cycle, Update method; Parameter passing applet, Applications.

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16. CYBER SECURITY

Importance and challenges in Cyber Security, Cyber security - Organizational Implications, Cyber Forensics and Auditing, Cyber Ethics and Laws:

17. CRYPTOGRAPHY & NETWORK SECURITY

Conceptual understanding of network security issues, challenges and mechanisms common network vulnerabilities and attacks and basic concept of cryptography. Evaluate various techniques of cryptography. Illustrate the algorithms of different symmetric key cryptography. Illustrate Apply the public key algorithms, digital signature and message digest. Analyze the approaches of security protocol and authentication. Analyze & explain the concept of electronic mail security and types of firewall and its configurations.

18. INTERNET OF THINGS

Understand the vision of IoT from a global context, Use of Devices, Gateways and Data Management in IoT. Analysed the use of IoT in Industrial and Commercial Building Automation and Real World Design Constraints. Understand the architecture of smart sensor. Build the interfacing among IoT components.

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Note: The syllabus / topics mentioned are indicative in nature. Candidates are expected to possess significant knowledge / proficiency pertaining to the relevant subjects and their qualifying degree.

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SYLLABUS FOR COMPUTER BASED TEST **ASSISTANT MANAGER (PS)-TRADE- MECHANICAL POSITIONS**

1. ENGINEERING MATHEMATICS:

Linear Algebra: Matrix algebra, systems of linear equations, eigenvalues and eigenvectors.

Calculus: Functions of single variable, limit, continuity and differentiability, mean value theorems, indeterminate forms; evaluation of definite and improper integrals; double and triple integrals; partial derivatives, total derivative, Taylor series (in one and two variables), maxima and minima, Fourier series; gradient, divergence and curl, vector identities, directional derivatives, line, surface and volume integrals, applications of Gauss, Stokes and Green's theorems.

Differential equations: First order equations (linear and nonlinear); higher order linear differential equations with constant coefficients; Euler-Cauchy equation; initial and boundary value problems; Laplace transforms; solutions of heat, wave and Laplace's equations.

Complex variables: Analytic functions; Cauchy-Riemann equations; Cauchy's integral theorem and integral formula; Taylor and Laurent series.

Probability and Statistics: Definitions of probability, sampling theorems, conditional probability; mean, median, mode and standard deviation; random variables, binomial, Poisson and normal distributions.

Numerical Methods: Numerical solutions of linear and non-linear algebraic equations; integration by trapezoidal and Simpson's rules; single and multi-step methods for differential equations.

2. APPLIED MECHANICS AND DESIGN:

Engineering Mechanics: Free-body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion; impulse and momentum (linear and angular) and energy formulations, collisions.

Mechanics of Materials: Stress and strain, elastic constants, Poisson's ratio; Mohr's circle for plane stress and plane strain; thin cylinders; shear force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular shafts; Euler's theory of columns; energy methods; thermal stresses; strain gauges and rosettes; testing of materials with universal testing machine; testing of hardness and impact strength.

Theory of Machines: Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of linkages; cams; gears and gear trains; flywheels and governors; balancing of reciprocating and rotating masses; gyroscope.

Vibrations: Free and forced vibration of single degree of freedom systems, effect of damping; vibration isolation; resonance; critical speeds of shafts.

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Machine Design: Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; principles of the design of machine elements such as bolted, riveted and welded joints; shafts, gears, rolling and sliding contact bearings, brakes and clutches, springs.

3. FLUID MECHANICS AND THERMAL SCIENCES:

Fluid Mechanics: Fluid properties; fluid statics, manometry, buoyancy, forces on submerged bodies, stability of floating bodies; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; dimensional analysis; viscous flow of incompressible fluids, Newtonian & Non-Newtonian fluids, boundary layer, elementary turbulent flow, flow through pipes, head losses in pipes, bends and fittings.

Heat-Transfer: Modes of heat transfer; one dimensional heat conduction, resistance concept and electrical analogy, heat transfer through fins; unsteady heat conduction, lumped parameter system, Heisler's charts; thermal boundary layer, dimensionless parameters in free and forced convective heat transfer, heat transfer correlations for flow over flat plates and through pipes, effect of turbulence; heat exchanger performance, LMTD and NTU methods; radiative heat transfer, Stefan-Boltzmann law, Wien's displacement law, black and grey surfaces, view factors, radiation network analysis.

Thermodynamics: Thermodynamic systems and processes; properties of pure substances, behaviour of ideal and real gases; zeroth and first laws of thermodynamics, calculation of work and heat in various processes; second law of thermodynamics; thermodynamic property charts and tables, availability and irreversibility; thermodynamic relations, Theory and Problems on Heat Engine, Boiler and Turbine.

Applications: *Power Engineering:* Air and gas compressors; vapour and gas power cycles, concepts of regeneration and reheat. *I.C. Engines:* Air-standard Otto, Diesel and dual cycles. *Refrigeration and air-conditioning:* Vapour and gas refrigeration and heat pump cycles; properties of moist air, psychrometric chart, basic psychrometric processes. *Turbomachinery:* Impulse and reaction principles, velocity diagrams, Pelton-wheel, Francis and Kaplan turbines.

4. MATERIALS, MANUFACTURING AND INDUSTRIAL ENGINEERING:

Engineering Materials: Structure and properties of engineering materials, phase diagrams, heat treatment, stress-strain diagrams for engineering materials.

Casting, Forming and Joining Processes: Different types of castings, design of patterns, moulds and cores; solidification and cooling; riser and gating design. Basic concepts of metallurgy, Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powder metallurgy. Principles of welding, brazing, soldering and adhesive bonding.

Machining and Machine Tool Operations: Mechanics of machining; basic machine tools; single and multi-point cutting tools, tool geometry and materials, tool life and wear; economics of machining; principles of non-traditional machining processes; principles of work holding, design of jigs and fixtures.

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Metrology and Inspection: Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly.

Computer Integrated Manufacturing: Basic concepts of CAD/CAM/CNC and their integration tools, 3D Printing.

Production Planning and Control: Forecasting models, aggregate production planning, scheduling, materials requirement planning.

Inventory Control: Deterministic models; safety stock inventory control systems.

Operations Research: Linear programming, simplex method, transportation, assignment, network flow models, simple queuing models, PERT and CPM

Environmental Pollution: Elementary knowledge on Water, Noise, Air pollution, Greenhouse Gas and remedial methods.

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SYLLABUS FOR COMPUTER BASED TEST **ASSISTANT MANAGER (PS)-TRADE- INSTRUMENTATION POSITIONS**

1. ENGINEERING MATHEMATICS:

Linear Algebra: Vector space, basis, linear dependence and independence, matrix algebra, eigen values and eigen vectors, rank, solution of linear equations – existence and uniqueness.

Calculus: Mean value theorems, theorems of integral calculus, evaluation of definite and improper integrals, partial derivatives, maxima and minima, multiple integrals, line, surface and volume integrals, Taylor series.

Differential Equations: First order equations (linear and nonlinear), higher order linear differential equations, Cauchy's and Euler's equations, methods of solution using variation of parameters, complementary function and particular integral, partial differential equations, variable separable method, initial and boundary value problems.

Vector Analysis: Vectors in plane and space, vector operations, gradient, divergence and curl, Gauss's, Green's and Stoke's theorems.

Complex Analysis: Analytic functions, Cauchy's integral theorem, Cauchy's integral formula; Taylor's and Laurent's series, residue theorem.

Numerical Methods: Solution of nonlinear equations, single and multi-step methods for differential equations, convergence criteria.

Probability and Statistics: Mean, median, mode and standard deviation; combinatorial probability, probability distribution functions - binomial, Poisson, exponential and normal; Joint and conditional probability; Correlation and regression analysis.

2. NETWORKS, SIGNALS AND SYSTEMS:

Network solution methods: nodal and mesh analysis; Network theorems: superposition, Thevenin and Norton's, maximum power transfer; WyeDelta transformation; Steady state sinusoidal analysis using phasors; Time domain analysis of simple linear circuits; Solution of network equations using Laplace transform; Frequency domain analysis of RLC circuits; Linear 2 port network parameters: driving point and transfer functions; State equations for networks.

Continuous-time signals: Fourier series and Fourier transform representations, sampling theorem and applications; Discrete-time signals: discrete-time Fourier transform (DTFT), DFT, FFT, Z-transform, interpolation of discrete-time signals; LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay, digital filter design techniques.

3. ELECTRONIC DEVICES:

P-N junction, Zener diode, BJT, MOS capacitor, MOSFET, LED, photo diode and solar cell; Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography and twin-tub CMOS process.

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4. ANALOG CIRCUITS:

Small signal equivalent circuits of diodes, BJTs and MOSFETs; Simple diode circuits: clipping, clamping and rectifiers; Single-stage BJT and MOSFET amplifiers: biasing, bias stability, mid-frequency small signal analysis and frequency response; BJT and MOSFET amplifiers: multi-stage, differential, feedback, power and operational; Simple op-amp circuits; Active filters; Sinusoidal oscillators: criterion for oscillation, single-transistor and op-amp configurations; Function generators, wave-shaping circuits and 555 timers; Voltage reference circuits; Power supplies: ripple removal and regulation.

5. DIGITAL CIRCUITS:

Minimization of functions using Boolean identities and Karnaugh map, logic gates and their static CMOS implementations, arithmetic circuits, code converters, multiplexers, decoders and PLAs; Sequential circuits: latches and flip-flops, counters, shift-registers and finite state machines; Data converters: sample and hold circuits, ADCs and DACs; Semiconductor memories: ROM, SRAM, DRAM; 8-bit microprocessor (8085): architecture, programming, memory and I/O interfacing; Digital TTL Logic.

6. CONTROL SYSTEMS:

Basic control system components; Feedback principle; Transfer function; Block diagram representation; Signal flow graph; Transient and steady-state analysis of LTI systems; Frequency response; Routh-Hurwitz and Nyquist stability criteria; Bode and root-locus plots; Lag, lead and lag-lead compensation; State variable model and solution of state equation of LTI systems.

7. COMMUNICATIONS:

Random processes: autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems; Analog communications: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, superheterodyne receivers, circuits for analog communications; Information theory: entropy, mutual information and channel capacity theorem; Digital communications: PCM, DPCM, digital modulation schemes, amplitude, phase and frequency shift keying (ASK, PSK, FSK), QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, SNR and BER for digital modulation; Fundamentals of error correction, Hamming codes; Timing and frequency synchronization, inter-symbol interference and its mitigation; Basics of TDMA, FDMA and CDMA, Career Communication.

8. ELECTROMAGNETICS:

Electrostatics; Maxwell's equations: differential and integral forms and their interpretation, boundary conditions, wave equation, Poynting vector; Plane waves and properties: reflection and refraction, polarization, phase and group velocity, propagation through various media, skin depth; Transmission lines: equations, characteristic impedance, impedance matching, impedance transformation, S-parameters, Smith chart; Waveguides: modes, boundary conditions, cut-off frequencies, dispersion relations; Antennas: antenna types, radiation pattern, gain and directivity, return loss, antenna arrays; Basics of radar; Light propagation in optical fibers.

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1. ENGINEERING MATHEMATICS:

Linear Algebra: Matrix algebra, systems of linear equations, eigenvalues and eigenvectors.

Calculus: Functions of single variable, limit, continuity and differentiability, mean value theorems, indeterminate forms; evaluation of definite and improper integrals; double and triple integrals; partial derivatives, total derivative, Taylor series (in one and two variables), maxima and minima, Fourier series; gradient, divergence and curl, vector identities, directional derivatives, line, surface and volume integrals, applications of Gauss, Stokes and Green's theorems.

Differential equations: First order equations (linear and nonlinear); higher order linear differential equations with constant coefficients; Euler-Cauchy equation; initial and boundary value problems; Laplace transforms; solutions of heat, wave and Laplace's equations.

Complex variables: Analytic functions; Cauchy-Riemann equations; Cauchy's integral theorem and integral formula; Taylor and Laurent series.

Probability and Statistics: Definitions of probability, sampling theorems, conditional probability; mean, median, mode and standard deviation; random variables, binomial, Poisson and normal distributions.

Numerical Methods: Numerical solutions of linear and non-linear algebraic equations; integration by trapezoidal and Simpson's rules; single and multi-step methods for differential equations.

Maclaurin's Theorem: Applicability in industry.

2. EM THEORY

Electric and magnetic fields, Gauss's Law and Ampere's Law. Fields in dielectrics, conductors and magnetic materials. Maxwell's equations. Time varying fields. Plane-Wave propagating in dielectric and conducting media. Transmission lines.

3. ELECTRICAL MATERIALS

Band Theory, Conductors, Semi-Conductors and Insulators. Super-conductivity. Insulators. Super conductivity. Insulators for electrical and electronics applications. Magnetic materials. Ferro and ferri magnetism. Ceramics, Properties and applications. Hall effect and its applications. Special semiconductors.

4. NETWORK THEORY

Circuits elements. Kirchoff's Laws. Mesh and nodal analysis. Network Theorems and applications. Natural response and forced response. Transient response and steady state response for arbitrary inputs. Properties of networks in terms of poles and zeros. Transfer function. Resonant circuits. Two-port networks. Elements of

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two-element network synthesis.

5. MEASUREMENTS AND INSTRUMENTATION

Units and standards. Error analysis, measurement of current, Voltage, Power, Power-factor and energy. Indicating instruments. Measurement of resistance, inductance, Capacitance and frequency. Bridge measurements. Electronic measuring instruments. Digital Voltmeter and frequency counter. Transducers and their applications to the measurement of non-electrical quantities like temperature, pressure, flow-rate, displacement, acceleration, noise-level etc. Data acquisition systems. A/D and D/A converters, SCADA System.

6. CONTROL SYSTEMS.

Block diagrams and signal flow graphs and their reduction. Time domain and frequency domain analysis of linear dynamical system. Errors for different type of inputs and stability criteria for feedback systems. Stability analysis using Routh-Hurwitz array, Nyquist plot and Bode plot. Root locus and Nicols chart and the estimation of gain and phase margin. Basic compensator design. State variable matrix and use in system modelling and design. Sampled data system and performance of such a system. Elements of non-linear control analysis. Control system components, electromechanical, hydraulic, pneumatic components.

7. ELECTRICAL MACHINES

Magnetic Circuits- Analysis and Design of Power transformers. Construction and testing. Equivalent circuits. Losses and efficiency. Regulation. Auto-transformer, 3-phase transformer. Parallel operation.

Basic concepts in rotating machines. EMF, torque, basic machine types. Construction and operation, leakage losses and efficiency. D.C Machines. Construction. Excitation methods. Circuit models. Armature reaction and commutation. Characteristics and performance analysis. Generators and motors. Starting and speed control. Testing. Losses and efficiency. Synchronous Machines. Construction. Circuit Model. Operating characteristics and performance analysis.

Synchronous reactance. Efficiency. Voltage regulation. Salient-pole machine. Parallel operation. Hunting. Short circuit transients. Induction machines. Construction. Principles of operation. Rotating fields. Characteristics and performance analysis. Determination of circuit model. Circle diagram. Starting and speed control. Fractional KW motors. Single-phase synchronous induction motors.

8. ELECTRICAL POWER SYSTEMS

Types of Power Stations, Hydro, Thermal and Nuclear Stations. Pumped storage plants. Economics and operating factors. Power transmission lines. Modeling and performance characteristics. Voltage control. Load flow studies. Optimal Power system operation. Load frequency control. Symmetrical short circuit analysis. ZBus formulation. Symmetrical Components. Per unit representation. Fault analysis. Transient and steady state stability of power systems. Equal area criterion. Power system Transients. Power system protection Circuit breakers. Relays and Numerical Relays, HVDC transmission. Economic load dispatch, Energy Exchanges for Energy Business.

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9. ANALOG AND DIGITAL ELECTRONICS AND CIRCUITS

Semiconductor device physics, PN junctions and transistors, circuit models and parameters, FET, Zener, tunnel, Schottky, photo diodes and their applications, rectifier circuits, voltage regulators and multipliers, switching behavior of diodes and transistors.

Small signal amplifiers, D.C amplifiers, Oscillators. Large signal amplifiers, coupling methods, push and pull amplifiers, operational amplifiers, wave shaping circuits. Multivibrators and flip-flops and their applications. Digital logic gate families, universal gates-combination circuits for arithmetic and logic operational, sequential logic circuits. Counters, registers, RAM and ROMs.

10. MICROPROCESSORS

Microprocessor Architecture-Instruction set and simple assembly language programming. Interfacing for memory and I/O. Applications of Micro-processors in power systems.

11. POWER ELECTRONICS

Power Semiconductor devices. Thyristor. Power transistor, GTOs and MOSFETS.

Characteristic and operation. AC to DC converters; 1-phase and 3-phase DC to DC

Converters; AC regulators. Thyristor controlled reactors; switched capacitor networks.

Inverters; single-phase and 3-phase. Pulse width modulation. Sinusoidal modulation with uniform sampling.

Switched mode power supplies.

12. RENEWABLES

Green energy (solar, biomass)

13. POWER STORAGE

Battery, capacitor, SMES, PHP

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SYLLABUS FOR COMPUTER BASED TEST ASSTT. TEACHER -BENGALI

১। পাঠ্যপুস্তক (Text) নির্ভর প্রশ্ন

পশ্চিমবঙ্গ মধ্যশিক্ষা পর্ষদ প্রকাশিত ‘সাহিত্য সঞ্চয়ন’ (প্রথম ভাষা- নবম ও দশম শ্রেণী), ‘সাহিত্য সম্ভার’ (দ্বিতীয় ভাষা – নবম ও দশম শ্রেণী), ‘প্রোফেসর শঙ্কুর ডায়েরী’, ‘কোনি’ (পশ্চিমবঙ্গ উচ্চ-মাধ্যমিক শিক্ষা সংসদ প্রকাশিত ‘সাহিত্যচর্চা’ (প্রথম ভাষা – একাদশ ও দ্বাদশ শ্রেণী), ‘সাহিত্যকথা’ (দ্বিতীয় ভাষা – একাদশ ও দ্বাদশ শ্রেণী) অবলম্বনে প্রশ্ন রচিত হবে।

২। বাংলা শিল্প, সাহিত্য ও সংস্কৃতির ইতিহাস

ক. পশ্চিমবঙ্গ উচ্চ-মাধ্যমিক শিক্ষা সংসদ প্রকাশিত ‘বাঙালির ভাষা ও সংস্কৃতি’ (একাদশ শ্রেণী) এবং ‘বাংলা ভাষা ও শিল্প সাহিত্য সংস্কৃতির ইতিহাস’ (দ্বাদশ শ্রেণী) অবলম্বনে প্রশ্ন রচিত হবে।

খ. বাংলা সাহিত্য: নতুন দিগন্ত (অনুবাদ ও অনুষ্ঙ্গ)

- ভারতীয় সাহিত্য কালিদাস, শূদ্রক, কবীর, ইকবাল, ভানুভক্ত, অমৃত প্রীতম, প্রেমচন্দ, বিজয় তেন্ডুল কার, গোপীনাথ মহান্তি, আইয়্যাপ্পা পানিকর
- আন্তর্জাতিক সাহিত্য শেক্সপিয়ার, টলস্টয়, চেকভ, মপাসা, গ্যোয়েট, নেরুদা, গ্যাব্রিয়েল গার্সিয়া মার্কেজ, ল্যান্ডস্টন হিউজ, আর্নেস্ট হেমিংওয়ে, টি. এস. এলিয়ট।

৩। ব্যাকরণ

- ধ্বনি ও ধ্বনি পরিবর্তন:
 - ক. ধ্বনি – বাংলা ধ্বনির শ্রেণীবিভাগসহ বিস্তারিত আলোচনা।
 - খ. ধ্বনি পরিবর্তনের কারণ ও পরিবর্তনের বিভিন্ন রীতি।
 - গ. সন্ধি
- শব্দ গঠন: উপসর্গ, অনুসর্গ, ধাতু ও প্রত্যয়
- বাংলা শব্দভাণ্ডার
- শব্দ ও পদ: বিশেষ্য- বিশেষণ – সর্বনাম – অব্যয় – ক্রিয়া বিস্তারিত আলোচনা
- কারক ও অ-কারক সম্পর্ক: শ্রেণীবিভাগ, বিভক্তি ও অনুসর্গ অনুযায়ী কারকের শ্রেণীবিভাগ
- সমাস: পরিভাষা ও তাদের ব্যাখ্যা, শ্রেণীবিভাগ
- বাক্য:
 - ক. বাক্য নির্মাণের শর্ত – যোগ্যতা, আকাঙ্ক্ষা, আসক্তি
 - খ. উদ্দেশ্য ও বিধেয় সম্পর্কে ধারণা
 - গ. বিশেষ্য খন্ড, ক্রিয়া বিশেষণ খন্ড, ক্রিয়া খন্ড
 - ঘ. বাক্যের গঠনগত ও অর্থ গত শ্রেণীবিভাগ
 - ঙ. বাক্যের রূপান্তর – গঠন ও অর্থ অনুসারে
- বাচ্য: শ্রেণীবিভাগ, বাচ্য পরিবর্তন
- এছাড়াও পশ্চিমবঙ্গ উচ্চ-মাধ্যমিক শিক্ষা সংসদ প্রকাশিত একাদশ শ্রেণীর বাঙালীর ভাষা ও সংস্কৃতির ‘ভাষা’ অংশ এবং দ্বাদশ শ্রেণীর ‘বাঙলা ভাষা ও শিল্প সাহিত্য সংস্কৃতির ইতিহাস’ গ্রন্থের ভাষা অংশ অবলম্বনে প্রশ্ন রচিত হবে।

৪। সাহিত্যের রূপ রীতি

- কাব্য: মহাকাব্য গীতিকবিতা
- নাটক: ট্রাজেডি, কমেডি, প্রহসন একাক্ষ
- উপন্যাস, ছোটগল্প, প্রবন্ধ: রূপবৈচিত্র্য

৫। স্বাধীনতা পরবর্তী বাংলা সাহিত্য

Note: The syllabus/ topics mentioned are indicative in nature. Candidates are expected to possess significant knowledge/ proficiency pertaining to the relevant subjects and their qualifying degree.

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SYLLABUS FOR COMPUTER BASED TEST **ASSISTANT TEACHER - BIOLOGICAL SCIENCE**

ZOOLOGY

Invertebrates:

1. Classification of major phyla upto subclass with examples.
2. Special features: Reproduction a Protozoa. Polymorphism of Siphonophora, Respiration in Arthropod. Nervous system in Gastropod. Water vascular system in Starfish.

Chordates:

1. Classification of Amphibians. Reptilians & Mammalians upto order with Examples.
2. Special features, Lateral sense organ in fishes. Non-poisonous and poisonous snakes. Heart and aortic arches, Brain in man Exoskeleton structures in bird.

