

RAJASTHAN PUBLIC SERVICE COMMISSION, AJMER

SYLLABUS FOR THE POST OF VICE PRINCIPAL/ SUPERINTENDENT, I.T.I., COMPETITIVE EXAMINATION FOR DEPARTMENT OF SKILL, EMPLOYMENT AND ENTREPRENEURSHIP

1. CIVIL ENGINEERING

- 1. Building Materials:** Various types of building materials viz: Stone, Lime, Glass, Timber, Paint, Varnishes, Bricks; Aggregates: Classification, properties and selection criteria; Cement: Types, Composition, Properties, Uses, Specifications and various Tests; Lime & Cement Mortars and Concrete: Properties and various Tests; Design of Concrete Mixes: Proportioning of aggregates and methods of mix design; Basic Admixtures.
- 2. Construction Technology and Management:** Brick & Stone masonry, Walls, Lintels, Arches, Staircases, Floors, Roofs, Doors, Windows, Plastering, Damp, sound and fire proofing, Anti-termite treatment, Centring & Shuttering, Scaffolding, Under pinning. Selection of site for construction of various types of buildings. Requirements and design criteria for foundations; construction details of walls, masonry, floors, staircases, arches, roofs, doors and windows. Requirements for Fire Protection, Ventilation and Air Conditioning and Acoustics, Eco-friendly and Green buildings. Construction Management, Plant and Equipment, Planning for construction using bar charts, Mile stone charts, and C.P.M. & PERT techniques.
- 3. Surveying:** Basic principles, Level, Theodolite, Tacheometer, Compass and other instruments, Temporary and permanent adjustments, Measurement of distances and directions, Levelling, Contouring, Traversing, Adjustment of survey data, Plane Table survey, Curves, Introduction to Total Station, EDM Surveys, Introduction to Remote Sensing and GIS, Basic principles of Photogrammetry.
- 4. Geotechnical Engineering:** Classification of soil as per I.S. Code. Field identification tests for soils; water content, specific gravity, void ratio; porosity, degree of saturation; unit weight, density index and their inter-relationship. Determination of various properties of soils, grain size distribution, Atterberg's/consistency limits.
Soil permeability and its determination in the laboratory and field; Darcy's Law, Flow nets-its construction and uses. Compaction and consolidation of soil and quality control, soil stabilization methods; Newmark's chart and its uses. Elements of shear strength parameters and their determination. Bearing capacity of shallow foundation, Earth pressures on retaining wall; Stability of slopes, Types of piles, driving of piles, load carrying capacity of piles, pile load testing, under-reamed pile foundation, bored compaction piles, Soil Exploration: Methods of site exploration, boring, sampling.
- 5. Structural Mechanics:** Stress and Strains, Elastic constants, Factor of Safety, Relation among elastic constants. Bending moment and shear force diagrams for cantilever, simply supported, overhanging, fixed & continuous beams subjected to static loads; concentrated, uniformly distributed and uniformly varying loads. Theory of simple bending.
Deflection of cantilever, simple supported, fixed and continuous beams. Two and three hinged arches.

- 6. Design of Steel Structures:** Provisions of latest IS: 800, IS: 875 and other relevant codes, Tension and compression members, Single and built-up sections, Connection and splices, Roof trusses, Simple beams and Purlin connections, Columns, lacing and batten, Grillage, Gusseted and slab base foundation, Plate and gantry girders, Through and deck type plate girder bridges.
- 7. Reinforced Concrete Structures:** Provisions of latest IS: 456 and other relevant codes, Introduction of working stress method