Cytology, Histology & development Biology:

1. Structure & function of plasma membrane. Mitochondria, Golgi complex and Endoplasmic reticulum.
2. Nucleic Acids: DNA-Physico Chemical structure-replication, transcription & role in cell cycle, RNA types: Structure of RNA function & role in protein synthesis.
3. Histology of Liver, Pancreas and Kidney.
4. Histological technique: Fixation & Fixative. Outline classification of dyes.
5. Outline knowledge of Gametogenesis; Ultra structure of sperm & ovum.
6. Morphogenetic movements and fate map.
7. Concept of organizers in development.
8. Organogenesis: Development of eye in chick.
9. Placenta types, structure and functions in rodents.

Distribution, Evolutionary Biology & Systematics:

1. Zoogeographical realms and subdivisions & their characteristic fauna.
2. Chemical basis of Origin of life.
3. Modern concept of evolution - Neo-Darwinism and Harby-Weinberg equilibrium.
4. Adaptation types: Adaptive radiation & adaptive convergence in mammals: Desert adaptation,
5. Biological species concept.
6. Importance of classification; Principles of zoological nomenclature.
7. Modes of speciation - Sympatric, allopatric & parapatric processes.



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Ecology, Animal behaviour, Biodiversity & Conservation:

1. Energy flow in the ecosystem.
2. Population Ecology: growth forms; regulation of population density.
3. Community ecology: habitat & niche concept. Resource partitioning, species diversity.
4. Ecological succession.
5. Instinctive and learning behaviour.
6. Complex behaviour: fixed action pattern; circadian, rhythm; migratory behaviour in bird.
7. Concept of biodiversity: Types of biodiversity & its importance mega diversity zones & Biodiversity Hotspots with special reference to India.
8. Concept of conservation: in situ and ex situ methods.
9. Wildlife conservations strategies.

Parasitology & Immunology:

1. Lifecycle, pathogenecity, clinical features & control of ---- *Plasmodium vivax*, and *Wuchereria bancrofti*
2. Mosquitoes as vector for disease transmission.
3. Classification of immunoglobulin; acquired & innate immune system; lymphoid & myeloid cells in immune system: T & B cell co-operation: macrophage.

Genetics & Molecular Biology:

1. Cell cycle.
2. Allele concept, multiple allele (ABO blood group); pseudo allele; isoallele; allelic interaction.
3. Sex determination with special reference to *Drosophila* and Man.
4. Gene as a structural & functional unit --- cistron concept; one gene - one 5. polypeptide; sickle cell anemia; thalassemia.
5. Genetics and molecular biology of replication, transcription and translation.
6. Mutation-types, detection, molecular mechanism, chromosomal aberration.
7. Elementary idea of DNA finger printing, PCR, cloning, oncogene.

Animal Physiology & Biochemistry:

1. Enzymes: Classes, kinetics and factors affecting it.
2. Structure and function of haemoglobin.
3. Structure of mammalian nephron; Physiology of urine formation; osmoregulators & osmoconformer.
4. Nature, origin and propagation of nerve impulse along a neuron.
5. Transport of oxygen & Carbon dioxide in mammals.
6. Elementary idea of structure of carbohydrate, protein & lipid.



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Endocrinology and reproductive biology:

1. Endocrine glands and hormones --- classification of hormones, mechanism and effects of hormonal actions.
2. Hormonal regulation of gametogenesis in males and females of mammals, reproductive cycle in mammals.
3. Brief notes on Endocrine disorders, RIA, ELISA, cry preservation of gametes.

Environment Biology:

1. Nature, sources & effects of major pollutants of air & water; noise pollution.

Applied Zoology:

1. Aquaculture: Induced breeding. Composite fish culture, Exotic fishes & their role. Freshwater & brackish water prawn culture.
2. Sericulture: Silk varieties in India; mulberry silkworm culture, diseases of silkworm and their control.
3. Biology & control of pests: Paddy pest (*Scirpophegor in ortu.tus*) Anomies sobulifra stored grain pest (*Sitophilus oryzea*) rodent pest (*Bandicoota begabusi*) Biological and Integrated Pest Management.
4. Animal husbandry: common dairy breeds (cow); techniques of dairy management (brief idea); common poultry breeds (fowl) rearing methods, diseases & control.

BOTANY

A. CELL:

- (a) Prokaryotes and Eukaryotes: Characteristics, and differences with reference to their Nuclear and cell wall compositions.
- (b) Structure, function and significance of cellular organelles and cell membrane. Chromosomes: Ultra-structures and chemical compositions.

B. PLANT ANATOMY

Plant Tissue: Definition, Classification, Distribution and Functions including Mechanical tissues.

Stele: Types & Evolution

Normal and anomalous secondary growth in stems and roots in plants. Root-stem Transition.

C. ECOLOGY AND ENVIRONMENT:

Divisions of ecology, ecological factors, ecological units; Energy flow in ecosystem; Ecological niche; General ideas about global warming; Eutrophication; Ozone depletion; Acid rain; Sustainable development. Afforestation - Process and significance; Biosphere Reserve. Pollution air, water and soil.



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D. PLANT GROUPS:

1. ALGAE: Range of thallus structures; Economic importance (as food, fodder, fertilizer and sources of iodine, laminarine starch, phycocolloid, agar, algin diatomite).
2. FUNGI: Structure of cell wall, mycelium, spore forms reproduction types: Homo-and heretrohallism, Parasexuality. Economic importance.
3. BRYOPHYTES & PTERIDOPHYTES: Structural organization or gametophytes and sporophytes-a brief knowledge. Economic importance.
4. GYMNOSPERMS & ANGIOSPERMS: Structural organization of ovule, male and female gametophytes in cycas and pixus post-fertilization changes in embryo-sac in angiosperms.

E. PLANT PATHOLOGY:

Necrosis, hypo plastic and hyperplastic symptoms of plant diseases, mechanism of infection Disease control-a brief knowledge, with emphasis on chemical and biological control.

F. TAXONOMY:

Concept of artificial, natural and phylogenetic system of classification; Outline classification of Cronquist (1981). Role of Cytology and Phytochemistry in taxonomic studies. Diagnostic characters, evolutionary significance of the following families: Magnoliaceae, Nymphaeaceae, Compositae (Asteraceae). Alismataceae, poaceae (Gramineae) and Orchidaceae.

ICBN-principles, rules of priority, effective and valid publication, brief note on cladistics. Functions of Herbaria and Botanical Gardens; Biodiversity and conservation-in-situ and ex-situ, Brief note on IUCN and Biosphere Reserves.

G. PALEOBOTANY:

Fossils --- Types, processes of fossilization, Geological time scale.

H. PLANT PHYSIOLOGY:

- (a) Preliminary ideas about acid, base, and buffer.
- (b) Transpiration: Mechanism and factors affecting it.
- (c) Role of mineral elements in plants.
- (d) Photosynthesis: Photosynthetic pigments and their properties, photo-phosphorylation. Calvin cycle, C4-cycle & photorespiration, CAM.
- (e) Respiration Concept of fermentation in terms of Industrial Biotechnology, Glycolysis, pentose phosphate pathway, Krebs cycle and Electron transport system.
- (f) Hormones-Role of auxin, gibberellins, cytokinins, ethylene and abscisic acid in plant growth and development.
- (g) Enzymes: Definition; Properties of Enzymes, and types of enzymes.

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I. PLANT BIOCHEMISTRY:

General Chemistry of carbohydrate, protein and fat.

J. CYTOGENETICS & PLANT BREEDING:

Cell Cycle - Definition and different phases. Mendelism, Linkage and Crossing over - Types with examples Chromosome aberration, Aneuploidy, Euploidy; Gene Mutation - Definition, types and importance, Gene regulation (Operation concept), genetic code, protein synthesis, Brief Knowledge about Transposon. Oncogene, Gene cloning, Gene transfer ,PCR. Definition, methods and importance of mass selection, pureline selection, hybridization and hybrid vigour. Tissue culture- Definition, Types and Prospects in Agriculture and Forestry.

K. PHARMACOGNOZY:

Active principles, macroscopic, microscopic characters and uses of the following drug-yielding plants: *Azadirachta* (neem) *Andrographis* (Kalmegh), *Rauwolfia*

L. MICROBIOLOGY:

Virus: general properties, structure of bacteriophage; concept of Plasmid. Electron microscopic structure of a bacterial cell. Development of endospore. Process of Transduction. Nutritional groups of Bacteria (Photo-autotroph. Chemoautotroph, Photoorganotroph and Chemoorganotroph).

PHYSIOLOGY

1. Cellular Physiology:

Molecular structure of cell membrane and mitochondria.

Enzymes - Properties, mechanism and kinetics of action, regulation of enzyme action, enzyme inhibitors.

2. Biochemistry & Metabolism:

Chemistry of carbohydrates, proteins, lipids and nucleic acids. Metabolic pathways - glycolysis, HMP shunt, TCA cycle, beta-oxidation of fatty acids, glycogenesis cholesterol synthesis, protein synthesis, purine and pyrimidine biosynthesis. Hormonal regulation of metabolic pathways. Oxidative phosphorylation.

3. Nutrition & Dietetics:

Digestion and absorption of nutrients, composition, functions and regulations of salivary juice, gastric juice, pancreatic juice and bile, Balanced diet, RDA, BMR, RQ, Specific dynamic action. Calorie value of foods, Biological value of proteins, NPU

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Vitamins - sources, functions, deficiency symptoms, hypervitaminosis, antivitamins. Minerals - functions and deficiency symptoms. Undernutrition and overnutrition and overnutrition. Diet chart formulation for adult person and pregnant woman.

4. Body fluid and Immunology:

Composition and functions of blood. Buffers in blood and regulation of blood pH. Coagulation of blood. Blood Groups. Formation, circulation and functions of lymph and tissue fluid. Immunity - Innate and acquired immunity, Humoral and cell mediated immunity. Hypersensitivity, Acquired Immuno Deficiency Syndrome.

5. Heart & Circulation:

Heart rate and its regulation. Cardiac output-measurement and factors affecting. ECG-normal ECG, leads, vectocardiogram. Blood pressure-vasomotor centres, vasomotor reflexes, capacitance and resistance vessels. Molecular mechanism of vasoconstriction and vasodilatation. Hypertension, arterial and venous pulse. Peculiarities of coronary and cerebral circulation.

6. Respiration:

Volumes and capacities of lungs, Mechanics of breathing-lung compliance, intrathoracic & intrapleural pressure, surfactant, work of breathing, Hypoxia, Oxygen toxicity Neural centers and reflexes regulating respiration.

7. Physiology of Excitable Tissue:

Molecular mechanism of contraction and relaxation of different types of muscles, Sarcotubular system and excitation - contraction coupling. Different elastic components of muscles, Heat production in muscles during activity.

Nerve impulse. Compound action potential of nerve. Membrane current and conductance. Voltage gated channels, molecular basis of synaptic transmission. Electron microscopic structure of my neural junction-active zones, gutter, post synaptic receptors, EPP, MEPP.

8. Nervous System:

Stretch reflex, inverse myotonic reflex, muscle spindle, propriospinal reflex, spinal shock, Structure, connections and functions of cerebellum, basal ganglia, thalamus, Hypothalamic control of food and water intake, neuro-endocrine functions. Functions of association cortex, Asymmetric functions of cerebral cortex, Functions of limbic system, Neural basis of memory. Sleep and REM Sleep. Impulse transmission in autonomic ganglia. Molecular basis of autonomic neural activity on effector organs.



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9. Special Senses:

Receptors as biological transducer, Muller's law of specific nerve energies, Transduction mechanism in rods and cones, auditory hair cells, gustatory and olfactory Neural basis of sensory coding - Pitch And loudness perception, odor and taste discrimination, physiology of colour vision, visual acuity.

10. Renal Physiology:

Histological structure of nephron and filtering membrane, glomerular filtration, counter current exchanger and multiplier. Physiological mechanism of tubular reabsorption and secretion. Diuresis. JG apparatus.

11. Endocrine system and Chronobiology:

Physiological functions of the hormones - pituitary, thyroid, parathyroid, pancreas, adrenal. Cell signaling mechanism of hormones - cAMP, IP3, DAG, Tyrosine kinase, Jak-STAT Pathway. Hypo and hyperactive states of endocrine glands - Acromegaly, Frolich's Syndrome, hashimoto's disease, Cushing's syndrome, Pheochromocytoma, Biorhythm, Zeitgeber, Free running rhythms, Cardiac rhythm in adrenal, pineal and sleep-wake behaviour, neural basis of single and multiple oscillators of cardiac rhythm jet-lag.

12. Reproductive Physiology:

Hormonal control of ovulation. Physiology of implantation, Hormonal control of pregnancy and lactation, Spermatogenesis and its hormonal control. Control of fertility and population

13. Exercise and Sports Physiology:

Maximum aerobic power and factors affecting it. Excess post exercise oxygen consumption (EPOC). Effect on training on physiological systems. Anaerobic threshold. Anaerobic capacity. Anaerobic and aerobic requirements in different sports activities.



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14. Body temperature Regulation:

Structure of skin, composition of sweat, channels of heat loss and gain. Neural and humoral control of body temperature.

15. Environmental Physiology:

Physiological changes in extreme environment: Hot, Cold, Hypobaric and Hyperbaric conditions. Heat stress. Acclimatization in high altitude, hot and cold environment Cardiovascular and respiratory effects of positive and negative G-Forces, Noise pollution and its impact on human life, Ionizing radiation hazards, Toxicology of industrial wastes- diseases due to excess accumulation of Pb, Hg and Cd in body. Addiction to tobacco, alcohol and narcotics, Over population - its causes and effects.

16. Biomedical Instruments:

Basic principles and uses of following instruments: UV - Spectrophotometer, ECG, EMG, EEG, Pulmonary function analyzer, CT Scan, MRI, Ultrasonography (USG), Dialyser, Pacemaker, Endoscopy.

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Note: The syllabus / topics mentioned are indicative in nature. Candidates are expected to possess significant knowledge / proficiency pertaining to the relevant subjects and their qualifying degree.



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SYLLABUS FOR COMPUTER BASED TEST **ASSISTANT TEACHER - CHEMISTRY**

Unit 1: Physical Chemistry (1)

Physical States of Matter, Physical Properties & Molecular Structure

- SECTION A:** The gaseous state: The mean free path, binary collision frequency (single gas), their dependence on temperature and pressure. Real gases-detailed study of van der Waals' equation and Critical constants of gases, the rule of Cailletet and Mathias The reduced equation of state and the principle of corresponding states. Maxwell's law of distribution of molecular velocities (derivation not required), effect of temperature on the distribution. Expressions for various types of velocities from Maxwell's equation. Kinetic energy distribution. Boltzmann factor and the Boltzmann equation. The barometric formula.
- SECTION B:** The liquid state: Surface tension: measurement, application and temperature dependence.
- SECTION C:** (i) Elementary ideas of crystallography - Laws of crystallography crystal lattice, simple crystal system, ionic and covalent crystals, Bragg's method of crystal analysis with illustration NaCl and KCl crystal faces, Born-Haber cycle.
(ii) Heat capacity of solids, Einstein's specific heat equation Debye's T^3 - Law (detailed deduction not required)
- SECTION D:** Colloidal system:
(i) Properties of colloids; optical, kinetic and electrical
(ii) Electro kinetic phenomena; charge and stability colloids, mechanism of coagulation
(iii) Determination of Avogadro's number from Perrin distribution equation and Einstein's diffusion equation.
(iv) Ultracentrifuge, Determination of size of colloid particles and molecular weights of macro-molecules.
(v) Colloidal electrolytes and their properties (soaps and detergents, Critical micellization concentration).proteins
- SECTION E:** Physical properties and molecular structure:
(i) Polar molecules and dipole moment (derivations equations not required)
(ii) Elementary ideas on molecular spectra, potential energy curves and Raman Spectra, with applications.



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Unit - 2: Physical Chemistry (2)

Thermodynamics & Its Applications to Equilibrium processes

SECTION A: Thermodynamics:

- (i) Heats of solution and dilution, heats of neutralization from bond enthalpies, Kirchhoff's equation.
- (ii) Carnot's theorem, thermodynamic scale of temperature, refrigeration cycle.
- (iii) Detailed treatment of entropy, free energy, Gibbs-Helmholtz equation, Partial molar quantities, Gibbs potential, Gibbs potential, Gibbs-Duhem equation, Maxwell's relations. Thermodynamic equation of state. Elementary idea of entropy and probability.
- (iv) Applications of thermodynamics: Clausius-Clapeyron equation. Nernst distribution law, Joule-Thomson effect, expression for $(C_p - C_v)$ for van der Waals gases.
- (v) Elements of statistical thermodynamics, Boltzmann distribution, partition functions and their relations with thermodynamic state functions.

- SECTION B:
- (i) Chemical equilibria: homogeneous equilibria. Experimental determination of equilibrium constants. Thermodynamic derivation of the law of mass action. The reaction isotherm & temperature dependence of equilibrium constants (van't Hoff equation)
 - (ii) Ionic equilibria - Determination of hydrolysis constant and degree of hydrolysis, Buffer capacity. Neutralisation indicators - theory and application, (pH titration curves). Relative strengths of acids and bases.

SECTION C: Electromotive force --- Different types of electrodes, glass and quinhydrone electrodes, important reference electrodes. Thermodynamics of a reversible chemical cell, standard electrode potentials and standard emf of Chemical cell (Nernst equation); Concentration cells, liquid junction potential, salt bridge. Redox potential, Redox series, Redox indicators (Theory and applications), Decomposition potentials, polarization, overvoltage, Dry cells (Leclanche cell), accumulators (acid and alkali). Applications of e.m.f. measurements - Thermodynamic parameters of electrochemical reactions (enthalpy, entropy and free energy), determination of solubility products, transport numbers, pH, K_w , valencies of ions and dissociation constants of weak electrolytes. Potentiometric titrations.



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SECTION D: Colligative properties: Thermodynamic derivation of Raoult law for lowering of vapour pressure, elevation of boiling point and depression of freezing point, van't Hoff's osmotic pressure equation, interrelationships; between the different colligative properties, abnormal colligative properties.

SECTION E: Equilibrium in heterogeneous systems & phase equilibria.

- (i) Derivation of phase rule; its significance. Duhem Margules equation.
- (ii) One component system - carbon dioxide, water, sulfur.

Unit - 3: Physical Chemistry (3)

Transport Phenomenon: Kinetics & Catalysis: Photochemistry Adsorption & Surface Phenomenon.

SECTION A: Viscosity of gases and liquids, viscosity co-efficients, and their dependence on temperature. Stoke's Law and terminal velocity, diffusion of gases and solutes in solution (Fick's law).

SECTION B: Electrochemistry:

- (i) Electrolytic conductance, Transport numbers and their interpretations; hydration of ions. Determination of ionic speeds. Qualitative treatment of Onsager equation and Debye Huckel theory.

SECTION C: Chemical Kinetics:

- (i) Order and molecularity of a reaction, first and second order kinetics. Determination of the order of a reaction. Zero and fractional order reactions.
- (ii) Influence of temperature on the speed of a reaction. Arrhenius equation. Mechanism of uni- and bi- molecular reactions from collision theory (detailed) and transition state theory (elementary).
- (iii) Simultaneous reactions: Parallel, consecutive and opposing reactions (simple-treatment), chain reaction (Hydrogen-Bromine reaction).

SECTION D: Adsorption and surface chemistry:

- (i) The phenomenon of adsorption on liquid and solid surfaces, Freundlich and Langmuir adsorption isotherms. B. E. T. equation (without derivation), surface area of adsorbents.
- (ii) Gibb's adsorption isotherm. Application of adsorption.



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SECTION E: Catalysis

- (i) Catalytic process: Theories of homogeneous and heterogeneous catalysis (single reactant case)
- (ii) Acid-base catalysis. Kinetic salt effects.
- (iii) Enzyme catalysis and its characteristics
- (iv) Application of catalysis in different fields

SECTION F: Photochemistry:

- (i) Elementary principles of spectrophotometry Lambert-Beers' law and its applications:
- (ii) Laws of photochemical reactions; H-Br reaction, H-Cl reactions, HI decomposition, photosensitized reactions, photochemical equilibrium.
- (iii) Elementary ideas of fluorescences and phosphorescence.

Unit - 4: Inorganic Chemistry (1)

Atomic Structure; Radioactivity & Nuclear Chemistry; Chemical Bonding.

- SECTION A:
- (i) Qualitative idea on Black-body radiation, photo-electric Effect and Compton effect, Plank's quantum equation.
 - (ii) Atomic spectra of hydrogen. Bohr's Theory of hydrogen atom (simple mathematical treatment). Sommerfeld extension. Limitation of Bohr-Sommerfeld theory. Quantum numbers, their significance; s,p,d,f - atomic orbitals. Sequence of energy levels. Aufbau principle, Hund's rule, Pauli exclusion principle. Electronic configuration of elements, ground state terms of many electron atoms and ions.
 - (iii) Wave-particle duality, Heisenberg Uncertainty principle, de-Broglie relationship, Schrodinger wave equation, wave mechanical interpretation of orbital, probability distribution curves, shapes of s, p, d and f orbitals (qualitative)

SECTION B: Radioactive decay, α - β - γ - rays; half-life and average life of radioelements. Characteristics of radioactive decay series (different types) and Uranium decay series, Group displacement Law, radioactive equilibrium, Nuclear binding energy (including determining factors), stability of nuclei. Nuclear reactions. (different common types); projectiles, target nuclei, compound nuclei, spallation reaction, Nuclear energy. Elementary ideas on Nuclear fission and fusion reactions. Radio carbon dating, Age of mineral (elementary principle only), Isotope exchange. Separation and uses of isotopes.



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SECTION C: Nature of chemical bond, Ionic bond, Lattice energy, Solvation energy, Born-Haber cycle (including mathematical calculation), Concepts of polarization, Fajan's rule. Ionic potential and its applications. Inert pair effect, Covalent bond and coordinate bond, σ and π bonds valence bond theory (simple mathematical treatment), assumptions, defects, Resonance. Molecular orbital theory (non-mathematical treatment), application to homonuclear diatomic molecules: H_2 to F_2 and heteronuclear diatomic molecules. NO, CO and HF and H_2O , BeF_2 , CO_2 , Bond orders; Hybridization, Bent's rule, shapes of molecules, VSEPR theory. Hydrogen bond and its effects on physical properties, Intermolecular forces (elementary idea), Metallic bond, (qualitative bond theory), conductors, semiconductors, superconductors, insulators.

Unit - 5: Inorganic Chemistry (5)

Chemical Periodicity; Acid-Base, Solvents & Redox Systems: s- & p- Block Elements & Their Compounds.

SECTION A: Periodic classification of elements on the basis of electronic configuration and periodic variation of properties; atomic radii, ionic radii, ionization energy; Slater's rule; electron affinity, electro negativity concept (Pauling & Allred-Rochow scales);

SECTION B: Modern concept of acids and bases including SHAB principle, strengths of acids and bases (qualitative idea). Non-aqueous solvents; Liquid ammonia & liquid SO_2 as solvents, Redox potentials. Formal potentials, applications of redox potentials, variation of redox potentials, under the influence of pH, precipitation and complex formation; disproportionation. Choice of indicators in redox titrations. Redox potential diagrams and their applications.

SECTION C: Noble gases; isolation properties and structure of compounds of noble gases.

SECTION D: B, Al, Ga, In, Tl- General group comparison. Boric acid, Borax, Boron nitrides, Borazine, Diborane, Borohydrides.

SECTION E: C, Si, Ge, Sn, Pb-General group comparison. Carbides, silanes, silicon halides, silicic acids, silicones, silicates.

SECTION F: N, P, As, Sb, Bi-General group comparison, Elemental states of P, As, Sb, Bi; Oxides and Oxyacids of Nitrogen and Phosphorus, Hydrazine, Hydroxylamine, Hydrazoic acid, Halides of nitrogen and phosphorus, Nitrides, condensed phosphorus, Phosphonitrite compounds.

SECTION G: O, S, Se, Te - General group comparison. Hydrides, Halides, Elemental states of S, Se, Te: Oxides and Oxyacids of Sulphur, Selenium and Tellurium. Thionic acids, sodium thiosulfate, polysulphides, hydrogen peroxide, ozone, peroxyacids of sulphur.

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SECTION H: F, Cl, Br, I - General group comparison. Elemental fluorine, Oxygen fluoride, Oxides and Oxyacids of Cl, Br, and I, Interhalogens and Polyhalides, Basic properties of halogens. Psedohalogens. Fluorocarbons.

Unit - 6: Inorganic Chemistry (6)

d-Block Elements & Their Compounds: Coordination Chemistry & Organometallics

SECTION A: Terristrial abundance of the metals; elementary idea of mineral formation; General methods of isolation of metals from their natural sources of occurance (technical details omitted) Availability in India and the chemistry of isolation of the following metals: Li, Rb, Cs, Ag, Au, Ti, V, Cr, Mn, Co, Ni, Pt, Ra, U.

SECTION B: Study of the elements of Group IA, IB, IIA and IIB with reference to their chemical reactions and properties (specially redox and coordination)

SECTION C: General characteristics of first now transition metals with reference to electronic configuration, oxidation states, redox properties, colour of the ions. Magnetic properties of first transition metal ions and their complexes. Determination of magnetic susceptibility and its application to complex compounds, Polyvanadates.

SECTION D: Introduction to coordination compounds. Werner's theory, Nomenclature of coordination compounds upto two metal atoms, Types of ligands, Chelates and inner-metallic complexes and their applications in chemical analyses. Isomerism of coordination compounds: different types; geometrical and optical isomerisms for coordinations numbers 4 and 6. Trans effect. Study of complexes in solution: detection, composition (Job's, slope ratio and mole ratiion methods), stability-potentionmetric method. Metal-ligand interactions: Valence Bond and Crystal Field Theories. Application of VB and CFT approaches in explaining stereochemistry, magnetic and spectral features ($d^1 - d^9$), systems of coordination compounds (coord. No. upto six) Introduction of ligand field theory (qualitative treatment only). Metal legand bonding, mo concept, σ and π bondings in complexes.

SECTION E: Metal complexes of π acids ligands: carbonyls, nitrosyls and cyanides. introduction of σ bonded and non-classically bonded organometallics, metal (mono) olefins-Zeise's salt; Metallocenes; Ferrocene, Metal-metal bonded complexex; inorganic rings, cages and clusters; boron cage compounds, carborances and metallocene carboranes. Catalysis by organometallic complexes; substitution, oxidative addition, reductive elimination, insertion reactions, hydrogenation, hydrofomylation and polymeization of alkenes; fluxional molecules.

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Unit - 7: Organic Chemistry (1)

- SECTION A:** Nature of bonds in organic compounds: Atomic orbitals, Molecular orbitals: bonding, non-bonding and antibonding. Hybridisation of atomic orbitals with reference of C, N, Cl, Br, I, O; Sigma and Pi-bonds; electronegativity ; Dipole moment (bond moment, group moment, polarization and polarisability of covalent bond). Inductive and effectromeric effects. Energetics of bond cleavage and bond formation; Bond energies and bond distances; Carbocations, carbanions, Free radicl, ambident ions (definitions, examples). Conjugation, Resonance, Hyperconnugation; Tautomerism with reference to the following systems only Keto-Enol, Nitro-Acinitro, Nitroso-Oximino. Strength of organic acids and bases.
- SECTION B:** Optical activity, optical rotations: Recemisation; Elements of symmetry, asymmetric and dissymmetric molecuclses, configuration and conformation, acyclic systems. D.L. and R. s. nomenclatures of acyclic systems. Erythro and Thero configurations. Fischer, sawhorse and Newman projection formula; Geometrical isomerism involving C=C and C=N bonds.
- SECTION C:** Investigation of reaction mechanisms: Rate law of a reaction; Activation energy, Transition ·state, Reaction intermediates, energy profile diagrams involving two transition states. Idea of a reversibility of a reaction, Kinetically and Thermodynamically controlled products: Primary kinetic isotope effects; classification of reagents and reactions; steric inhibition and steric strain in organic molecules. Pericyclic reactions, electrocyclic opening and closure.
- SECTION D:** Mechanism of organic reactions- What and Why ? Addition reactions: Electrophiliic, Nucleophilic and Radical . Classical and non-classical carbonium ion. Comparative study of (i) electrophilic addition at C=C; (ii) Nucleophilic addition at C=O group of aldehydes and ketons; (iii) Nucleophilic substitution at C=O group of acids and their derivatives; Substitution reaction at the saturated carbon atom (SN₁, SN₂, SNi); and the aromatic system (SE₂), Elimination reactions: beta elimination (E₁, E₂ and E₁ cB) and alpha elimination carbenes; polymerization reactions: Ionic and Free radical mechanisms.
- SECTION E:** Stereochemistry: Atropisomerism-Byphenyls (excluding R-S configuration). Substituted aliens. Resolution of recemic modifications. Walden inversion, Mutarotation, Asymmetric synthesis, Epimerisation; Elementary idea of sterospesific and stereosclective reactions.
- SECTION F:** Melecular Rearrangements: Allylic, Claisen Pinacol pinacolone. Acyclic systems: Hofmann, Lassen Curtius, Schmidt, Fries and Beckmann. Cyclic systems: Demjanov and Favorskii.

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SECTION G: Elementary idea of the applications of U. VIR and H-NMR spectroscopy for simple organic molecules.

Unit - 8: Organic Chemistry (2)

SECTION A: Aliphatic Compounds:
Nomenclature and general methods of preparation, properties and reactions with mechanism in respect of the following:

- Hydrocarbons - Alkanes, Alkenes, Alkaienes, Alkynes and their halogen derivatives.
- Monohydric alcohols;
- Ethers and thioethers;
- Carbonyl compounds;
- Saturated monocarboxylic acids and their derivatives;
- Alkyl nitrites, Nitroalkanes, Nitriles, Isonitriles, Amines, Urea, Diazomethane, Diazoacetic ester.
- Amino acids and proteins: Definition and Classification; Syntheses (by Gabriel phthalimide method, Strecker's method and Azlactone method), properties and reactions of Glycine and Alanine; Tests, peptide linkage and its geometry.
- Carbanion Chemistry with reference to acetoacetic ester, malonic ester and cyanoacetic ester.

SECTION B: Alicyclic Compounds General methods of preparation, properties and reactions with mechanism of alicyclic compounds (one ring only) with upto six carbon atoms; Bayer Strain theory; Conformational aspects boat, half-chair and chair forms; axial and equatorial bonds, Conformation, reactions of mono-and di-substituted derivatives only.

SECTION C: General methods of preparation, properties, reactions, structure and sythetic used of Grignard reagents; preparation of uses of Li and Zn alkyls.

SECTION D: Carbohydrates: Nomenclature: Classification; Reactions and structure elucidation of Glucose and Fructose: Ascending and descending in sugar series. Aldopentoses. Aldohexoses; Ketopentoses and Ketohexoses; Interoconversion of aldohexose to ketohexose and vice versa; Configuration of Arabinose, Glucose, Fructose; Conformation of Glucose; Inversion of Sucrose; Ring-chain tautomerism.

Unit - 9: Organic Chemistry (3)

SECTION A : Aromatic Compounds:
(i) Idea of aromatic compounds upto-pi-electron system; Aromaticity and Aromatic character;

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- (ii) Benzene: Modern idea of structure, Electrophilic substitution; preparation properties and important reactions with mechanism of homologues of benzene, halogen derivatives; Nucleophilic and cine substitution: Benzyne intermediates; Orientation and reactivity--- mechanistic approach.
- (iii) Aromatic nitro compounds: General methods of preparation, properties, reactions with mechanism.
- (iv) General methods of preparation, properties and reactions with mechanism of the following classes of compounds: Phenols, Aromatic alcohols, Aromatic aldehydes, Aromatic Ketones, Aromatic carboxylic acids and their derivatives, Phenolic aldehydes and ketones, Phenolic acids, Nitro phenols, Benzoquinones and aromatic sulphonic acids.
- (v) Aromatic diazo compounds: preparation, properties and reactions with mechanism.
- (vi) General methods of preparation, properties and reactions with mechanism of the following classes of compounds: Phenols, Aromatic alcohols, Aromatic aldehydes, Aromatic Ketones, Aromatic carboxylic acids and their derivatives, Phenolic aldehydes and ketones, Phenolic acids, Nitro phenols, Benzoquinones and aromatic sulphonic acids.
- (vii) General methods of preparation properties, reactions with mechanism of the following bi-functional compounds: Diols, Hydroxy ketones, Hydroxy aldehydes, Dicarbonyl compounds (alpha, beta and gamma) keto acids, unsaturated aldehydes. Unsaturated ketones, Unsaturated acids, Lactones.

SECTION B: Polynuclear hydrocarbons: Synthesis, reactions and structures of Naphthalene and Anthracene; Synthesis (only) of Phenanthrene.

SECTION C: Heterocyclic Compounds: General methods of synthesis, properties and important reactions of the following compounds. Pyrrole, Furan, Thiophene, Pyridine, Quinoline and Indole and derivatives of Pyrrole and Pyridine.

SECTION D: Dyes: Classification, Elementary idea of colour and constitution; Preparation and uses of Phenolphthalein, Methyl orange, Congo red, Malachite green, Alizarin and Indigo.

SECTION E: Problems incorporating reactions including in the syllabus.

Unit - 10: Advanced Level Chemistry & Application Oriented Chemistry

SECTION A: Bioinorganic Chemistry
Essential and trace elements of life, role of metal ions (Na^+ , K^+ , Mg^{2+} , Ca^{2+} , $\text{Fe}^{3+/2+}$, $\text{Cu}^{2+/1+}$, Zn^{2+}) in biology. Basic reactions in the biological systems. Transport of ion

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across biological membrane, Na^+ ion pump. Transport and storage of metabolic energy, ATP-ADP interconversion. O_2 - uptake proteins: hemoglobin and myoglobin; electron transport proteins: cytochromes and ferredoxins; redox metalloenzymes: catalase, peroxidase, super oxide dismutase, ascorbate oxidase. Bioinorganic chemistry of nitrogen fixation, respiratory electron transport chain, photosynthesis. Toxic effects of metal ions, Chelation therapy, metal dependent diseases, metal complexes as drugs.

SECTION B:

Chemical Analysis: Principles & Applications:

Gravimetric and titrimetric (acid-base, redox, complexometric EDTA) estimations of common cations and anions (single & in mixtures). Chemical separation techniques: chromatography, ion exchange, solvent extraction: Instrumental methods of analysis: conductometry, potentiometry, polarography, amperometry, UV-VIS spectrophotometry, flame photometry, AAS and AES spectrometry, neutron activation analysis. IR, NMR and ESR spectroscopy applications to simple inorganic and organic systems. Analysis of complex materials; ores, alloys, drugs, pharmaceuticals, air and water samples. Error analysis.

SECTION C:

Chemistry on Materials:

Production and uses of stainless steels and alloy steels, glass and ceramic materials, Portland cement (composition and setting). Chemical and biofertilizers, natural and synthetic rubbers, synthetic fibres, biopolymers and biodegradable polymers; common drugs and pharmaceuticals, common pesticides (applications and residual toxicity). Solid, liquid and gaseous fuels, coal based chemicals and petrochemicals (C_1 to C_3 compounds); oils, soaps and detergents, hydrogenation of oils, production of vanaspathi and margarine. Constituents and formulations of paints and varnishes, common cosmetics and perfumes, food additives and preservatives.

SECTION D:

Environmental chemistry

Environmental segments: atmosphere, hydrosphere, lithosphere and biosphere. Environmental cycles: hydrologic cycle, oxygen-, nitrogen-carbon, phosphorus- and sulfur cycles, composition and structure of the atmosphere. Chemical and photochemical reactions in the atmosphere, ozone layer and its importance. Major air pollutants and their sources, green house effect, acid rain, photochemical smog; air pollution control measures, Environmental role of water, major water pollutants, water quality parameters, water treatment: (domestic, industrial and waste water).

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SYLLABUS FOR COMPUTER BASED TEST **ASSISTANT TEACHER - EDUCATION**

I. Philosophical Foundations of Education

- (A) Concept and Aims of Education, Methods of Teaching and Role of Teachers in the light of Idealism, Nauralism, Pragmatism and Marxism.
- (B) Philosophical and Psychological bases of Curriculum. Principles of Curriculum Construction. Evaluation of Madhyamik and H. S. Curriculum of W.B. in the light of the principles. Co-curricular activities. Freedom and discipline.

II. Psychological Foundations of Education

- (A) Growth and development of the child Stages and areas of development. Physical, Cognitive, Social and development upto the stage of adolescence. Intelligence-Concept and Two factor theory.
Personality-Concept and Trait theory.
- (B) Theories of Learning: Connectionism (Throndike, Pavlov, Skinner) and cognitive (Gestalt). Factors affecting Learning: Maturation Interest, and Motivation.
Memory and Attention.

III. Sociological Foundations of Education

- (A) Social Groups: Primary and Secondary
Social Processes: Associative and Dissociative.
Education, Society and Social Change.
Education and Socialization.
- (B) Current sociological Problems of Education in India: Illiteracy and Universalisation of Primary Education Equality of Educational Opportunity - Education of SC, ST and OBC.

IV. Historical Foundation of Education

- (A) Salient features of Brahmonic and Buddhist Education in Ancient Indian. Islamic Education in Mediaeval India.
- (B) Landmarks in the History of India Education during pre-independence era; Serampore Missionary activities in education Macaulay's contribution to Indian education Wood's Despatch, Hunter Commission. Sadler Commission. Wardha Scheme, Sargent Report.



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V. Modern Development in Indian Education

- (A) Landmarks in the History of Indian Education during post-independents era with special reference to structure, curriculum, medium of instruction at the Primary and Secondary stages: Report of the Mudaliar Commission Radhakrishnan Commission, Kothari Commission, Ramamurti Committee and Mitra Commission. Salient features of Education Policy statement, 1968. National Policy on Education, 1986, Contemporary issues in education.
- (B) Present structure, administration and progress of Primary and Secondary education in India, particularly in West Bengal

VI. Contribution of Great Educators

- (A) Indian - Vidyasagar, Vivekananda, Rabindranath, Mahatma Gandhi.
- (B) Western - Rousseau, Pestalozzi, Dewey and Froebel with special emphasis on Aim of Education, Methodology, Discipline, Role of Teacher and their works.

VII. Guidance in Education and Impact of Mass Media on Education

- (A) **Guidance and Counselling in Education**
Concept, Types and Tools of guidance and counselling. Techniques and importance of guidance and counselling.
- (B) **Impact of Mass Media on Education**
Print media, Cinema, Radio, Electronic media including Television.

VIII. Mental Hygiene

- (A) Concept and Criteria of Mental Health. Scope of Mental Hygiene. Maladjustment: Concept and types, Causes, prevention and remedies of maladjustment. Adjustment Mechanism.
- (B) Mental disorder - classification and brief description
Therapeutic measures: Psychoanalytic, Behaviouristic and Play Therapies.

IX. Measurement and Evaluation in Education

- (A) Concept of Measurement and Evaluation. Need and Scope of Evaluation in Education, Tools and Techniques of Evaluation. Construction and standardization of Achievement Tests. Defects of present system of Examination and Suggestions for its improvement.
- (B) Different types of tests.
Tests for the measurement of Intelligence, Interest and Personality



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X. Educational Statistics:

- (A) Need for Statistics in Education. Frequency Distribution, Graphical Representation of Data, Measures of Central Tendency, Measures of Variability.
- (B) Normal Probability curve its properties and uses. Skewness and Kurtosis. Percentile and Percentile Rank. Derived Scores - Standard Score, T-Score, Coefficient of Correlation by Rank difference and product moment method.

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SYLLABUS FOR COMPUTER BASED TEST ASSISTANT TEACHER – ENGLISH

Poetry

Sidney	:	Loving in Truth
Spenser	:	One day I wrote her name
Shakespeare	:	Shall I compare thee....
John Donne	:	The Good Marrow
George Herbert	:	Virtue
Alexander Pope	:	The Rape of the Lock (Cantos I & II)
Blake	:	The Tyger; The Lamb
William Wordsworth	:	Tintern Abbey
Samuel Taylor Coleridge	:	Christabel; Kubla Khan
P. B. Shelley	:	Ode to the West Wind; to a Skylark
John Keats	:	Ode to a Nightingale; To Autumn
Alfred Tennyson	:	Ulysses
Robert Browning	:	My last Duchess.
W.B. Yeats	:	The Wild Swans at Coole
Wilfred Owen	:	Strange Meeting
T.S. Eliot	:	Hollow Men

Drama

Shakespeare	:	Macbeth
Goldsmith	:	She Stoops to Conquer
George Bernard Shaw	:	Arms and the Man
J. M. Synge	:	Riders To the sea

Novel

Jane Austen	:	Pride and Prejudice
Charles Dickens	:	David Copperfield

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Short Story and Essay

A. Short Story

Joseph Conard	:	The Lagoon
James Joyce	:	Araby
Somerset Maugham	:	The Lotos Eater
Katherine Mansfield	:	The Fly

B. Essay

Charles Lamb	:	Dream Children: A Reverie; The Superannuated Man
G.B. Shaw	:	Freedom
Francis Bacon	:	of Studies

Grammar and Usage

Common Errors

Subject Verb Agreement; Tenses; Active and Passive Voice, Articles, Prepositions,

Adverbs, Adjective

Sentence Forms

Simple Compound, Complex, Relative Clauses

Joining and Splitting of Sentences

Narration

Direct and Indirect

Writing of Official Letters and Official Notice

Literary Devices:

Rhetoric and Prosody

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SYLLABUS FOR COMPUTER BASED TEST

ASSISTANT TEACHER - GEOGRAPHY

A. Geo-Tectonics:

Earth's Crust (Composition and Layering); Rocks (Origin, Types and Characteristics); Folds and Faults (Types and Landforms); Mountain Building and Plate Tectonics, Continental Drift. Isostasy, Earthquakes (Causes and Effects) and Volcanoes.

B. Geomorphology:

Lithology and Landform; Weathering; Mass Wasting; Evolution of Slope; Hydrological Cycle; Run-off, Landform and Process (Fluvial, Glacial, Wind, Karst and Marine); Cyclic and Non-Cyclic concepts; Landscape Evolution, Geomorphic hazards.

C. Geographical Thoughts:

Approaches to Geographical Studies (Deterministic, Possibilistic, Quantitative Revolution, Welfare, Societal, Behavioral, Radical Schools, Functional, Structural, Materialistic, Ecological, Regional and Systematic); Concept of Space (Points, Distances, Interactions, Organization, Regions), Emergence of welfare geography.

D. Climatology:

Composition of the Atmosphere; Global Warming and possible consequences; Green House Effect, Elements and Factors of Climate; Insolation, Heat Belts; Pressure Belts; Planetary Wind System; Jet Stream; Humidity and precipitation; Cyclones and Anticyclones; Air mass; Monsoon; Thunderstorms; Climatic hazards, Climatic Classification Koppen's and Thornthwait's schemes.

E. Biogeography:

Soils (Factors and Processes of Formation, Soil Profiles, Physical and Chemical Properties); World Soil Groups (Zonal, Azonal and Intra-Zonal); Soil Erosion and Conservation; Plants (Factors of Plant Growth, Major Types of Natural Vegetation and Environmental Relations); Forest Conservation, Social forestry, Biodiversity, Animal Communities.

F. Environmental Geography:

Ecosystem (Principles and Components, Energy Flow, Food Chain, Food Web and Bio-geochemical Cycles); Biomes (Concepts, Types and Ecological Adaptation); Environmental Degradation and Hazards, Management and Conservation; Meaning of Natural Environment; Man-Environment Relationship; Natural Regions and Environmental Adaptation of Human Life; Economy and Society.



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G. Economic Geography:

Resources (Concept and Theories, Creating Factors and Processes, Classification, Utilization-processes, technology and environment quality); Economic Resources (Classification and Significance); Forms of Economy; Activity Components of Resource Utilization (Lumbering, Dairy Farming, Fishing, Mining, Power Generation; Agriculture and Industry), Models of Economic System; Theories of Location of Economic Activity, Ranking of World Economics, WTO and International trade, Economic disparity and social inequality; Sustainable development and impact of globalization.

H. Human Geography:

Population (Growth, Distribution, Age-Sex Composition, Occupational Resource; Characteristics of World's Human Resource; Theories of population growth, population growth, food security, unemployment, work participation, gender issues, social well being.

I. Regional Geography of India:

Relief; Drainage; Climate; Soil; Forest Resources; Mineral Resources, Power Resources; Irrigation; Agriculture, Industry; Population: Trade and Commerce, Transport, Basis of Regional Divisions of India (Physical and Economic), Concept, nature, type, scale and dimensions.

J. Cartographic Techniques:

Scale; Techniques of Data Representation; Map-Classification and Interpretation, Thematic Mapping, Principles and Methods of Projection, Elementary Surveying and Levelling (Principles and Methods with Chain, Compass, Dumpy Level and Theodolite); Common Statistical Techniques for Geographical Data Analysis, Aerial Photo and Satellite Imagery interpretation; Remote Sensing and GIS.

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SYLLABUS FOR COMPUTER BASED TEST

ASSISTANT TEACHER - HISTORY

- I. Feature of the Indus Valley Civilization -decline of the Indus Civilization - the Vedic Civilization Sodas'a Mahajanapadas - Buddhism and Jainism The rise and fall of the Maura Empire: Asoka's Dhamma - Imperial Guptas - Palas and Senas of Bengal.
- II. The establishment of the Delhi Sultanate The Slave dynasty the Khilji and Tughluq Rulers - The Khilji Revolution - The administrative structure under the Sultanate including provincial government The problem of theocracy Vijayanagar Empire.
- III. Disintegration of the Sultanate Babar - the importance of his invasion of India - Mughal - Afghan contest and Sher Shah Suri - Consolidation of the Mughal empire under Akbar - Territorial expansion under Akbar - Manasabdari System - Religious policy.
- IV. An overview of the reigns of Jahangir and Shahjahan - Aurangzeb's expansionist policies conflict with the Marathas - Shivaji The character of the Maratha Swarajya Aurangzeb and the disintegration of the Mughal empire The growth of regional powers, Bengal, Awadh, Hyderabad and the crisis of the empire in the early eighteenth century.
- V. Causes of the conflict between Siraj-ud-daula and the East India Company Kasim, private trade and the English East India Company - Brief Overview of British expansion the Colonial Economy: Land revenue settlements - Drain of Wealth Deindustrialization - Limited development of modern industries.
- VI. Early resistance to British rule - Paik, Chur & Poligar rebellions - Wahabi and Farazi Santal Rebellion The revolt of 1857; context and nature, Western Education and Social reform - Rammohan Ray, Young Bengal & Vidyasagar - Brahmo Samaj and prarthana Samaj - Aligarh Movement: Early stages of Indian nationalism pre-Congress associations - foundation of the Congress - the nature of the early Congress.
- VII. The rise of Extremism in Indian Policies Anti-partition and Swadeshi movement - separate electorate and the British divide and rule policy: Gandhi and Indian Nationalism Non-Co-operation, Civil Disobedience, Quit India Movement: Muslim League and the demand for Pakistan - Partition and Independence.
- VIII. The French Revolution of 1789 - Social context of the Revolution of Popular movement the Reign of Terror: Robespierre the rise of Napoleon Bonaparte Napoleon's internal reconstruction Napoleonic and Europe: Expansion and collapse of the Napoleonic empire.
- IX. The Vienna Congress (1815) - The Metternich System the Revolutions of 1830 1848 the new political ideologies: Nationalism, Liberalism and Socialism - the unification of Germany and Italy - Industrialization in England and Europe.
- X. European imperialism: Economic forces behind European Imperialism of the late 19th Century colonialism and the Scramble for Africa -Germany's Welt Politik - Triple Alliance and Triple Entente - the origins of the First World War Peace settlement of 1919 The Russian Revolution - Weimar Republic and the rise of Nazism in Germany - Fascism in Italy - Origins of the Second World War.

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SYLLABUS FOR COMPUTER BASED TEST **ASSISTANT TEACHER – MATHEMATICS**

1. CLASSICAL ALGEBRA:

1. Integers: Statement of well ordering Principle, first and second principles of mathematical induction. Proofs of some simple mathematical results by induction. Divisibility of integers. The division algorithm. The greatest common divisor of two integers a and b - its existence and uniqueness. Relatively prime integers. Prime integers. Euclid's first theorem; if some prime p divides ab , then p divides a or b . Euclid's second theorem: there are infinitely many prime integers. Unique factorization theorem.
2. Complex numbers: Definition on the basis of ordered pairs. Algebra of complex numbers, Modulus, Amplitudes, Argand Diagram, De-Moivre's theorem and its applications, Exponential, Sine, Cosine and Logarithm of a complex number.

Definition of a^z ($a \neq 0$), Inverse Circular and Hyperbolic functions.

3. Polynomials with real coefficients: Fundamental theorem of classical algebra (statement only). The n th degree Polynomial equation has exactly n roots. Nature of roots of an equation (Surd and imaginary) roots occur in pairs). Statement of Descartes rule of signs and its applications. Multiple roots. Relation between roots and coefficients. Symmetric functions of roots. Transformation of equations. Reciprocal equations. Cardan's method of solving a cubic equation. method of solving a bi-quadratic equation.
4. Inequalities: $A.M. \geq G.M. \geq H.M.$ and Cauchy's inequality their simple and direct applications.

2. MODERN ALGEBRA:

1. Basic Concepts: Sets, subsets, equality of sets, operations on sets Union, Intersection, Complements and Symmetric difference. Properties including De-Morgan's laws. Cartesian products, Binary relation from a set to a set (domain, range, Examples from $R \times R$). Equivalence relation. Fundamental theorem on Equivalence relation. Partition, Relation of partial order. Congruence relation modulo n is an equivalence relation. Congruence classes. Mapping Injection, Surjection and Bijection. Inverse and Identity mapping. Composition of mappings and its associativity.
2. Introduction of Group Theory: Groupoid, Semi-group, Monoid, Group definition with both sided identity and inverses. Examples of finite and infinite groups taken from various branches. Additive (multiplicative) group of integers modulo an integer (resp. a prime). Klein's 4 group Integral powers of an element and laws of indices in a group. Order a group and order of an element of a group. Subgroups. Nec. And Suff. Condition for a subset of a group to be subgroup. Intersection and Union of two subgroups. Cosets and Lagrange's theorem. Cyclic groups - definition, examples and subgroups of cyclic groups. Generators Permutations. Cycle. Transposition. Even odd permutations. Symmetric group. Definition and order of Alternating subgroup. Normal subgroups of a group Definition, examples and characterizations.

Quotient group of a group by a normal subgroup. Homomorphism and Isomorphism of groups. Kernel of homomorphism. Fundamental theorem of homomorphism. An infinite cyclic group is isomorphic to $(\mathbb{Z}, +)$ and a finite cyclic group of order n is isomorphic to the group or residue classes modulo n .

3. Introduction to rings and fields: Ring-definition and example. Ring of integers modulo n . Properties directly following from the definition. Integral domain and Field-Definitions and examples. Sub-ring sub-field & characteristic of a ring.



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3. MATRIX THEORY AND LINEAR ALGEBRA:

1. Matrices of Real and Complex Numbers: Definition, examples, equality, addition, multiplication of matrices, Transpose of a matrix, Symmetric and Skew-symmetric matrices.
2. Determinants: Definition of a determinant of a square matrix, Basic properties, Minors and Cofactors, equations by Cramer's rule. Problems of determinants up to order 3.
3. Rank of a Matrix: Adjoint of a square matrix. For a square matrix A of order n, $A \cdot \text{Adj. } A = \text{Adj. } A \cdot A = \det A \cdot A$. Singular, non-singular and invertible matrices. Elementary operations. Rank of matrix and its determination. Normal forms: Elementary matrices; The normal form equivalence of matrices. Congruence of Matrices. Diagonalisation of matrices. Real quadratic form involving three variable. Reduction to Normal form.
4. Vector/ Linear Space Over a Field: Definition and example of vector space. Subspace. Union, Intersection and sum of vector spaces. Linear span. Generators and basis of a vector spaces. Formation of basis from linearly independent subset. Special emphasis of \mathbb{R} .
5. Row-space and column-space of a matrix: Definitions of row-space and column-space of a matrix. Row rank, column rank and Rank of a matrix.
6. System of Linear Equations: Solution space of a homogeneous system as a subspace. Condition for the existence of non-trivial solution of a system of linear homogeneous equations. Necessary and sufficient conditions for the consistency of a system of non-homogeneous equations. Solution of system of equations by matrix method.
7. Linear Transformation on Vector Spaces: Definition of linear transformation. Null space, Range space, Rank and Nullity of linear transformation. Sylvester's law of Nullity. (Inverse of linear transformation relative to ordered bases of finite dimensional vector spaces.)
8. Inner product space: Definition and examples. Norm. Euclidean Vector space - Triangle inequality and Cauchy - Schwarz inequality in Euclidean vector space. Orthogonality of vectors. Orthonormal basis. Gram-Schmidt process of Orthonormalization.
9. Eigen value and Eigen vector, Characteristics equation of a square matrix. Caley-Hamilton's Theorem. Simple properties of Eigen values and Eigen vectors.

II. REAL ANALYSIS

1. Real-Number: Geometric representation and Cantor, Dedekind Axiom. Salient properties taken as axioms Bounded set. Least upper bound axioms. Archimedean property. Decimal representation of real numbers.
2. Points Sets in \mathbb{R}^1 and \mathbb{R}^2 : Elementary properties and union of atmost denumerable sets. Denumerability of rational numbers and non-denumerability of real numbers and of an interval. Neighbourhood of a point, interior point, of linear point set, open and closed sets, limit point of a set in \mathbb{R}^1 and \mathbb{R}^2 concepts and simple properties. Union, intersection and complement of open and closed sets and Bolzano-Weiestrass theorem in \mathbb{R}^1 . Covering by open intervals of linear point set, Lindel of covering theorem and Heine Borel theorem (statements only) and compact sets in \mathbb{R}^1 .
3. Real-valued functions defined on intervals: Bounded and monotonic functions. Limits, Algebra of limits. Sandwich rule, condition for the existence of a finite limit. Important limits like:

$$\frac{\sin x}{x}, \frac{\log(1+x)}{x}, \frac{e^x - 1}{x} \quad \text{as } x \rightarrow 0 \text{ etc}$$



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4. Sequence of Points in One Dimension: Bounds, limits, convergence and divergence. Operation on limits. Sandwich rule. Monotone sequence. Nested interval theorem. Cauchy's General Principle of convergence. Cauchy sequence, Limits of important sequence. Definition of e . Cauchy's first and second limit theorem. Subsequence.
5. Infinite Series of Constant Terms: Convergence and divergence. Cauchy's criterion. Abel-Pringsheim's Test. Tests (Comparison test, Root Test) convergence of series of non-negative terms.
Series of arbitrary terms. Absolutely convergent and conditionally convergent series. Alternative series. Leibnitz test. Root and Ratio Tests. Non-absolute convergence --- Abel's and Dirichlet's tests (statement and applications).
6. Continuity of a function at a point and on an interval: Continuity of some standard functions, continuity of composite functions. Piecewise continuous functions. Uniform continuity. Discontinuities of different kinds. Properties of continuous functions on a closed interval. Existence of inverse functions of a strictly monotone function and its continuity.
7. Concept of Differentiability and differential: Chain rule. Sign of derivative. Successive derivatives. Leibnitz theorem. Theorems on Derivatives: Darbox theorem, Rolle's theorem. Mean value theorems of Lagrange and Cauchy. Taylor's theorem.
Maclaurin's series. Expansion of e^x , a^x , $a > 0$, $\log(1+x)$ $(1+x)^m$, $\sin x$, $\cos x$ etc. with their respective ranges of validity.
8. Indeterminate forms: L Hospital's rule and its consequences.
9. Maxima and Minima: Points of local extremum of a functions in an interval. Sufficient condition for the existence of a local maximum/minimum of a function at a point. Applications in Geometrical and Physical problems.
10. Tangents and Normal: Pedal equation, Pedal of a curve, Rectilinear Asymptotes (Cartesian and parametric form). Curvature- radius and center of curvature. Chord of curvature. Curve-Tracing (familiarity with well-known curves).
11. Indefinite and Suitable Corresponding Definite integrals for the functions,
 $\sin^m x, \cos^n x, \sin^n x, \frac{\sin^m x}{\cos^n x}, \tan^n x, \sec^n x$
 $\cos^m x, \sin^n x$ etc. $\frac{l \cos x + m \sin x}{p \cos x + q \sin x}$
 $\frac{1}{(a+\cos x)^n}$ $\frac{1}{(n^2+a^2)^n}$, where l, m, p, q, n are positive integers
12. Area enclosed by a curve, length of a curve.
13. Sequence of functions: Pointwise and uniform convergence. Cauchy's criterion of uniform convergence. Limit function: Boundness, Repeated limits, continuity and differentiability.



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14. Series of functions: Pointwise and uniform convergence. Tests of convergence statements of Abel's and Dirichlet's tests and their applications.

Passage to the limit term-by-term; boundedness, continuity, integrability and differentiability of a series of functions in case of uniform convergence.

15. Power Series: Radius of convergence of its existence, Cauchy Hadamard theorem. Uniform and absolute convergence. Properties of sum function. Abel's limit theorems. Uniqueness of P. S. having the same sum function, Exponential. Logarithm and trigonometric functions defined by power series and deduction of their salient properties.

16. Riemann integration: Upper sum and lower sum. Upper and lower integral. Refinement of partitions and associated results. Darboux theorem. Necessary and sufficient condition of integrability. Integrability of sum, product, quotient and modulus. Integral on the limit of a sum. Integrability monotone function, continuous function and piece wise continuous function. Primitive, properties of definite integral, Fundamental theorem of integral calculus First and second mean-value theorem of integral calculus (statements and applications only).

17. Improper Integrals: Tests of convergence: comparison and r-test (statement only). Absolute and non-absolute convergence-corresponding test (statement only). Working knowledge of Beta and Gamma functions and their interrelations.

18. Functions of two variable: Limit, continuity, partial derivatives. Functions on R^2 differentiability, differential. Chain rule. Euler's theorem, commutativity of partial derivatives statement of Schwarz and Young theorems.

III. DIFFERENTIAL EQUATIONS

1. Significance of ordinary differential Equations: Geometrical and physical consideration. Formation of differential equation by elimination of arbitrary constants. Meaning of the solution of ordinary differential equation. Concepts of linear and non-linear differential equations.
2. First order linear equations: Integrating factor. Equations reducible to first order linear equations.
3. Equations of first order but not of first Degree: Clairaut's equation, singular solution.
4. Applications: Geometric applications, Orthogonal trajectories.
5. Higher order linear equations with constant coefficients: Complementary function. Particulars integral, Symbolic operator. D. Method of variation of parameters. Euler Equations - reduction to an equation of constant coefficients.

IV. ANALYTICAL GEOMETRY OF TWO AND THREE DIMENSIONS

A. TWO DIMENSIONS

1. Transformations of rectangular Axes: Translation, Rotation and their combinations. Theory of Invariants.
2. General Equations of Second Degree in two variables: Reduction to canon.



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3. Paris of straight lines: Condition that the general equation of second degree in two variables may represent two straight lines. Point of intersection of two intersection straight lines. Angle between two lines given by $ax^2 + 2hxy + by^2 = 0$ Angle bisectors. Equation of two lines joining the origin to the points in which a line meets a conic.
4. Circle, parabola, ellipse and phyperbola : Equations of pair of tangents from an external point, chord of contact, Poles and Polars. Conjugate point and conjugate line.
5. Polar Equations: Polar equations of straight lines, circles and conic referred to a focus as pole, Equations of tangent, normal and chord of contact.

B. THREE DIMENSIONS

1. Rectangular cartesion co-ordinate in space: half and octants concept of a geometric vector (directed line segment projection of a vector on co-ordinate axis. Inclination of a projection of a vector on co-ordinate axis. Inclination of a vector with an axis. Co-ordinates of a vector. Direction cosine of a vector. Distance between two points. Division of a directed segment in a given ratio.
2. Equation of plane: General form, intercept and Normal forms. The sides of a plane signed distance of a point from a plane. Equation of a plane passing through the intersection of two planes. Angle between intersection planes, Besectors of angels between two intersecting planes. Parallelism and perpendicularity of two planes.
3. Straight lines in space: Equation (symmetric and parametric form) Direction ratio and Direction cosines. Canonical equation of the line of intersection to two intersecting plane. Angle between two lines. Distance of a point from a line. Condition of coplanarity of two lines. Equations of skewlines. Shortest distance between two skew lines.
4. Sphere: General equation, circle, sphere-through the inter section of two-spheres. Radical Plane. Tangent, Normal.
5. General equation of znd degree in 3 variables. Reduction to canonical forms. Classification of quadrics.

V. VECTOR ALGEBRA & ANALYSIS

1. Vector Algebra: Vector (directed line segment) Equality of two free vectors. Addition. Multiplication by a scalar. Position Vector: Point of division. Conditions of collinearity of 3 points and co planarity of 4 points. Rectangular components of a vector in two and three dimensions, product of two or more vectors: scalar and vector products, Scalar triple products and vector triple products. Products of four vectors.

Direct applications of vector algebra in (i) Geometrical, trigonometrically problems, (ii) Work done by a force. Moment of a force about a point, vectorial equations of straight lines and planes. Volume of trahedron. Shortest distance between two skew lines.

2. Vectm Analysis: Vector differentiation with reference to a sector variable. Vector functions of one scalar variable. Derivative of a vector. Second derivative of a vector. Derivatives of sums and products. Velocity and Acceleration as derivative.



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VI. MECHANICS – I

1. Composition and Resolution of coplanar concurrent forces. Resolution of forces. Moments and Couples.
2. Reduction of a system of coplanar forces. Conditions of equilibrium of coplanar forces.
3. Fundamental ideas and principles of Dynamics. Laws of motion. Impulse and impulsive forces. Work, power and energy, principles of conservation of energy and momentum.
4. Motion in a straight line under variable acceleration. Motion under inverse square law. Composition of two S. H. M's of nearly equal frequencies. Motion of a particle tied to one end of an elastic string. Rectilinear motion in a resisting medium. Damped forced oscillation. Motion under gravity where the resistance varies as some integral (nth) power of velocity. Terminal velocity.
5. Impact of elastic bodies. Newton's experimental law of elastic impact. Loss of K. E. in a direct impact.
6. Expressions for velocity and acceleration of a particle moving on a plane in Cartesian and Polar co-ordinates. Motion of a particle moving in a plane in Cartesian and Polar co-ordinate.
7. Central forces and central orbits. Characteristics of central orbits.
8. Tangential and Normal accelerations. Circular motions.
9. Motion of a particle in a plane under different laws of resistance. Motion of a projectile in a resisting medium in which the resistance varies the velocity.
10. Laws of friction, cone of friction. To find the positions of equilibrium of a particle lying on a (i) rough plane curve, (ii) rough surface under the action of any given forces.
11. General formula for the determination of centre of gravity.

VII. LINEAR PROGRAMMING PROBLEM (L.P.P.)

1. Definition of L.P.P. Formation of L.P.P. from daily life involving inequations. Graphical solution of L.P.P.
2. Basic solution and Basic Feasible solution (BFS) with reference to L.P.P. Matrix formulation of L.P.P. Degenerate and non-degenerate B.F.S. Hyperplane, convex set, Cone, Extreme points. Convex hull and convex polyhedron. Supporting and separating hyperplane. Simple results on convex sets like the collection of all feasible solutions of an L.P.P. constitutes a convex set.

The extreme points of the convex set of feasible solutions correspond to its B.F.S. (no proof). The objective function has its optimal value at an extreme point of the convex polyhedron generated by the act of feasible solutions (no proof). Fundamental theorem (no proof). Reduction of a F.S. to a B.F.S.

3. Slack and Surplus variables. Standard form of L.P.P. theory of simplex method. Feasibility and optimality conditions.
4. The algorithm. Two phase method. Degeneracy in L.P.P. and its resolution.



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5. Duality Theory: The dual of the dual to the Primal.

Relation between the objective values of dual and the primal problems. Relation between their optimal values. Complementary slackness. Duality and simplex method and their applications.

6. Transportation and Assignment problems, and that optimal solution.

VIII. MECHANICS –II

1. Laws of friction, cone of friction. To find the positions of equilibrium of a particle lying on a (a) rough plane curve, (ii) rough surface under the action of any given forces.

2. General formula for the determination of centre of gravity.

3. Astatic equilibrium, Astatic Centre. Positions of equilibrium of a Particle lying on a smooth plane curve under action of given forces.

4. Virtual work: Principle of virtual work for a single particle. Deduction of the conditions of equilibrium of a particle under coplanar forces from the principle of virtual work. The principle of virtual work for a rigid body. Forces which do not appear in the equation of virtual work. Forces which appear in the equation of virtual work. The principle of virtual work for any system of coplanar force acting on a rigid body.

Converse of principle of virtual work.

5. Forces in 3-dim: Moment of a force about a line. Axis of couple. Resultant of any number of couples acting on a rigid body. Reduction of a system of forces acting on a rigid body. Poinso's Central axis. Wrench, Pitch, Intensity and screw. Invariant and equation of the central axis of a given system of forces.

6. Motions under inverse square law in a plane. Escape velocity. Planetary motions and Kepler's Laws. Artificial satellite Motion. Slightly disturbed orbit. Conservative field of force and principles of conservation of energy, Motion under rough curve (circle, parabola, ellipse, Cycloid) under gravity.

7. RIGID DYNAMICS:

Moments and products of inertia. Theorem of parallel and perpendicular axes. Principles axes of inertia, momental ellipsoid Equipomental system. D'Alembert's principle. Equation of Motion. Principles of moments. Principle of conservation of linear and angular momentum. Principles of energy.

Equation of Motion of a rigid body about a fixed axis.

Expression for KE. and moment of momentum of a rigid body moving about a fixed axis. Compound pendulum.

Equation of Motion of a rigid body moving in 2-dim. Expression for K.

E.and angular momentum about the origin of a rigid body moving in 2 dim. Motion of a solid revolution moving on a rough horizontal & inclined plane. Conditions for pure rolling.

Impulsive action.

Generalized coordinates, momentum Lagrangian, Cyclic coordinates, Ronthian.

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IX. A. MATHEMATICAL THEORY OF PROBABILITY

Random experiments. Simple and compound events. Event space. Classical and frequency definitions of probability and their drawbacks. Axioms of probability, Statistical regularity. Multiplication rule of probabilities. Bayes theorem. Independent events. Independent random experiments. Independent trials. Bernoulli trials and law. Multinomial law. Random variables, Probability distribution. Distribution function, discrete and continuous distributions. Binomial, Poisson, Uniform, normal distribution. Cauchy gamma distributions. Beta distribution of the first and of the second kind. Poisson process. Transformation of random variables. Two-dim, prob. Distribution. Discrete and continuous distributions in two dimensions. Uniform distributions, and two-dimensional normal distribution. Conditional distributions. Transformation of random variables in two dimensions. Mathematical expectation. Mean, variance, moment, central moments. Measures of location, dispersion, skewness and Kurtosis. Median, Mode, quartiles, Moment-generating function characteristics function. Two dimensional expectation. Covariance. Co-relation Co-efficient. Joint characteristic function. Multiplication rule for expectations, conditional expectations, Regression curves, least square regression lines and parabolas. Chi square and distributions and their important properties, inequality Convergence in probability. Bernoulli's limit theorem. Law of large numbers. Poisson's approximation to binomial distribution. Normal approximation to binomial distribution. Concept of asymptotically normal distributions. Statement of central limit theorem in the case of equal components and of limit theorem for characteristic functions and in applications. (Stress should be more on distributive function theory than on combinational problems. Different combinatorial problems should be avoided).

B. MATHEMATICAL STATISTICS:

Random samples. Distribution of the sample. Tables and graphical representations. Grouping of data. Sample characteristic and their computation. Sampling distribution of a statistic. Estimates of a population characteristic or parameter. Unbiased consistent estimates. Sample characteristics as estimates of the corresponding population characteristics. Sampling distributions of the sample mean and variance. Exact sampling distributions for the normal populations.

Bivariate samples. Scatter diagram. Sample correlation coefficient. Least square regression lines and parabolas. Estimation of parameters. Method of maximum likelihood. Applications to binomial. Normal populations. Confidence intervals. Such intervals for the parameters of the normal populations. Approximate confidence interval for the parameter of a binomial population. Statistical hypothesis. Simple and composite hypothesis. Best critical region of a test. Neyman Pearson theorem and its applications to normal populations. Likelihood ratio testing and its applications to normal population.



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X. NUMERICAL ANALYSIS

1. Computational Errors: Round-off errors, significant digits, errors in arithmetical operations, guard figures in calculations.
2. Interpolation: Polynomial Interpolation, remainder, Equally-spaced interpolating points-difference, difference table, propagation of errors; Newton's forward and backward, Stirling and Bessel interpolation formulae, divided differences, divided difference, formula, confluent divided differences, inverse interpolation.
3. Numerical Differentiation: Error in numerical differentiation. Newton's forward and backward and Lagrange's numerical differentiation formula.
4. Numerical Integration: Degree of precision, open & closed formulae, composite rules. Newton-Cotes (closed-type) formula - Trapezoidal, Simpson's one third and Weddle's rules, error formulae in terms of ordinates (proofs not necessary).
5. Numerical Solutions of Equations: Initial approximation by methods of tabulation and graph, methods of bisection, fixed point iteration with condition of convergence. Newton - Raphson & Regula-falsi methods, computable estimate of the error in each method.
6. Solution of ODE:
First Order First degree: By Euler, RK4 and Milne's method.

Note: The syllabus / topics mentioned are indicative in nature. Candidates are expected to possess significant knowledge / proficiency pertaining to the relevant subjects and their qualifying degree.



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SYLLABUS FOR COMPUTER BASED TEST ASSISTANT TEACHER - PHILOSOPHY

Group -A (INDIAN PHILOSOPHY)

1. GENERAL FEATURES OF INDIAN PHILOSOPHY
2. CARVAKA:
 - (a) Epistemology
 - (b) Metaphysics
 - (c) Ethics
3. JAINISM
 - (a) Anekantavada, (b) Syadvada, (c) Jaina theory of self and liberation
4. BUDDHISM
 - (a) Four noble truths, (b) Pratityasamutpada, (c) Nairatmyavada, (d) Ksanabhangavada, (e) Four schools of Buddhism.
5. NYAYA-VAISESIKA
 - (a) Nyaya epistemology
 - (b) Nyaya theory of God
 - (c) Nyaya theory of soul
 - (d) Vaisesika metaphysics:
 - (i) Categories of reality (Padartha)
 - (ii) Dravya - Definition of dravya and its different kinds.
 - (iii) Guna - Definition of guna and a short account of its different kinds.
 - (iv) Karma - Definition and a short account of its different kinds.
 - (v) Samanya - Definition of samanya. Samanya and jati, upadhi and jati. Arguments for accepting samanya as a padartha. Classification of samanya. Jatibadhakas.
 - (vi) Visesa - Definition of visesa.
Arguments for accepting visesa as a separate category
 - (vii) Samavaya - Definition of samavaya Distinction between samyoga and samavaya.
Distinction between samavaya and svarup-sambandha. Arguments for accepting samavaya as a category Arguments for accepting samavaya as one and eternal
 - (viii) Abhava - Justification for accepting abhava as a separate category of reality.
Refutation of the Prabhakara view that abhava is non-different from its locus.
Different kinds of abhava
6. SAMKHYA AND YOGA
 - (a) Samkhya theory of causation (satkaryavada); different forms of satkaryavada.
 - (b) Samkhya theory of Prakrti
 - (c) Samkhya conception of Guna
 - (d) Relation between Prakrti and Gunas
 - (e) Proofs for the existence of prakrti
 - (f) Samkhya theory of Purusa; proofs for the existence; of purusa Doctrine of plurality of selves.
 - (g) Theory of evolution (after Vacaspati's commentary)
 - (h) Samkhya theory of liberation - jivanmukti and videhamukti.
 - (i) Yoga conception of God.
 - (j) Cittabhumi and Cittavrtti

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- (k) Eight- fold means of Yoga.
- (l) Samadhi - its different types.

7. MIMAMSA (PRABHAKARA AND BHATTA)

- (a) Arthapatti and Anupalabdhi as sources of valid knowledge.
- (b) Pramanyavada in respect of origin of knowledge and knowledge of knowledge.

8. VEDANTA (SAMKARA AND RAMANUJA)

- (a) Nature of Brahman, according to Samkara.
- (b) Saguna Brahman and nirguna Brahman, according to Samkara.
- (c) Relation between Brahman and the world (Jagat) according to Samkara.
- (d) Samkara's doctrine of Maya
- (e) Ramanuja's criticism of Samkara's doctrine of Maya
- (f) The Advaita theory of liberation - Jivanmukti and videhamukti
- (g) Ramajuja's theory of Brahman
- (h) Relation between Jiva and Brahman, according to Ramanuja

Group -B (ETHICS)

- 1) The Nature of Ethics
- 2) Moral and Non-moral Action
- 3) The Nature of Moral Judgement
- 4) Object of Moral Judgement
- 5) Postulates of Morality
- 6) Theories of Punishment
- 7) Standard's of Morality

Hedonism:

- (a) Psychological and Ethical, (b) Egoistic Hedonism, (c) Gross Egoistic Hedonism, (d) Refined Egoistic Hedonism (e) Altruistic Hedonism - Bent ham's Theory, (f) Mill's Utilitarianism, (g) Act - Utilitarianism and Rule - Utilitarianism

9. Deontological Theories Act - Deon

tological Theories Rule - Deontological
Theories Kant's Theory

10. Practical Ethics

- (i) The concept of Practical Ethics, (ii) Euthanasia (iii) Killing Animals (iv) Environmental Ethics



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Group- C (HISTORY OF WESTERN PHILOSOPHY)

Plato:	(a) Theory of Knowledge (b) Theory of Forms
Aristotle:	(a) Doctrine of Causality (b) Theory of Substance (c) Matter and Form (d) Criticism of Plato's Theory of Forms
Descartes:	(a) Cartesian Method (b) Cartesian Method of Doubt (c) Cogito ergo sum (d) Criterion of Truth (e) Theory of Ideas (f) Proofs for the Existence of God (g) Doctrine of Substance (h) Mind-Body Relation (i) Proof of the External World
Spinoza:	(a) Doctrine of Substance (b) Relation between Substance and Attributes (c) Doctrine of Modes (d) Theory of Knowledge (e) Mind - Body Relation (f) Conception of Freedom; Intellectual Love of God.
Leibnitz:	Doctrine of Monads; Truths of Reason of Truths of Facts; The Principles of Non-Contradiction, Sufficient Reason and the Identity of Indiscernible; The Doctrine of Pre-established Harmony; Theory of Knowledge. Problem of Evil.
Locke:	Refutation of Innate Ideas and Principles; Theory of Ideas: Distinction between Primary and Secondary Qualities. Theory of Knowledge.
Berkeley:	Rejection of Materialism; Criticism of Abstract Ideas; Rejection of the Distinction between Primary and Secondary Qualities; Esse est Percipi; Role of God in Berkeley's Philosophy.
Hume:	Distinction between Impressions and Ideas; Relation of Ideas and Matters of Facts; Causality; Self, Scepticism.
Kant:	Apriori and Empirical Knowledge; Analytic and Synthetic Judgement; Synthetic Apriori Judgement-Kant's Problem; Copernican Revolution In Philosophy; Space and Time; Categories of the Understanding.



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Group-D (PSYCHOLOGY)

Methods of Psychology:	Introspection: Extrospection; Experimental Method.
Sensation:	Definition; Attributes of Sensation; Weber-Fechner Law
Perception:	Definition; Distinction between Sensation and Perception; Gestalt Theory of Perception.
Memory:	Factors of Memory: Marks of Good Memory: Laws of Association. Causes of Forgetfulness.
Attention:	Nature, Condition and Span of Attention: Division of Attention.
Learning:	Theories of Learning: Trial and Error Theory; Pavlov's Conditioned Response Theory: Gestalt Theory.
Instinct:	Biological Theory; Psychological Theory.
Consciousness:	Levels of Consciousness; Proofs for the Existence of the Unconscious; Freud's Theory of Dream.
Intelligence:	Definition; Measurement of Intelligence; I.Q. Binet - Simon Test of Intelligence; Terman Merrill and Wechsler Test of Intelligence. Theories of Intelligence: Unifactor; Two-Factor (Spearman's Theory); Multifactor Theory.

Group-E (LOGIC)

Basic Concepts: Social Group; Community; Association; Institution; Customs; Folkways and Mores.
Social Class and Caste: Principles of Class and Caste; Class Attitudes and Class Consciousness.
Social Change: The MaI"xist Theory of Social Change.

Political Philosophy: Nature and Scope; Scientific Theory and Philosophical theory. Political Ideals:
Democracy - Its different forms.

Socialism - Utopian and Scientific. Sarvodaya;
Gandhiji's Conception of Non-violence. Gandhiji's
Theory of Trusteeship.

Group-F (SOCIAL AND POLITICAL PHILOSOPHY)

- 1) Categorical Propositions and Classes: Quality, Quantity and Distribution of Terms; Translating Categorical Propositions into Standard form.
- 2) Immediate Inference: Conversion, Obversion, Contraposition: Square of Opposition; Determination of the truth-value of a proposition, given the truth-value of another proposition.
- 3) Categorical Syllogism: General Rules and Fallacies; Solving Problems and Proving Theorems concerning Syllogism.
- 4) Boolean Interpretation of Categorical Propositions, Venn Diagrammatic Representation of Categorical Propositions. Use of Venn Diagram to Test Arguments for validity; Review of the Traditional Laws of Logic concerning Immediate Inference and Syllogism: hypothetical and Disjunctive Syllogism: Dilemma.

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- (5) Truth Functions: Negation, Conjunction, Disjunction, Conditional, Biconditional. Testing Argument-forms and Arguments for validity by applying (a) Truth- table Method, (b) Method of Resolution, (c) Shorter Truth-table Technique- Reductio Ad Absurdum. Testing Statement/Statement-form for Validity of Truth-table Method and method of Resolution. Proving invalidity, to Construct Formal Proof of Validity.
- (6) Quantification: Translating Sentences into Quantificational Language: Quantification Rules - UI, EI, UG EG. To Construct Formal Proof of Validity of Arguments involving Monadic Quantification, To Prove invalidity of Arguments involving Monadic Quantification.
- (7) Analogy and Probable Inference: Induction by Simple Enumeration; Analogical Argument; Appraising Analogical Arguments.
- (8) Causal Connection and Mill's Methods of Experimental Enquiry. The Meaning of Cause; Doctrine of Plurality of Causes: Method of Agreement; Method of Difference; Joint Method of Agreement and Difference; Method of Concomitant Variation; Method of Residues. Criticisms of Mill's Methods; Vindication of Mill's Methods.
- (9) Hypothesis: Distinction between Scientific and Unscientific Explanation; Criteria for appraising Scientific Explanation.

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SYLLABUS FOR COMPUTER BASED TEST **ASSISTANT TEACHER - PHYSICAL EDUCATION**

1. Physical Education, Olympics, Recreation and Outdoor Education

Definition, meaning, aim, objectives, need, importance and scope of Physical Education, Modern concept of Physical Education, Play, Games and Sports, Body Types.

History of Physical Education in India, Contribution of important institutions and personalities, Sports awards of India, Sports organizations in India; Contribution of Akhara, Bratachari and Vyamshala, Olympic Games, Asian Games, Commonwealth Games.

Recreation in Physical Education and Modern Society, Outdoor education: Camp, Adventure Sports, Excursion, Picnic, Play Day; Folk Games culture of West Bengal.

2. Anatomy, Physiology and Exercise Physiology

Structure and functions of skeletal system including joint types and their movements, Structures and functions of muscular, circulatory and respiratory system.

Effect of exercise and training on muscular system, circulatory system and respiratory system. Tidal Volume, Residual Volume, Second wind, Minute ventilation, Vital capacity, Respiratory rate, Lung Volume; Athletic Heart, Stroke Volume, Cardiac output, Oxygen Debt, Blood Pressure, Pulse pressure, Heart rate. Blood: Composition, Group and Functions.

3. Psychology and Sociology of Physical Education and Sports.

Psychology and Sports Psychology, Learning, Motor learning, Transfer of training and learning, Personality, Attention, interest, instinct and emotion in Physical Education & Sports, Growth and development, Anxiety, Stress, Motivation, Aggression in Physical Education and Sports.

Sociology and Sports Sociology, Social values of Sports; Group dynamics; Leadership quality, Play theory; Social service and Social Agencies.

Meaning and concept of Gender studies; Sex differences; Gender inequalities in Sports; Women in Sports, Barrier of Women participation in Sports in our society.

4. Kinesiology and Biomechanics

Definition, Importance and Need; Different types of joint movements; Types of Muscle Contractions; Posture; Force, Lever, Laws of Motion, Friction, Projectile, Axes, Planes, Center of Gravity, Equilibrium; Analysis of Human Fundamental Movements.

5. Sports Training and Sports Medicine

Definitions, Aims, Objectives and Principles of Sports Training. Warm-up, Cooling down, Conditioning, De-conditioning; Different physical fitness components and its development; Training Load; Planning and Periodisation; Different Methods of Sports Training. Talent identification.

Meaning, definition and concept of sports medicine and rehabilitation; Aims, Objectives and principles of rehabilitation. Different rehabilitative exercises. Sports injury and its management. Postural deformities and corrective exercises; Massage. Doping.

6. Health Education, Fitness and Wellness

Definition, meaning and concept of Health, Health Education, Health Instruction and Health Supervision; Dimensions, Spectrum and determination of health; Health Service and personal hygiene; Communicable and non-communicable diseases; First Aid.

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Meaning and modern concept of fitness; Physical fitness (Skill-related and health- related); Definition, meaning and concept of Wellness; Component of Wellness, Dimensions of wellness; Factors affecting wellness; Modern lifestyle; Effect of Smoking, Alcohol & Drugs; Hypokinetic diseases and its management; Stress management.

Physical activity and health benefits; Concept of Aerobic and anaerobic exercises; Different types of exercises for fitness development; Weight management; Obesity, BMI, Body composition, Balance diet, Food and nutrition and Sports nutrition, Types of nutrients (Macro and Micro); Role of Carbohydrate, Protein, Fat and Minerals for Sports performance.

7. Educational Technology, Methods of Teaching and ICT

Definition, Factors of teaching; Types of Education; Various methods (Indoor & Outdoor) of teaching used in Physical Education; Presentation Technique; Teaching Aid; Learning Design (Different types of Lesson Plans); Classification of students.

Need and Importance of ICT in Physical Education and Sports; Components and use of Computer in Physical Education and Sports; Software and their uses in Physical Education and Sports; MS Word; MS Excel; MS Power Point; Computer Memory; Types and Functions of Computer Network; Computer Virus.

8. Test, Measurement and Evaluation

Definition of test, measurement and evaluation; Criteria of a good test, need and importance of test, measurement and evaluation.

Measurement of strength, endurance, agility, flexibility, speed, reaction time, balance, coordination, body composition, strength endurance and power.

Skill Test: - Soccer, Basketball, Volleyball, Hockey, Tennis and Badminton.

Harvard Step Test, Queen's College Test, Beep Test, Margaria-Kalamen Test, Barrow Motor Ability Test, Youth Fitness Test and Health Related Physical Fitness Test.

Anthropometric Measurement, Measurement- Skin fold and Waist Hip Ratio.

9. Management and Officiating in Physical Education and Sports

Definition, Importance, Purpose, Principles, Scope of Sports Management and Officiating. Importance and Functions of Office Management; Care of equipments; Public Relations in Sports; Sports Journalism and Mass Media; Budget, Purchase, Duties and responsibilities of Officials, Qualities of an Official; Tournaments, Intramural and Extramural Competitions; Layout of Play fields, Grounds and Courts. Rules, Regulations and Officiating of Games & Sports.

10. Yoga Education and Inclusive Education

Definition of Yoga; Classical approach to Yoga Practices; Chakras, Nadis, Astanga Yoga, Karma Yoga, Kriya Yoga, Hatha Yoga; Yoga Therapy; Pancha Kosa; Patanjali Yoga Sutra; Effect of Asana and Pranayama on Human Body. Bandha, Mudra and Kriya.

Concept of Special Education: Integrated Education, Inclusive Education and their Relationship to Physical Education; Factors Affecting Inclusion; Advantages of Inclusive Education for the individual and society.

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SYLLABUS FOR COMPUTER BASED TEST

ASSISTANT TEACHER - PHYSICS

MECHANICS AND GENERAL PROPERTIES OF MATTER

Scalars and Vectors, unit vector, addition and subtraction of vectors (analytical method), product of two vectors, vector analysis, Matrices. Mechanics of single particle and a system of particles, Lagrangian and Hamiltonian formulation. Angular momentum, Conservation of angular momentum. Moment of inertia, radius of gyration. Theorem of parallel and perpendicular axes. Centripetal force and centrifugal force.

Relation between G and g , variation of g , Gravitational potential intensity at a point due to spherical and other symmetrical bodies, Kepler's laws of planetary motion.

Elastic deformations, Torsion of wire, Torsional Oscillation. Bending of uniform beam, clamped at one end supported at both ends.

Surface tension and its molecular origin, surface energy. Excess pressure on a curved liquid surface, shape of liquid drops, surface tension and evaporation.

Coefficient of viscosity. Viscous flow through a capillary tube. formula. Stokes law, Reynold number.

HEAT

1. Kinetic theory of Gases --- Basic assumptions of the theory, perfect gas equation. Temperature; Degrees of freedom; classical law of distribution of energy; specific heat of gases, Ratio of specific heats at constant pressure and at constant volume. Absolute scale of temperature.
2. Deviation from perfect gas equation, vander Wall's equation of State. Critical constants.
3. Heat conduction in Solid, conductivity and diffusivity.
4. First Law of thermodynamics.
Second Law of thermodynamics, Reversible and irreversible processes. Condition of reversibility. Carnot's theorem. Kelvin temperature scale. Heat engines.
Entropy concept. Entropy of an ideal gas, Entropy of a mixture of gases. Entropy change in reversible and irreversible processes, principle of increase of entropy.
5. Throttling process, Joule Thomson effect, liquefaction of gases critical phenomena.

SOUND (OSCILLATION AND WAVES)

1. Simple harmonic Motion. Superposition of two harmonic oscillations with constant phase, frequency and amplitude difference beat phenomenon, coupled vibration.
2. Damped harmonic oscillator, Q -factor, Forced vibration. Resonance, sharpness of resonance. An harmonic oscillation.
3. Waves in continuous medium, Elastic waves in solids, liquids and gases, phase and group velocity. Energy transport by a traveling wave. Energy flux in a sound wave. Relative and absolute intensity. Decibel and phone; standing wave.
4. Transverse vibration of strings.
5. Doppler effect in sound, ultrasonic.



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OPTICS

1. Short wave-length limit and geometrical optics, Fermat's Principle and its application to reflection and refraction at plane surfaces, combination of lenses: equivalent lens. Thick lenses, Principal plane, Nodal points. Helmholtz-Lagrange law for magnification.
2. Aberrations - spherical aberration, causes and remedy. Qualitative ideas of astigmatism, distortion, chromatic aberration.
3. Ramsden and Huygens's eye pieces (Ray diagram), Angular magnification. Resolving power (no deduction).
4. Electromagnetic nature of light. Electromagnetic spectrum. Huygens's principle.
5. Interference of light, Coherent and incoherent sources. Interference by division of wave front and division of amplitude. Different types of interferometer (Principle only) Resolving power, Michelson and Fabry Perot interferometer.
6. Fresnel diffraction. Division of wave front into half period zones, zone plate. Plane diffraction grating. Resolving power, and dispersive power of a plane diffraction grating (Deduction not necessary).
7. Polarization: Biaxial and uniaxial crystals, ordinary and extra-ordinary rays. Half and quarter wave plates. Optical activity. Faraday effect, Kerr effect.

MAGNETISM, ELECTROSTATICS AND CURRENT ELECTRICITY

1. Magnetic potential and fields due to short magnet and magnetic shell.
2. Intensity of magnetization, moment of a magnet, magnetic saturation, permeability and susceptibility, Dia, Para and Ferro magnetism, Hysteresis.
3. Couple on a magnet in a uniform field, work done in deflecting a magnet, magnetic needle in two cross magnetic fields.
4. Electric potential and electric intensity. Potential and intensity at a point due to charge. Electrostatic induction, lines of forces, distribution of charge and potential on a surface. Equipotential surface, total normal induction, Gauss theorem and its applications. Coulomb's theorem and its applications. Mechanical force on a charged surface, energy per unit volume of a medium. Capacity of conductor and factors controlling it, energy of a charge; Multiple expansion.
5. Electric polarization and dipole, electric displacement, dielectric constant, Capacitance of common condenser (spherical, parallel plate and cylindrical).
6. Magnetic effect of electric current, Laplace's equation, Biot Savart law, Ampere's theorem. Magnetic field on the axis of a circular coil, solenoid, field due to a current in an infinitely long wire; effect of magnetic field on current carrying conductors; Moving coil Galvanometer, ammeter and voltmeter.
7. Kirchhoff's laws and its application, Seebeck, Peltier and Thomson effect, Thermo electric power, Thermo couple.
8. Self and Mutual inductances, Varying currents, Growth and decay of currents in L-R circuit. Charging and discharging of a condenser in C-R circuit. Time constant and log decrement.
9. R.M.S. and mean values of alternating current. Reactance and impedance, phase angle. Power in a.c. circuits. LR, CR and LCR circuits series and parallel resonant circuits; Q-factor.



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MODERN PHYSICS

1. X-rays, production and nature, Compton effect, Mosley's law, Rutherford model Bohr model of atoms. Pauli Principle, photo electric effect.
2. Planck hypothesis, deBroglie hypothesis, Schrodinger equation, eigenvalues and eigenstates, Orthonormalization, expectation value, commutation relation and measurement, particle in a box. Linear harmonic oscillator. Potential well and barrier problems.
3. Hydrogen atom, angular momentum, spherical harmonics, parity, atomic spectra, time independent perturbation method. Two electron atom, spin-orbit interaction, sodium D-lines, Zeeman and Stark effect.
4. Molecular spectra, vibration and rotation, Raman effect, selection rules, symmetry.
5. Crystal structure, direct and reciprocal lattice, lattice vibration, s=acoustic and optical modes, band theory, Kronig Penny model, Metal, semiconductor and insulator, Hall effect.
6. Statistical Mechanics, ensemble, canonical and grand canonical ensemble, Bose Einstein and Fermi Dirac statistics, Bose Einstein condensation.
7. Nuclear Physics, nuclear spin and nuclear magnetic moment, nuclear radium mass and binding energy, stability condition, Nuclear disintegration, short range interaction, Youkawa model, elementary particles, baryons and leptons.
8. Lasers, coherence properties, applications, He-Ne Laser, optical fiber.
9. Relativity, Lorentz transformation, four-vector, Energy-mass relations.

ELECTRONICS AND INSTRUMENTATION:

1. Diodes, p-n junction, zener diode, rectification.
2. Transistors: Bipolar junction transistor, hybrid parameters, CB, CC and CE configurations, amplifiers.
3. Boolean algebra, Logic gates, AND, OR, NOT, NAND AND NOR gates.
4. Vacuum techniques, production and measurement
5. Particle accelerators and detectors.

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SYLLABUS FOR COMPUTER BASED TEST
ASSISTANT TEACHER - SANSKRIT

1. GRAMMAR:

Case-ending: Stress on Principles and Application in Language, i.e. syntactic structure, Declension (Special stress on stems ending in at, an, as, Sarvanamans, numerals one to eight)

Conjugation (Special stress on the groups Bhavadi, Adadi, Rudhadi, and Hvadi. Further stress on the tenses and moods - lat, lot, lan, vidhilin, Irt, and lit)

Sandhi (specially Visargasandhi)

Krt Suffixes

Taddhita-suffixes (special stress on apatya matup etc iyasun and isthan)

San, Yan addition to roots.

Namadhatu-s

Rules and application of Atmanepada and Parasmaipada

Samasa (excluding samasantavidhana)

2. HISTORY OF LITERATURE:

Vedic - Samhitas, Upanisads, Vedangas (Total Structure of the Vedic Literature)

Ramayana and Mahabharata. General Knowledge about the Puranas and their content.

Dramatic Literature (up to 12th Century A.D.)

Narrative Literature

General Knowledge about the works of Manu and Kautilya

Imp. Question on Grammar and translation (from Bengali, English into Sanskrit) should be set in such a way that sense of language and grammatical application could be tested in a varied but integrated form.

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SYLLABUS FOR COMPUTER BASED TEST CHEMIST POSITIONS

Paper 1 (Organic and Analytical Chemistry)

Unit -I: Basic Concepts of organic chemistry & Stereochemistry

- a) **Electronic Displacements:** Inductive, electrometric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength. Electrophiles and Nucleophiles; Nucleophilicity and basicity, Types, shape, and relative stability of carbocations, carbanions, free radicals and carbenes. Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Different types of substitutions (SN^1 , $SN2$, SN , SN^1CB), Elimination and free radical reaction. Name reactions (Aldol and Benzoin condensation, Knoevenagel condensation, Perkin, Cannizzaro and Wittig reaction, Claisen condensation, Dieckmann and Reformatsky reactions)
- b) **Stereochemistry:** Fischer Projection, Newmann and Sawhorse Projection formulae; Geometrical isomerism: cis-trans and syn-anti isomerism E/Z notations with C.I.P rules.
- Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with one and two chiral-centres, Distereoisomers, meso-structures, Racemic mixture and resolution, inversion. Relative and absolute configuration: D/L and R/S designations.
- Types of cycloalkanes and their relative stability, Baeyer strain theory. Conformational analysis of alkanes (ethane and n-butane): Relative stability with energy diagrams. Energy diagrams of cyclohexane: Chair, Boat, and Twist boat forms.

Unit-II: Introduction to analytical chemistry and data processing

Role of analytical chemistry, classification of analytical methods, types of instrumental analysis Errors of analysis, classification, source and minimization of errors, absolute and relative errors, accuracy and precision, significant figures, mean value and deviation, average and standard deviation, median value, range, confidence intervals. Sampling in analysis. Definition, theory of sampling, technique of sampling, statistical criteria of good sampling. stratified sampling, transmission, and storage of samples.

Unit-III: Analysis of Soil and Water

Analysis of Soil: Sampling, Carbonate, Organic carbon, and organic matter, Total nitrogen, ammonia and nitrates, Total determination of major soil constituents by fusion analysis, silica and total combined oxides of iron, aluminium, and titanium, Determination Ca, Mg, Na, K, phosphate, boron, Co, Cu, Zn, Exchangeable cations, Cation exchange capacity, chemical analysis as a measure of soil fertility.

Analysis of Water: Sources of water, classification of water for different uses, types of water pollutants and their effects, Analytical methods for the determination of ions in water: CO_3 , HCO_3 , FC , SO_4 , PO_4 , NO_3 . Analytical methods for the determination of cations in water: Fe, Fe^{2+} , Ca, Mg^{2+} , Cr, As, Pb, Hg, Cu, Zn, Cd, Co. Determination of Dissolved oxygen (D.O), Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD), standards for drinking water.



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Unit IV: Analytical Methods

a) Solvent Extraction and Ion exchange: Principles, classification of extraction, mechanism of extraction, extraction equilibria, techniques of extraction, application in analytical chemistry. Ion exchange: Type of ion exchange resins, synthesis and characteristics of ion exchange resins, action of ion exchange resins, ion exchange equilibria, technique of ion exchange, application of ion exchange in analytical chemistry.

Fundamentals of Spectroscopy: Instrumentation, Theory and Applications of IR, NMR (Proton & Carbon 13), Mass & Raman Spectroscopy.

Chromatographic methods: Basic principles and applications of chromatographic techniques (Paper, TLC, ion exchange, HPLC, GLC).

Spectroscopic methods: atomic adsorption Spectroscopy- Principles and applications of AAS in chemical analysis. Flame photometric methods - Principles, interface in flame photometry, application in quantitative analysis. Nephelometric method- Principle and applications in analysis.

b) X-ray diffraction method: Weiss indices, Miller indices, Laue method, Bragg's law, and applications in determination of crystal structure.

Electron spin resonance: Principles, zero field splitting and Kramer's degeneracy. factors affecting the g value, hyperfine splitting, and applications to sample radicals. Thermal analytical methods: Thermogravimetric analysis (TGA). Derivative Thermogravimetric analysis (DTG). Applications of thermogravimetry. Differential Thermal Analysis (DTA)- Applications of differential thermal analysis in simultaneous TG-DTA curves, CD, CV, Polarography.

Unit-V: Analysis of Ore

General techniques of analysis applied to complex materials- Scope of metallurgical analysis - General methods of dissolution of complex materials -Various chemical methods for the effective separation of the constituents in the complex materials. Analysis of ores: Iron ore- Analysis of the Constituents - Moisture, loss of ignition, Total Iron, ferrous Iron, Ferric Iron, alumina, silica, Titania, Lime, Magnesia, Sulphur, phosphorus, manganese, alkalis, combined water, Carbon in blast furnace, flue dust and sinter. Manganese Ore Analysis of the Constituents-Total Manganese, MnO₂, SiO₂, BaO. Fe₂O₃.Al₂O₃, CaO, P and S Chromite Ore -Analysis of the Constituents - Chromium, SiO₂, FeO, Al₂O₃, CaO, & MgO. Aluminium Ore (Bauxite) Analysis of the Constituents Silica, Alumina, Fe₂O₃, Titania, MnO, P₂O₅, CaO, MgO, vanadium, zirconium, and alkalis.

Paper 2 (Physical and Inorganic Chemistry)

Unit-I (Energetics)

a) **Thermodynamics:** Laws of thermodynamics, thermodynamic functions, standard states for gases, liquids and solids, internal energy, enthalpy, entropy and free energy and calculations between them. Activity, fugacity and mean activity coefficients, Debye-Huckel Limiting Law, thermodynamics of Mixing and Mixtures of Volatile Liquids-ideal and Real Solutions and Activity-Excess Functions for non-ideal solutions. Non-equilibrium thermodynamics.

b) Photochemistry & Chemical Dynamics:

Le Chatelier's Principle, Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reactions, quenching.

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Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence. Empirical rate laws, Theories of reaction rate, Determination of reaction mechanism, Reaction in solutions, catalytic reaction kinetics, Techniques for fast kinetics viz, flow method, relaxation method, flash photolysis, NMR method.

Unit-II: Electrochemistry & Solid state Chemistry

a) Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. Application of EMF, determination of activity coefficients and transference numbers. Debye-Huckel-Onsager treatment and its extension, ion solvent interactions. Debye-Huckel-Bjerrum model. Solution of Strong electrolytes. Debye-Huckel theory for activity coefficient of electrolytic solutions; determination of activity and activity coefficients; ionic strength.

Thermodynamics of electrified interface equations. Derivation of electro-capillarity, Lippmann equations (surface excess), methods of determination. Structure of electrified interfaces, Helmholtz-Perrin, Guoy-Champman, Stern models.

Over potentials, exchange current density, derivation of Butler-Volmer equation, Tafel plot. Introduction to corrosion, homogenous theory, forms of corrosion, corrosion monitoring and prevention methods.

b) Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Defects in crystals. Electrical properties, Metals, insulators, semiconductors, super conductors, band theory of solids. Solid state reactions: Classification, brief account of the experimental methods of study of solid state reactions.

Phase Diagram: Phase behaviour of one and two component systems (solid-solid, solid-liquid, solid-vapour, liquid-liquid, liquid-vapour equilibrium). Ehrenfest classification of phase transitions.

Unit – III

a) Symmetry and Group Theory

Symmetry elements and Symmetry operation, Groups and Subgroups, Symmetry point group. Schonflies symbols, Matrix representations of groups. Character of a representation. The Great Orthogonality theorem (without proof) and its importance. Character tables and their uses. Derivation of character table for Cav, Cav

b) Electronic Spectra of Transition Metal Complexes.

Spectroscopic ground states, Orgel diagrams for d1-d states in O, and Ta symmetry, Tanabe-Sugano diagrams for d2 configuration in O. and Ta symmetry. Calculations of Dq, B and β parameters.

Unit – IV

a) Metal-Ligand Bonding

Crystal-Field Theories:

Limitation of Crystal Field Theory, Molecular orbital theory for Octahedral, Tetrahedral and Square Planar Complexes, σ and π bonding in Molecular Orbital Theory. Application of MOT to Correlation diagrams.

b) Chemistry of Transition & Inner Transition Elements

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Unit – V

Coordination chemistry of Transition Metal ions, Stabilization of Unusual oxidation states, Stereochemistry of coordination compounds, Splitting of d-orbitals in Low symmetry environment, Jahn-Teller effect, Interpretation of Electronic Spectra including Charge Transfer Spectra, Spectrochemical series, Nephelauxetic series, Fluxional molecules, Iso and Hetero Poly acids. Structures of Mixed Metal Oxides: Spinel & Inverse Spinel, Ilmenite and Perovskite structure, Coloured Minerals and Gem quality crystals. Chemistry of Lanthanides and Actinides: Oxidation state, Spectral and Magnetic Properties, Stereochemistry, Use of Lanthanide Compounds as Shift reagents, Actinide contraction, Oxidation states, Comparisons between Lanthanides and Actinides

a) Chemistry of Main Group Elements A & B

General characteristics, Allotropes, Structure and Reactions of simple and industrially important compounds: Boranes, Carboranes, Silicones, Silicates, Boron nitride, Borazines and Phosphazenes. Hydrides, Oxides and Oxoacids of pnictogens (N, P), chalcogens (S, Se & Te) and halogens, Xenon compounds, Pseudo halogens and Interhalogen compounds

b) Environmental pollution and remedies.

Important aspects and control of Air Pollution and Noise Pollution, Treatment of solid and hazardous waste based on characterization, sanitation methods for protection of community health, Steps for sustainable development of green environment, different de-carbonization routes, fog harvesting

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SYLLABUS FOR COMPUTER BASED TEST **DRAUGHTSMAN POSITIONS**

UNIT 1: BASIC ENGINEERING DRAWING

Engineering Drawing:

State the importance of engineering drawing, State the areas of civil engineering drawing.

List of drawing instruments, equipments and materials to be used during training:

State instruments, equipments and materials, List out instruments, equipments and materials, State the standard as per 962-1987, To use different drawing instruments, equipments and materials, Follow precautions in the use of instruments, equipments and materials.

Layout of drawing Sheet:

State the system of layout of drawing sheet, List the different layout for designated drawing sheet Explain the title block.

Folding of drawing Sheet:

State the purpose of folding a drawing sheet, Explain the method of folding for drawing sheet

UNIT 2: GEOMETRICAL CONSTRUCTION:

Plane Geometrical construction:

Define the terms of most commonly used geometrical shapes

Types of Lines and Angles:

Define points and lines, State the classification of lines, State the different types of angles, Explain the method of measuring angles.

Triangles and their types:

Define triangles, Name the different types of triangles and state their properties.

Quadrilaterals and their properties:

Define a quadrilateral, Name the quadrilaterals, State the properties of quadrilaterals

Polygon and their properties:

Define Polygon, Name the Polygon in terms of the number of sides, State the properties of polygon.

UNIT 3: CHAIN SURVEYING

Introduction - History and principles of chain survey and instrument & employed

Define surveying, Explain the classification of Surveying, Narrate different methods of measurements, Express the instruments used for chain surveying.

Introduction about chain survey instruments

State the construction and uses of the chain survey instruments

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Testing of metric chain (20m/30m)

State the necessity of checking the chain, State the methods of testing, List out then errors in the chain, State the limits of error in chain, Explain the adjust the chain, State Indian optical square

Measurement of distance by chain and chaining

State chaining and chaining a line, State unfolding the chain, Describe the reading the chain, State folding the chain, Calculate the errors in chaining

UNIT 4: COMPASS SURVEYING

Identification and parts of instruments in compass survey:

State about traversing, State types of compass, Name the prismatic compass and construction, Construction of survey's compass

Determining the bearing of a given triangular plot of ABC and calculation of included angles:

Calculate angles from bearing, calculate bearing from angles

Determining the bearing of a given pentagonal plot of ABCDE and calculation of included angles

Calculate angles from bearings for a closed traverse, calculate bearing from angles for a closed traverse, calculate bearing of a pentagon

Magnetic declination and local attraction

Define the dip of the Magnetic needles, State the magnetic declination and variations, Calculate true Bearing, State local attraction and its elimination, Explain about errors and limits, State the testing the prismatic compass

UNIT 5: PLANE TABLE SURVEYING

Instrument used in plane table surveying:

State plane tabling, Name the instruments and accessories used in plan tabling, State the construction and uses of instruments and accessories used in plan tabling, Explain about leveling, centering and orientation in plain tabling, Explain the methods of plain tabling

Resection method of plane table survey:

State the resection method of plane table survey

UNIT 6: LEVELLING

Types of levelling:

Name the various types of levelling, Explain simple levelling, Explain differential levelling, Complete the reduced levels of points.

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UNIT 7: ROAD ENGINEERING - I:

Introduction to road engineering:

Define road, Define highway engineering, Define necessity and characteristics of road

Technical term used in road engineering:

Define road and Total Station advantage, Define various terms used in road engineering, Describe the various advantages of road

Principle of road alignment:

Alignment of road, Express the principle of highway alignment, Explain the different survey required for alignment

Classification of roads:

Describe the different classification of roads

UNIT 8: ROAD ENGINEERING II:

Road Margins:

Define road margin, Describe the element Total Station of road margin

Camber, super elevation, sight distance and gradient:

Define camber, Explain super elevation, sight distance and express gradient

UNIT 9: TOTAL STATION

Introduction to total station:

Get introduced to the Total station, Learn the evaluation of Total station from the convectional equipmen Total Station, Explain the benefit Total Station and uses of Total station

Types of total station:

Explain the advantages and disadvantages of Total station, Explain the types of Total Station, Explain the precautions to be taken while using Total Station

Measurement with total station:

Explain the equipment required for Total Station surveying, Explain the procedure of measurement with Total Station

Characteristics and features of total station:

Define the features of Total Station, State the characteristics of Total Station, Advantages and disadvantages of Total Station



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Principle of EDM- Working need setting and measurement Total Station:

Define EDM, State the principle of EDM, Features of EDM

Setting and measurement Total Station:

Define distance measuring, State principal of EDM, State classification of EDM

Total station Prism- instrument error operation:

Explain Total Station prisms, Describe sources of error in EDM, EDM instrument operation, Uses of EDM

Electronic display and data recording:

Define electronic data recording, Explain field computers, Define recording module, Internal memories

Rectangular and Polar Co-ordinate system:

Illustrate rectangular and polar coordinates

UNIT 10: GLOBAL POSITIONING SYSTEM

Introduction of GPS:

Explain GPS coordinate system, Describe Geographic latitude and longitude, GPS equipment

Satellite and Conventional Geodetic system:

What is satellite system, Define Geodetic system

GPS coordinate system and component Total Station of GPS & System segment Total Station:

Explain GPS coordinate system, Describe Geographic Latitude and Longitude, Explain and describe component Total Station GPS receiver

GPS segment Total Station:

Define GPS segment

Principle of Operation of GPS and surveying with GPS:

State the Principle of Operation of GPS, Describe the role of transit in GPS

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FOR ALL POSTS- GENERAL STUDIES

QUANTITATIVE APTITUDE:

- Number System
- Simplification
- Averages
- Ratio and Proportion
- Work and Time
- Speed, Time and Distance
- Percentages
- Profit and Loss
- Partnership
- Ages
- Simple Interest
- Compound Interest
- Probability
- Area & Volume

REASONING:

- Series Completion
- Analogy
- Coding and Decoding
- Classifications
- Blood Relations
- Directions
- Syllogism
- Seating Arrangements
- Ranking and Sequences
- Data Interpretation
- Data Sufficiency
- Figure

GENERAL ENGLISH:

- Reading Comprehension
- Jumble Sentences
- Close Test
- Phrase Replacement

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- Active & Passive Voice
- Direct & Indirect Speech
- Synonyms
- Antonyms
- Comprehension Ability
- Sentence Completion
- Idioms & Phrases
- One word Substitution
- Sentence Improvement
- Spotting Error / Common Errors

GENERAL KNOWLEDGE:

- Geography of India
- History of India
- Indian Economy
- Environmental Science
- Indian Politics

CURRENT AFFAIRS:

- International Organization
- Awards & Honors
- Books & Authors
- Defense & Security
- Economic Affairs
- National News
- International News

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SYLLABUS FOR COMPUTER BASED TEST LANGUAGE GROUP – BENGALI/ NEPALI

1. BENGALI:

Multiple Choice questions are based on unseen passage/s to assess comprehension, interpretation and inference. Vocabulary and inference of meaning will also be assessed. The passage may be factual, descriptive or literary.

OR

2. NEPALI:

Multiple Choice questions are based on unseen passage/s to assess comprehension, interpretation and inference. Vocabulary and inference of meaning will also be assessed. The passage may be factual, descriptive or literary.

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SYLLABUS FOR COMPUTER BASED TEST **LIBRARIAN POSITIONS**

Unit I: Library, Information & Society

Library as a Social Institution, Library movement, Role of Libraries in formal and informal Education; Types of Libraries: National, Public, Academic & Special; Laws of Library Science; Information Society: Its evolution and implications; Freedom of access to information: Intellectual property rights, copyright, censorship; Extension & Community Information Services; Library Legislation in India; Professional Associations: Roles and Activities

Unit II: Library Management

Library Planning; Collection Management: Document Selection, Ordering, Processing & Weeding
Library Committee: Library Rules and Regulations; Human Resource Management; Office Management; Financial Management: Budget and Budgetary Control; Library Statistics and Annual Report; Library Standards; Library Maintenances: Shelving, Stock Verification & Conservation. Concept of E-Library

Unit III: Knowledge Organization and Information Processing: Library Classification Library Cataloguing

Classification: Its Nature, Purpose and Function; Knowledge Classification and Document Classification; Subjects and their formation: Universe of Subjects, Modes of formation of Subjects etc.; General Theory of Classification: Normative Principles and their Application, Standard Schemes of Library Classification; Trends in Library Classification; Library Cataloguing: Canons, and Principles- Types, Purpose and their Physical forms; Different Kinds of Entries and rules for Filling Entries; Principles of Subject Cataloguing: Assigning Subjects Headings using Library of Congress Subject- Headings & Sear's List of Subject Headings etc.; Cataloguing Standards: ISBD, ISBN, ISSN, Computerized Cataloguing- MARC, UNIMARC, CCF; Recent trends in Cataloguing.

Unit IV: Information Sources, Services and Systems

Reference and Information Sources: Documentary, non- documentary sources-Evaluation of reference sources; Users of Information: Types, Character tics, need and study of users; Organization of Information: Abstracting and Abstracts Indexing Languages; Information Centers: Different levels of Information Centers (International, National, Regional & Local); Information Systems: Structure and Services of Information Systems; Library as an Information System; Information Services: Need and Types of Reference, Documentation & Information Services.

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Unit V: Basics of Computers Application in Libraries

Components of Computer System; Generation and Types of Computers; Hardware and Software; Data Storage Media; Operating System and their Types; DOS and Windows; File Creation; Application Software; Computer Networking; Library and Information Networks.

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SYLLABUS FOR COMPUTER BASED TEST OFFICE EXECUTIVE POSITIONS

General Studies	<ul style="list-style-type: none">• Geography of India.• National News (Current).• Indian culture.• Scientific observation.• History of India.• International problems.• Economic problems in India.• Political science.• Famous places in India.• About India and its neighboring countries.• World Organization.• Economic problems in India
QUANTITATIVE APTITUDE:	<ul style="list-style-type: none">• Ratio and Proportions.• Percentage.• Profit and loss.• Discount. Simple interest.• Simplification.• Decimals.• Recurring Decimals.• Divisibility. Fractions LCM.• HCF.• Partnership.• Average.• Time and work, time and distance• Number System• Probability
Current Affairs	<ul style="list-style-type: none">• Scientific research.• Sports.• History.• Literature.• Polity.• Indian Constitution.• Culture.• Geography.• Daily observations and experiences



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English	<ul style="list-style-type: none">• Antonyms and their correct usage• Fundamentals of the English language.• Grammar.• Sentence structure.• Synonyms.• Vocabulary
REASONING:	<ul style="list-style-type: none">• Series Completion• Analogy• Coding and Decoding• Classifications• Blood Relations• Directions• Syllogism• Seating Arrangements• Ranking and Sequences• Data Interpretation• Data Sufficiency

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SYLLABUS FOR COMPUTER BASED TEST **O&M SUPERVISOR – TRADE- MECHANICAL POSITIONS**

Mechanics

1. Fundamentals of Engineering Mechanics
2. Equilibrium
3. Friction
4. Centroid & moment of Inertia
5. Simple Machines
6. Dynamics

Theory of Machines

1. Simple mechanism
2. Friction
3. Power Transmission
4. Governors and Flywheel
5. Balancing of Machine
6. Vibration of machine parts

Strength of Material

1. Simple stress & strain
2. Thin cylinder and spherical shell under internal pressure
3. Two dimensional stress systems
4. Bending moment & shear force
5. Theory of simple bending
6. Combined direct & Bending stresses
7. Torsion

Mechanical Measuring Instruments

1. Introduction to measurement
2. Linear measurement
3. Angular measurement
4. Limits fits and tolerances
5. Transducers
6. Strain measurement
7. Measurement of Pressure
8. Temperature measurement

Pneumatics & Hydraulics

1. Properties of Fluid
2. Fluid Pressure and its measurements
3. Hydrostatics
4. Fluid Flow
5. Flow through pipe

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6. Impact of jets
7. Hydraulic turbines
8. Hydraulic Pumps

Production Design

Engineering Drawing & Design/Design Calculation

Manufacturing Processes (Drilling, Milling, Boring)/ Manufacturing Technology

1. Tool Materials
2. Cutting Tools
3. Lathe Machine
4. Shaper
5. Planning Machine
6. Milling Machine
7. CNC Machine
8. Slotter
9. Grinding
10. Internal Machining operations
11. Surface finish, lapping

Manufacturing Processes/ Heat & Surface Treatment, Heat & Mass Transfer

Metrology and Measurements/Tolerance Limits, Fits

Thermal Engineering/ Power Plant Engineering

1. Concepts and terminology
2. Energy and Work Transfer
3. First Law of thermodynamics
4. Second Law of Thermodynamics
5. Working substances
6. Ideal gases and real gases
7. Vapor Power Cycles
8. Gas Power cycles
9. Fuels and Combustion
10. Heat Transfer
11. Refrigeration cycles
12. Power Plant Engineering/Introduction
13. Steam Power Plant
14. Nuclear Power Plant
15. Diesel engine power plant
16. Hydel Power Plant

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SYLLABUS FOR COMPUTER BASED TEST **O&M SUPERVISOR – TRADE- ELECTRICAL POSITIONS**

Electrical Basics

1. Fundamentals
2. Magnetic circuit
3. Poly-phase circuits
4. Generation of Elect. Power
5. Conversion of Electrical Energy
6. Wiring and Power Billing
7. Measuring Instruments
8. Introduction to renewable power generation

Electrical Engineering Material

1. Conducting materials
2. Semiconducting materials
3. Insulating materials
4. Dielectric materials
5. Magnetic materials
6. Material for special purposes

DC/AC Machine & Transformer

1. DC Machines
2. Single phase transformer
3. Auto transformer
4. Three phase transformer
5. Induction motor (Single & Three Phase)
6. Alternator
7. Synchronous Motor
8. AC commutator motors
9. Special Electric Machine

Analog Circuits/ Electronics

1. P-n junction diode
2. Special semiconductor devices
3. Rectifier circuits & filters
4. Transistors
5. Transistor circuits
6. Transistor amplifiers & oscillators
7. Field effect transistor
8. Operational amplifiers

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Electrical Measurements & Measuring Instruments

1. Measuring instruments
2. Analog ammeters and voltmeters
3. Wattmeter and measurement of power
4. Energy meters and measurement of energy
5. Measurement of speed, frequency and power factor
6. Instrument transformer
7. Measurement of resistance
8. Measurement of inductance and capacitance
9. Digital instruments

Control System

1. Signal flow graph
2. Time response of system
3. Analysis of stability
4. Frequency response of system
5. Nyquist plot

Digital Electronics

1. Number Systems and Codes
2. Logic Gates
3. Boolean Algebra
4. Combinational Circuits
5. Sequential Circuits
6. Logic Families
7. Counters
8. Registers
9. Digital to analog converters
10. Analog to Digital Converters
11. Display Devices

Generation, Transmission & distribution of Electrical Power

1. Generation of electricity
2. Transmission of electric power
3. Overhead line
4. Performance of short & medium lines
5. EHV transmission
6. Distribution System
7. Underground cable
8. Economic Aspects
9. Types of tariff
10. Substation
11. Protection System

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Circuit and Network Theory

1. Circuit elements and laws
2. Magnetic circuits
3. Network analysis
4. Network theorems
5. Ac circuit and resonance
6. Coupled circuits
7. Transients
8. Two-port network
9. Filters

Microprocessor

1. Introduction to microprocessor & Micro controller
2. 8085A microprocessor Architecture
3. Instruction set of Intel 8085A
4. 8085 A programming
5. Memory and I/O Interfacing
6. Peripheral Interface
7. Interfacing DAC & ADC
8. Application of 8085 A

Power Electronics & Drives

1. Thyristor
2. Firing Circuits For Thyristor
3. Phase Controlled Rectifier
4. Inverter
5. Chopper
6. Cyclo Converter
7. Power Semiconductor Devices
8. Thyristor Applications
9. A.C & D.C Drives

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SYLLABUS FOR COMPUTER BASED TEST OPRT. / TECH. TRADE – FITTER POSITIONS

UNIT- I : SAFETY AND ITS IMPORTANT :

Safety and General Precautions in Industry/Shop floor - Personal Protective Equipment (PPE) - First Aid – Operations of Electrical Mains - Disposal of Waste Materials- Occupational Safety and Health – Safety Signs – Response to Emergencies – Importance of House Keeping – Material Handling - Lifting and Handling Loads – Moving Heavy Equipment.

UNIT – II : BASIC FITTING:

Linear Measurement – Base unit of linear measurement, System of units of measurement, Multiples of a Metre and their values.

Steel Rule - Purpose of steel rule, Types, precautions to be followed while using steel rule.

Marking Instruments – Feature, uses and type of Scriber, Caliper, Punches, Hammer, “V” Block, Try Square - Bevel Gauge, Bevel Protractor, Combination Set, Surface Gauge, Surface Plate, Angle Plate.

Cutting Tools – Hack Saw Frames, Hacksaw Blades, Files and Special files types and specification, Cold chisel and types, Power Saws, Drilling Machines, Drilling Operations, Drills, Taps, Dies, Tap drill size and Blank Size calculation.

Grinding – Grinding Machines, Grinding Wheel Specification, Loading, Glazing, Dressing and Truing.

Work holding Devices – Bench Vice, Machine Vice, Clamps and Strap.

Tool Holding Devices – Drill Chuck & Key, Tapper Sleeve & Sockets, Tap Wrench, Die Stock.

Precision Measuring Instruments – construction, Least Count, Graduation and types of Vernier Caliper, Micro Meter, Vernier Micrometer, Screw thread Micrometer, Vernier Bevel Protractor, Dial Caliper, Dial test indicator and comparator.

UNIT III : SHEET METAL WORK:

Safety in sheet metal work shop - Metal sheets and their uses – Hand lever shear – Sheet metal Tools, Different shear operation - Rivet & Riveting - Solder & Soldering

UNIT – IV : WELDING:

Safety in welding shop - Welding Hand Tools – Gas Welding Equipment and Process – Setting of Parameter for Arc welding Machines – Oxy – Acetylene cutting Equipment. – Arc welding defects and Testing – Types of Joints – Selection and Storage of Electrodes.

UNIT – V : LIMIT, FIT, TOLERANCE AND INTERCHANGEABILITY:

Necessity of Interchangeability – Standard System of Limit and Fits Terminology – Fits and Classification as per Indian Standard –BIS system of Limits and Fits reading the standard chart – Hole and Shaft basis system of Limit and Fit.

UNIT – VI : TURNING :

Safety while working on Lathes – Lathe Main Parts – Feed & Thread cutting Mechanism – Methods of Holding Jobs – Different Lathe Operations – Lathe Tool and its Nomenclature – Tool Selection – Lathe cutting speed and Feed – Use of Cutting fluid (Coolant) and Properties.

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UNIT-VII: BASIC MAINTENANCE, ERECTION AND TESTING OF MACHINERIES:

Total Productive Maintenance – Routine Maintenance – Break down Maintenance & Preventive Maintenance - Installation of Machinery – Foundation bolts and types – Sling Load for Shifting – Erection Tools and Techniques – Fork Lift and Pallet Truck - Lubricant and its Properties – Types of Lubrication - Different Methods of Lubrication.

Repair Technique – Power Transmission Elements and its types, application and Uses (Gear, Belt and Pulley, Coupling, Chain and Sprocket, Clutches, Bearing and bearing metals – Velocity Ratio calculation in Gear and Belt and chain drive.

UNIT - VIII : Metal & Non Metal :

Ferrous Metal Manufacturing process and properties (Pig Iron , Cast Iron , Wrought Iron and Steel) – Non - Ferrous Metal properties and uses (Aluminium , Lead , Tin Copper , Zinc and their Alloys) – Heat Treatment – Structure of steels – Annealing – Normalizing - Hardening – Tempering – Different methods of Surface hardening - Prevention of Rust and Corrosion -Galvanizing , Electro Plating , Cladding , Metal Spraying and Cementation.

UNIT - IX ASSEMBLING:

Locking Devices – Screws, Bolt and Nuts, Keys, Cotters, Split Pin, Screw Driver, Spanners, Power Tools.

Gauges and Template – Radius gauge , Screw Pitch gauge , Drill Gauge , Centre gauge , Feeler gauge , Wire gauge , Telescopic gauge.

Limit Gauges – Principle of 'Go' and 'No-GO' - Plug gauge, Snap gauge, Ring gauge, Taper gauge. Sine bar and Slip gauge – Principle, uses, application and Taper calculation. Finishing Process – Lapping, Honing, Frosting and Scrapping – Application and Methods.

Jig and Fixtures – Construction, Types and its accessories – Advantages and Disadvantages.

Inspection – Visual inspection, Quality Standard, Quality control inspection.

UNIT – X HYDRAULICS AND PNEUMATICS:

Hydraulics – Safety precautions – Symbols – Filters – Pumps – Cylinders – Flow control Valves – Tube and pipe assembly – application and common maintenance of hydraulic.

Pneumatics – Safety Precautions – Symbols – FRL Unit – Actuator – Cylinder – Types of pneumatic valve – Air compressor parts and function – Electro pneumatic system - application and common maintenance of pneumatic.

Pipe and Pipe fittings – Pipe fitting Tools, Symbols, Standard pipe fitting accessories, Pipe thread, Pipe die and Tap, Repair and maintenance of Water Tap.

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SYLLABUS FOR COMPUTER BASED TEST **OPRT. / TECH. TRADE – ELECTRICIAN POSITIONS**

UNIT-I : SAFETY RULES – FUNDAMENTAL OF ELECTRICITY

Safety Rules, Hazards, Types of Fire Extinguishers, Personal Protective Equipments, Types of Wires and Joints. Soldering Methods, Ohm's Law – Simple Electrical Circuits and Problems. Kirchhoff's Law and its application – Under Ground Cables - Capacitor types Functions Grouping and uses.

UNIT-II: AC CIRCUITS – CELLS AND BATTERIES – WIRING INSTALLATION

AC Circuits – Power, Energy, Power Factor in AC Single Phase Circuits, Poly phase circuit, Cells and Batteries - Basic Wiring Practice, Wiring Installation and Earthing – Types - Testing a Domestic Wiring Installation – Location of Faults, Remedies. Industrial Wiring – Isolator, Switches, Fuses, Relays, Timers and Limit Switches – Types of Circuit Breakers, Technique for neutral voltage reductions.

UNIT-III: ILLUMINATION AND ELECTRICAL MEASURING INSTRUMENTS

Illumination – Construction Details of Various Lamps – Electrical Measuring Instruments and types - Ammeter, Voltmeter, Ohm Meter, Power Factor Meter, Frequency Meter, Multi meter, Watt Meter, Energy Meters (1 Phase and 3 Phase). Tong Tester (Clamp on Meter), Smart Meters, Automatic Meter Reading - Supply Requirements.

UNIT-IV: ELECTRICAL APPLIANCES

Domestic Appliances – Concept of Neutral and Earth – Cooking Range, Induction Heater, Food Mixer – Automatic Electric Iron Box, Electric Geyser Wet Grinder, Washing Machine and Fans.

UNIT-V: TRANSFORMERS

Transformer – Principle, Classification, EMF Equation, Transformer Losses. Open Circuit Test, Short Circuit Test – Efficiency – Voltage Regulation. Parallel Operation of Single Phase and Three Phase Transformers – Methods of Cooling of Transformer – Necessity of Cooling - Transformer Oil and Testing – General Maintenance of three Phase Transformer.

UNIT-VI: DC MACHINES

DC Generators – Principle of Operation – Construction – Parts – Types – Characteristics – Build up of emf – Application – Losses efficiency

DC Motors – Principle of Operation – Starters – DOR – Armature reaction – Commutation – Speed Control Methods – Applications – Winding lap and Wave – Losses and efficiency – Maintenance, Service and repair.

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UNIT-VII: AC MACHINES

Three Phase Induction Motors – Principle of Working – Construction – Parts – Types – Squirrel Cage Induction Motor – Slip ring Induction Motor – Characteristics – Slip Vs Torque – Type of Starters – Basic Contactor Circuit – Parts and Functions.

Single Phasing Prevention – Losses and efficiency – Methods of Speed Control – Windings – Types – Concentric / Distributed – Single / double layer winding and related terms – Maintenance Service and repair – Trouble Shooting.

Single Phase Induction Motors - Working Principle – Types – Construction – Parts – Starting & running Methods – Domestic and Industrial – Applications Maintenance and Trouble Shooting

UNIT-VIII: SYNCHRONOUS MACHINE

Alternators - Working Principle – Construction – Parts – Types – Relation between Poles, Speed and Frequency – Voltage Regulation – Losses and efficiency – Characteristics – Phase Sequence – Parallel Operation – Care and Maintenance.

Synchronous Motor – Working Principle – Power factor improvement.

UNIT-IX: ELECTRONICS

Resistors – Colour Code, Types and Characteristics – Active and Passive Components Diodes – Rectifiers – Characteristics – Transistors, SCR, DIAC, TRIAC – Applications – Digital Electronics – Logic gates and Combinational Circuits – UPS and Invertors.

UNIT-X: POWER GENERATION, TRANSMISSION AND DISTRIBUTION

Types of Power Generation –Conventional and Non-Conventional Energy Sources – Solar and Wind Energy – Solar Panels – Transmission and Distribution Network – Line Insulators – Over Head Poles – Safety Precautions and IE Rules for Service Lines – Terms related to Distribution.

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THE WEST BENGAL POWER DEVELOPMENT CORPORATION LIMITED

(A Government of West Bengal Enterprise)

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SYLLABUS FOR COMPUTER BASED TEST **SAFETY OFFICERS POSITIONS**

1. SAFETY, HEALTH AND ENVIRONMENT MANAGEMENT

1.1 INTRODUCTION

- 1.1.1 Management and management principles and types of management
- 1.1.2 Management Principles: General principles of management, managerial role, authority, responsibility and power, span of management, delegation and decentralization of authority.
- 1.1.3 Safety, Health and Environment Management (SHE), Occupational Safety, Health and Environmental Safety Management – Principles and Practices
- 1.1.4 Role of Management in industrial safety
- 1.1.5 Organization behaviors and Human factors contributing to accident

1.2 PLANNING FOR SAFETY

- 1.2.1 Planning for safety: Definition, Purpose, Nature, Scope and procedure, Range of planning, variety of plans.
- 1.2.2 Strategic planning and tools of implementation. Management by objectives and its role in safety, health and management (SHE). Policy formulation and implementation

1.3 ORGANIZING FOR SAFETY

- 1.3.1 Organizing: Definition, need, nature and principles. Organizing for safety, Health and Environment Organization structure, functions and responsibilities
- 1.3.2 Safety Committee: Structure and functions
- 1.3.3 Line and Staff functions for safety, Health and Environment

1.4 DIRECTING FOR SAFETY

- 1.4.1 Direction: Definition, process, principles and techniques
- 1.4.2 Leadership: Role functions and attributes of a leader.
- 1.4.3 Communication: Purpose, process, types and channels, essential rules for communication. Two-way communication. Barriers in communication, essentials of effective communication. Communication and group dynamics.

1.5 MONITORING FOR SAFETY, HEALTH AND ENVIRONMENT

- 1.5.1 Occupational Safety, Health and Environment Management System, Bureau of Indian Standards on Safety and Health: 14489-1998 and 15001-2000, ILO and EPA standards 8

1.6 PRINCIPLES OF ACCIDENT PREVENTION

- 1.6.1 Definition: Incident, Accident, Injury, Dangerous occurrences, Unsafe Acts, Unsafe Conditions, Hazards, Error, Oversight, Mistakes etc
- 1.6.2 Accident Prevention: Theories/Models of accident occurrences. Principles of accident prevention. Accident and Financial implication

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1.7 SAFETY, HEALTH AND ENVIRONMENT (SHE) EDUCATION AND TRAINING

- 1.7.1 SHE: Element of training cycle, Assessment of needs. Techniques of training, design and development of training programs. Training methods and strategies types of training. Evaluation and review of training programs
- 1.7.2 Competence Building Technique (CBT), Concept for training, Safety as a online function. Role of Multi-media communication, Applications of Computers. Relevance of WTO regarding safety, Health and Environment

1.8 EMPLOYEE PARTICIPATION IN SAFETY

- 1.8.1 Employee Participation: Purpose, areas of participation, methods. Role of trade union in Safety Health and Environment Protection. Safety Promotion and Safety Awards and Suggestion Schemes, Safety Competitions, Safety Incentives Publicity schemes, Audio visual publicity, Other Promotional methods.

1.9 GLOBAL WARMING AND MITIGATION MEASURES

- 1.9.1 Global Warming and Mitigation measures
- 1.9.2 Human behavior: Individual differences, behavior as function of self and situation, perception of danger and acceptance of risk, knowledge, and responsibility vis-à-vis safety performance, theories of motivation and their application to safety, role of, supervisors and safety departments in motivation
- 1.9.3 Conflict & Frustration: Identification of situations leading to conflict and frustration and techniques of management

1.10 MANAGEMENT INFORMATION SYSTEM FOR SAFETY

- 1.10.1 Sources of information on Safety, Health and Environment Protection. Compilation and collation of information, Analysis and use of modern 9 methods of programming, storing and retrieval of MIS for safety, health and environment
- 1.10.2 QCC HS computer software application and limitation 1.10.3 Status and future goals of computer utilization in Safety, Health and Environment (SHE) services in industries.

2. SAFETY ENGINEERING-I

2.1 MACHINE OPERATION AND GUARDING

Principles in machine guarding - Ergonomics of machine guarding - Type of guards, their design and selection - Guarding of different types of machinery including special precautions for wood working, paper, rubber and printing machinery, machine, tools etc. - Built-in safety devices, maintenance and repairs of guard's incidental safety devices and tools

2.2 SAFETY IN THE USE OF MACHINES

- 2.2.1 Safety in the use of 1) Power Presses (all types) 2) Sharing 3) Bending 4) rolling 5) Drawing 6) Turning 7) Boring 8) Milling, shaping 9) Planning broaching, Planing 10) grinding 11) CNCs
- 2.2.2 Need of Selection and care of cutting tools
- 2.2.3 Preventive maintenance, Periodic checks for safe operation
- 2.2.4 Associated hazards and their prevention

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2.2 MATERIAL HANDLING AND STORAGE OF MATERIALS

- 2.3.1 Manual: Kinetics of manual material handling, maximum loads that could be carried. Lifting and carrying of objects of different shapes, size and weight. Safe use of accessories for manual handling storage of materials. Safety in stacking and unstacking, floor loading conditions. Lay-out conditions for safety in storage, Ergonomics of manual handling and storage.
- 2.3.2 Mechanical: Lifting machinery, Lifts and Hoists; Safety aspects in design and construction, testing, use and care, signaling, inspection and maintenance. Safety in design and construction, operation, inspection and maintenance of industrial trucks, lifting tackles and loose gears, conveyors. Safety features, safe locations, testing, inspection and maintenance of lifting tackles, safe working load for all mechanical material handling equipment. The competent persons in relation to safety legislation –duties and responsibilities

2.4 WORKING AT HEIGHTS:

- 2.4.1 Working at heights: Incidence of accidents. Safety features associated with design construction and use of stairways, ramps, working platforms, gangways, ladders of different types, and scaffolds of different types including Boatswain's chair and safety harness, working on roofs other safety requirements while working at heights.
- 2.4.2 Working in Confined Spaces
- 2.4.3 Working Underground

2.5 HANDTOOLS AND PORTABLE TOOLS

Main causes of tool accidents and Control of tool accidents. Centralized and personal tool issue system. Purchase, storage and supply of tools. Inspection, maintenance and repairs of tools. Detectable causes of tool failures. Tempering, safe ending, and dressing of certain tools. Safe use of various types of hand tools used for metal cutting, wood cutting, miscellaneous cutting work, other hand tools such as torsion tools, shock tools, non-sparking tools. Portable power tools and their selection, inspection, maintenance, repair and safe use.

2.6 PLANT DESIGN AND HOUSEKEEPING

Plant layout and design and safe distance. Need for planning and follow up. Safety and good. Typical accidents due to poor housekeeping. Disposal of scrap and other trade wastes. Prevention of spillage. Marking of aisles space and other locations. Use of color as an aid for good housekeeping. Housekeeping contests. Cleaning methods. Employee assignment. Inspections and check-lists. Benefits of good housekeeping. Role of preventive maintenance in safety and health. Importance of standards and codes of practice for plant and equipment.

2.7 INDUSTRIAL LIGHTING & ILLUMINATION

Purpose of lighting. Benefits of good illumination - Phenomenon of lighting and safety - Lighting and the work - Sources and types of artificial lighting - Principles of good illumination - Recommended optimum standards of illumination - Design of lighting installation - Maintenance, standards relating to lighting and color

2.8 VENTILATION AND HEAT STRESS

Purpose of ventilation - Physiology of heat regulation - Thermal environment and its measurement - Thermal comfort - Indices of heat stress - Thermal limits or comfort, efficiency and freedom from health risk - Natural ventilation - Mechanical Ventilation - Air conditioning - Control of heat exposures at source, dilution and local ventilation – Recommended values for air changes required for various areas as per Factories Act, 1948 and national standards IS3103-1975 code of practice for Industrial ventilation, national building code Part VIII, Building Services

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2.9 NOISE AND VIBRATION

Continuous and impulse noise - The effect of noise on man - Measurement and evaluation of noise - Noise isolation - Noise absorption techniques, Silencers - Practical aspect of control of noise - Vibration: Effects, measurement and control measures such as vibration damping

2.10 ELECTRICAL HAZARDS

- 2.10.1 Hazards of electrical energy - Safe limits of amperages, voltages - Safe distance from lines - Capacity and protection of conductors - Joints and connections - Means of cutting off power - Overload and short circuit protection - No load protection - Earth fault protection - Earth insulation and continuity tests - Earthing standards - Protection against surges and voltage fluctuation
- 2.10.2 Hazards arising out of 'Borrowed' neutrals - other precautions - Safety in the use of portable electrical apparatus - Types of protection for electrical equipment in hazardous atmosphere - Electrical area classification - Criteria in their selection, installation, maintenance and use

2.11 STATIC ELECTRICITY

- 2.11.1 Introduction, Electro-static charging - where charging can occur contact electrification. Electro Static discharges (Sparks). Electro static hazards and their control. Earthing and bonding. Recommended earthing resistance for control of electricity.

2.12 LIGHTING ARRESTORS

- 2.12.1 Definition, lightning splash, lightning strokes, lightning protection systems. Characterization of health effects of lightning stroke (electrical effects, side flashers, thermal effects, mechanical effects. Function of lightning. Where lightning protection is required - System design, material of construction, component of a lightning arrestors, earth terminal / network.

2.13 Safety check list for buying new machinery for the plant.

3. SAFETY ENGINEERING-II

3.1 CONSTRUCTION INDUSTRY

- 3.1.1 Basic Philosophy peculiarities and parameters governing the safety in construction such as site planning and layout, safe access, good housekeeping, safety in the use of construction machinery, signs and indication liaison for safety with local authorities, structural soundness accident and hazards their cause and effects

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3.2 BOILER SAFETY

- 3.2.1 Safety in Boilers
- 3.2.2 Safety Precautions and operations of boilers
- 3.2.3 Different types of boilers when not in use
- 3.2.4 Preservations of boilers when not in use
- 3.2.5 Steam pressure, Pressure gauge
- 3.2.6 Treatment of feed water etc.

3.3 ENVIRONMENT MANAGEMENT

- 3.3.1 Environment Protection
- 3.3.2 Principles and Practices for Prevention and control of air pollution, water pollution, solid and hazardous waste management.
- 3.3.3 ISO 14001 EMS system
- 3.3.4 Cleaner technologies

3.4 PERMIT TO WORK

- 3.4.1 Work permit Application, Adoption and Enforcement

3.5 WELDING SAFETY

- 3.5.1 Welding, Gas cutting
- 3.5.2 Precautions in welding, gas cutting, brazing, soldering, and other operations

4. QUALITY CONTROL IN OCCUPATION SAFETY, HEALTH AND ENVIRONMENT

4.1 PLANT AND EQUIPMENT SAFETY APPRAISAL AND CONTROL TECHNIQUES

- 4.1.1 Plant Safety rules and Procedures, Safe operating systems, Safety Checklists, Plant safety inspections. Safety sampling - Safety survey - Job Safety Analysis - Safety Inventory system - Product safety - Safety tag systems - Total Loss control and Prevention

4.2 HAZARD IDENTIFICATION TECHNIQUES

Hazard and Risk analysis: Quantitative and Qualitative: Failure Mode and Effect Analysis (FMEA) & Maximum Credible Accident Analysis (MCAA) - Fault tree analysis- Event Tree analysis- Example of each HAZAN – HAZOP – Managerial Oversight review technique (MORT), Incident Recall technique -Critical Incident review technique – Safety integrity levels (SIL) etc.

4.3 ACCIDENT AND INCIDENT INVESTIGATION, REPORTING AND ANALYSIS

Accident and Incident Investigation: Philosophy, Purpose, Process and types of Investigation. Identifying the key factors and the immediate and basic causes. Corrective action. Agencies investigating accident. Accident Reporting: Report forms, writing reports, essential elements Accident and Incident analysis: Standard classification of factors associated with accidents. Methods of collecting and tabulating data, Record keeping.

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4.4 MEASUREMENT AND EVALUATION OF PERFORMANCE

- 4.4.1 Definition of Accident, Reportable, Non-Reportable, Fatal, Non fatal
- 4.4.2 Near miss accident - Lost time accident - Disabling injury - Accidents reportable under the factories Act and ESI act - Frequency rate - Severity rate - Incidence rate - Frequency severity index – Safe score
- 4.4.3 Temporary disablement and permanent disablement - Partial and total disablement - Time charges schedules in workmen’s compensation Act 1928 and the National and International Standards.

4.5 MAJOR ACCIDENTS HAZARDS CONTROL

- 4.5.1 Major Accident Control: Definition, Major Accident Hazards, Identification and Assessment of MAH Units. Role of Government, Role of Management, Local authorities and Public.

4.6 SAFETY AUDIT SYSTEM

- 4.6.1 Preparation and Assessment of Safety audit
- 4.6.2 Report of BIS 14489:1998, Safety Report, Standards, ILO Code of Practice for Major Accident control

4.7 MAJOR HAZARD CONTROL

- 4.7.1 Major Accident Control System: Local, State, National and International.

5. INDUSTRIAL HYGIENE AND OCCUPATIONAL HEALTH – PART-I

5.1 ILO CONVENTION AND RECOMMENDATION

- 5.1.1 ILO Convention and Recommendation concerning Occupational health and Safety
- 5.1.2 Relevant conventions and recommendation of ILO in the furtherance of Safety, Health and Environment (SHE). SHE a human right issue. Trade policy affecting OHS
- 5.1.3

Year	Conventions and Recommendations
1981	155 – OHS 164 - OHS
1985	161 – OHS 171 – OHS
1988	167 – Safety and Health in construction 175 – Safety and Health in Construction
1990	170 – Chemicals 177 – Chemicals
1993	174 – Prevention of major industrial accidents 181 – Prevention of major industrial accidents

- 5.2 THE FACTORIES ACT, 1948 AND THE FACTORIES RULES Factories Act - Provisions under the factories act and rules made there under with amendments - Case Laws under the factories act

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5.3 SOCIAL SECURITY – LEGISLATIONS

- 5.3.1 Workmen's Compensation Act and Rules
- 5.3.2 ESI Act and Rules. Contract Labor (Abolition and Regulation) Act
- 5.3.3 Public Liability Insurance Act
- 5.3.4 Social Accountability 8000 SA – 8000

5.4 SAFETY, HEALTH AND ENVIRONMENT (SHE) RELATED IMPORTANT LEGISLATION: SALIENT FEATURE:

- 5.4.1 Sections pertaining to SHE
- 5.4.2 Indian Boilers Act, 1923 with allied Regulations, 1961; Indian electricity Act 2003 and Rules; Indian explosives Act, 1984 and Rules; Petroleum Act and Rules; Gas cylinders rules; Calcium carbide rules; The Insecticides Act and rules
- 5.4.3 Radiation protection rules; Hazardous material transportation rules;
- 5.4.4 Static and mobile (Unfired) pressure vessel rules, 1981 as amended in 2000
- 5.4.5 The Dockworkers (Safety, Health and Welfare) act 1996 and rules and regulations
- 5.4.6 The Building and other construction workers (regulation of employment and conditions of service) Act, 1996
- 5.4.7 The Building and other construction workers (Regulation of employment and conditions of service) Central Rules, 1998
- 5.4.8 The Building and other construction workers Welfare Cess Act, 1996 Cess Rules, 1998

5.5 ENVIRONMENT PROTECTION LEGISLATIONS:

- 5.5.1 Water (Prevention and control of pollution) Act 1974 and rules – Air (Prevention and Control of Pollution) Act, 1981 and 1982 and Rules. Motor vehicles act, 1988 as amended in 2000, The Central Motor Vehicles Rules, 1989 as amended in 2000 and transport of hazardous good rules
- 5.5.2 Environment protection act 1986 (Amended) and rules - MSIHC Rules –Noise Pollution Act, 1998, Bio-Medical Waste, Hazardous Waste management rules
- 5.5.3 Chemical Accidents (Emergency Preparedness, Planning and Response) Rules, 1986.

6. INDUSTRIAL HYGIENE AND OCCUPATIONAL HEALTH – PART-II

6.1 INDUSTRIAL HYGIENE

- 6.1.1 Definition of Industrial Hygiene, industrial Hygiene: Control methods, Substitution, Changing the process, isolation, wet method, local exhaust ventilation, personal hygiene, housekeeping and maintenance, waste disposal, special control measures
- 6.1.2 Introduction to chemical hazards - Dangerous properties of chemicals, dust, gases, fumes, mist, vapors, smoke and aerosols
- 6.1.3 Route of entry to human system, recognition, evaluation and control of basic hazards, Concepts of dose response relationship, Bio-chemical action of toxic substances
- 6.1.4 Concept of threshold limit values - Air sampling strategies - Personal exposure monitoring
- 6.1.5 Work environment monitoring - Biological sampling & analysis

6.2 PERSONAL PROTECTIVE EQUIPMENT

- 6.2.1 Need for personal protective equipment, Selection, applicable standards, supply, use, care and maintenance of respiratory and non-respiratory personal protective equipment
- 6.2.2 Non-respiratory personal protective devices: Head Protection, Ear Protection, Hand Protection, Face and eye protection, Hand Protection, Foot Protection, Body Protection

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- 6.2.3 Respiratory Personal protective devices: Classification of Hazards, Classification of respiratory personal protective devices, Selection of respiratory Personal protective devices
- 6.2.4 Instructions and training in the use, maintenance and care of Self containing breathing apparatus. Training in the use of breathing apparatus (Open circuits and Close unit)
- 6.2.5 Testing procedures and standards

6.3 OCCUPATIONAL HEALTH

6.3.1 Definition : As per WHO

6.3.2 COMMON OCCUPATIONAL DISEASES:

- Occupational involving risk of contracting these disease - Mode of causation of the diseases and its effects - Diagnostic methods
- Biological Monitoring - Methods of prevention - Compensation for occupational diseases
- Evaluation of injuries
- Occupational Health Management Services at the work place
- List of Notifiable diseases Schedule III of Factories Act – 1948

6.3.3 OCCUPATIONAL HEALTH HAZARDS

- 6.3.3.1 Adverse health effects of noise, vibration, cold, heat stress, improper illumination, thermal radiation, ionizing and Non-ionizing radiations
- 6.3.3.2 Permissible threshold exposure limits – Short term and long term effects of exposures - Preventive and control measures.

6.4 COMMON OCCUPATIONAL DISEASES

- 6.4.1 Common Occupational Disease as per the Schedule III of the Factories Act
- 6.4.2 Pre- employment, Periodical medical examination of workers. medical surveillance for control of occupational disease and health records
- 6.4.3 Fundamentals of First – aid-burns, fractures, Suffocation, Toxic ingestion – Bleeding wounds and Bandaging, Artificial respiratory, techniques

6.5 OCCUPATIONAL HEALTH HAZARDS

- 6.5.1 Physiology of respiration, cardiac cycle, muscle contraction, nerve conduction system etc. Assessment of workload based on Human Physiological reactions. Permissible limits of load for manual lifting and carrying. Criteria for fixation limits
- 6.5.2 Working Posture: Its effects on cardio-vascular and musculo-skeletal system and implications on health. Nutrition and its importance in manual work. Nutritional requirements and nutritional of diet 24
- 6.5.3 Assessment of work capacity fatigue and rest allowances. Physiological test for assessment of occupational health. Nutrition: Nutritional requirements and the Diets for exercise, work and physical fitness
- 6.5.4 Environmental Physiology

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6.6 ERGONOMICS

- 6.6.1 Introduction to Ergonomics, Definition, Aims and Scope, Man-machine (Job), Environment System, Constituents of Ergonomics, Application of Ergonomics in industry for safety, Health and Environment
- 6.6.2 Ergonomics of Automation / Assembly, visual fatigue, Ergonomics of rehabilitation while assigning alternate jobs. Anthropometry and fundamental of bio-mechanics: basic and applied aspects: Anthropometric measurements and their usefulness in industry
- 6.6.3 Ergonomic design of work station: Concept of workstation and its design. Improving safety and productivity through work station design. Technical and engineering control measures. Economics consideration.

7. SAFETY IN CHEMICAL AND PETROCHEMICAL INDUSTRY

7.1 UN CLASSIFICATION OF HAZARDOUS MATERIALS

- 7.1.1 UN Classification of Hazardous materials
- 7.1.2 Safety in chemical industry
- 7.1.3 Criteria for siting and layout of chemical and petrochemical plants
- 7.1.4 Plant area classification
- 7.1.5 Instrumentation for safe plant operations

7.2 HAZARD IN UNIT PROCESSES AND UNIT OPERATIONS

- 7.2.1 Hazard in Unit processes and Unit operations
- 7.2.2 Control, precautions and prevention, specific safety measures for certain chemical industry like fertilizer, insecticide, pesticides-choler-alkali, explosives, and polymer plants
- 7.2.3 Sampling technique for toxic and flammables, Pharmaceuticals, Petro-chemical etc.

7.3 SAFETY PRECAUTIONS

- 7.3.1 Precautions in the process and operations involving explosives, flammables, toxic substances, dusts, gases, vapor cloud formations and combating

7.4 STORING AND HANDLING OF CHEMICALS

- 7.4.1 Receiving, storing and handling of chemicals
- 7.4.2 Chemical compatibility considerations

7.5 TRANSPORTATION OF HAZARDOUS MATERIAL

- 7.5.1 Transportation of Hazardous material
- 7.5.2 Safety precautions for transporting hazardous / toxic / flammable / explosive / radioactive substances by all modes

7.6 TRANSFER OF CHEMICALS THROUGH PIPE LINES

- 7.6.1 Transfer of chemicals by pipelines within and outside installations, above and underground and submarines

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7.7 COLOR CODING

- 7.7.1 Color coding identification of contents
- 7.7.2 Safety precautions for working on pipelines, safe entry procedures to
- 7.7.3 Confined spaces including reaction vessels
- 7.7.4 Safe procedure of start up and shut down procedures
- 7.7.5 Safety in preventive and emergency maintenance operations

7.8 MSDS

- 7.8.1 Use of Material safety data sheets

7.9 WORK PERMIT SYSTEM

- 7.9.1 Work permit system, confined space, hot work, working at height

7.10 FIRE AND EXPLOSION

- 7.10.1 Fire and Explosion
- 7.10.2 Chemistry of fire, factors contributing towards fire, classification of fires. Common causes of industrial fire
- 7.10.3 Determination of fire load. Design of building plant, exits etc for fire safety and fire resistance of building materials
- 7.10.4 Prevention of fire. Portable extinguishers, hydrant system, Sprinkler system, introduction to Carbon-di-oxide systems, Foam extinguisher system, Dry chemical extinguishing system, Halon replacement of fire fighting product
- 7.10.5 Fire detection and alarm system
- 7.10.6 Special safety precautionary measures for control of fire and explosion in handling / processing flammable liquids, gases, vapors, mists and dusts etc. 27 BLEVE (Boiling liquids expanding vapor explosion, vapor cloud explosion) including pesticides
- 7.10.7 Fire emergency action plan. Deflagration and Detonation

7.11 FIRE EXPLOSION AND TOXICITY INDEX

- 7.11.1 Salient features of fire explosion and toxicity index, Dow, dispersion, Probability analysis, modeling.
- 7.11.2 Pressure vessels fired and unfired, codes of practices governing their safety

7.12 ASSESSMENT OF RELIABILITY OF VESSELS, TEST CHECKS

- 7.12.1 Assessment of reliability of vessels, test checks

- 7.13 Inspection techniques for plants, reaction vessels, check list for routine inspection, checklist for specific maintenance and breakdown

7.14 INSPECTION TECHNIQUES

- 7.14.1 Corrosion and erosion, location, causes inspection and prevention.

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8. SAFETY IN CONSTRUCTION INDUSTRY.

8.1 MEANING AND SCOPE OF SAFETY IN CONSTRUCTION

- 8.1.1 Understand the basic philosophy, peculiarities and parameters governing the safety in construction such as site planning and layout
- 8.1.2 Know the safe access
- 8.1.3 Know about the Good Housekeeping, safety in the use of construction machinery
- 8.1.4 Know about the signs & indication
- 8.1.5 Know about the accidents and hazards – their causes and effects

8.2 SAFETY IN CONSTRUCTION OPERATIONS

8.2.1 Underground works Safety in using and operating machine and equipment relating to the below works

- 8.2.1.1 Know about excavation
- 8.2.1.2 Know about drilling and blasting
- 8.2.1.3 Know about trenching
- 8.2.1.4 Know about shoring
- 8.2.1.5 Know about strutting
- 8.2.1.6 Know about tunneling
- 8.2.1.7 Know about piling

8.2.2 Above ground works Safety in use and operations of related machinery and equipment relating to the below works

- 8.2.2.1 Know about scaffolding
- 8.2.2.2 Know about centering
- 8.2.2.3 Know about formwork ladders
- 8.2.2.4 Know about wall and floor openings
- 8.2.2.5 Know about staircases and railings
- 8.2.2.6 Know about structural steel work including welding, cutting, erection, etc.

8.2.3 Underwater operations Safety in use and preparation of related machinery and equipment

- 8.2.3.1 Know about river training
- 8.2.3.2 Know about well sinking
- 8.2.3.3 Know about caissons
- 8.2.3.4 Know about underwater concreting cofferdams and special operations concerted with irrigation work

8.2.4 Movement of materials and personnel

- 8.2.4.1 Know how to handle heavy/long items
- 8.2.4.2 Know about railway wagons, motor trucks, vehicles etc.
- 8.2.4.3 Know about Hazardous materials

8.2.5 Special works

- 8.2.5.1 Know about high rise buildings, bridges, roads, railways asphaltting pneumatic caissons, electrical installations and lifts.
- 8.2.6 Fire prevention and protection at work site

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8.3 Safety in Demolition operations

8.3.1 Understanding the planning and permit

8.4 Safety with regard to storage, stocking and handling of materials of construction

8.4.1 Know about hazards, health ill effects while handling construction materials and chemicals

8.4.2 Know safety measures with respect material such as cement, limes, aggregates, fly ash, timber, steel, glass, paints, varnishes, petroleum products related products etc.

8.5 Accident prevention

8.5.1 Know about Occupational hazards,

8.5.2 Know about Occupational diseases relating to construction work

8.5.3 Know about safety in the use of Personal Protective equipment specific to construction industry

8.5.4 Know about health and welfare measures

8.5.5 Know about emergency medical measure for construction site, treatment of injuries and rehabilitation

8.6 Statutory obligations

8.6.1 Know about construction safety law and obligations

8.6.2 Know about IS and NB Codes

8.6.3 Know about local building and development by laws

8.6.4 Know about Accident investigation and reporting, monitoring safety performance

8.7. Special precautions

8.7.1 Understanding the special precautions for works of engineering construction like distilling/fractionating columns, towers, chimney silos, silos and gas installations, transmission/communication lines

8.7.2 Know about cable car installations, air fields

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NOTE: The syllabus/topics mentioned are indicative in nature. Candidates are expected to possess significant knowledge/proficiency pertaining to the relevant subjects and their qualifying degree.

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SYLLABUS FOR COMPUTER BASED TEST **SUB-ASSISTANT ENGINEER (CIVIL)**

Building Materials: Physical and Chemical properties, classification, standard tests, uses and manufacture/quarrying of materials e.g. building stones, silicate based materials, cement (Portland), asbestos products, timber and wood based products, laminates, bituminous materials, paints, varnishes.

Estimating, Costing and Valuation: estimate, glossary of technical terms, analysis of rates, methods and unit of measurement, Items of work – earthwork, Brick work (Modular & Traditional bricks), RCC work, Shuttering, Timber work, Painting, Flooring, Plastering, Boundary wall, Brick

building, Water Tank, Septic tank, Bar bending schedule, Centre line method, Mid-section formula, Trapezoidal formula, Simpson's rule, Cost estimate of Septic tank, flexible pavements, Tube well, isolates and combined footings, Steel Truss, Piles and pile-caps. Valuation – Value and cost, scrap value, salvage value, assessed value, sinking fund, depreciation and obsolescence, methods of valuation.

Surveying: Principles of surveying, measurement of distance, chain surveying, working of prismatic compass, compass traversing, bearings, local attraction, plane table surveying, theodolite traversing, adjustment of theodolite, Levelling, Definition of terms used in levelling, contouring, curvature and refraction corrections, temporary and permanent adjustments of dumpy level, methods of contouring, uses of contour map, tachometric survey, curve setting, earth work calculation, advanced surveying equipment

Soil Mechanics: Origin of soil, phase diagram, Definitions-void ratio, porosity, degree of saturation, water content, specific gravity of soil grains, unit weights, density index and interrelationship of different parameters, Grain size distribution curves and their uses Index properties of soils, Atterberg's limits, ISI soil classification and plasticity chart Permeability of soil, coefficient of permeability, determination of coefficient of permeability, Unconfined and confined aquifers, effective stress, quick sand, consolidation of soils, Principles of consolidation, degree of consolidation, pre-consolidation pressure, normally consolidated soil, e-log p curve, computation of ultimate settlement Shear strength of soils, direct shear test, Vane shear test, Triaxial test Soil compaction, Laboratory compaction test, Maximum dry density and optimum moisture content, earth pressure theories, active and passive earth pressures, Bearing capacity of soils, plate load test, standard penetration test

Hydraulics: Fluid properties, hydrostatics, measurements of flow, Bernoulli's theorem and its application, flow through pipes, flow in open channels, weirs, flumes, spillways, pumps and turbines

Irrigation Engineering: Definition, necessity, benefits, effects of irrigation, types and methods of irrigation, Hydrology – Measurement of rainfall, run off coefficient, rain gauge, losses from precipitation – evaporation, infiltration, etc. Different type of canals, types of canal irrigation, loss of water in canals Canal lining, basic design of small dams, types and advantages Shallow and deep tube wells, yield from a well Weir and barrage, Failure of weirs and permeable foundation, Slit and Scour, Kennedy's theory of critical velocity Lacey's theory of uniform flow Definition of flood, causes and effects, methods of flood control, water logging, preventive measure Land reclamation, Characteristics of affecting fertility of soils, purposes, methods, description of land and reclamation processes Major irrigation projects in India

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Transportation Engineering: Highway Engineering – cross sectional elements, geometric design, types of pavements, pavement materials – aggregates and bitumen, different tests, Design of flexible and rigid pavements – Water Bound Macadam (WBM) and Wet Mix Macadam (WMM), Gravel Road, Bituminous construction, Rigid pavement joint, pavement maintenance, Highway drainage, Railway Engineering- Components of permanent way – sleepers, ballast, fixtures and fastening, track geometry, points and crossings, track junction, stations and yards Traffic Engineering – Different traffic survey, speed-flow-density and their interrelationships, intersections and interchanges, traffic signals, traffic operation, traffic signs and markings, road safety

Environmental Engineering: Quality of water, source of water supply, purification of water, distribution of water, need of sanitation, sewerage systems, circular sewer, oval sewer, sewer appurtenances, sewage treatments Surface water drainage Solid waste management – types, effects, engineered management system Air pollution – pollutants, causes, effects, control Noise pollution – cause, health effects, control

Structural Engineering:

Theory of structures: Elasticity constants, types of beams – determinate and indeterminate, bending moment and shear force diagrams of simply supported, cantilever and over hanging beams Moment of area and moment of inertia for rectangular & circular sections, bending moment and shear stress for tee, channel and compound sections, chimneys, dams and retaining walls, eccentric loads, slope deflection of simply supported and cantilever beams, critical load and columns, Torsion of circular section

Concrete Technology: Properties, Advantages and uses of concrete, cement aggregates, importance of water quality, water cement ratio, workability, mix design, storage, batching, mixing, placement, compaction, finishing and curing of concrete, quality control of concrete, hot weather and cold weather concreting, repair and maintenance of concrete structures

RCC Design: RCC beams-flexural strength, shear strength, bond strength, design of singly reinforced and double reinforced beams, cantilever beams T-beams, lintels One way and two way slabs, isolated footings Reinforced brick works, columns, staircases, retaining wall, water tanks (RCC design questions may be based on both Limit State and Working Stress methods)

Steel Design: Steel design and construction of steel columns, beams roof trusses plate girders

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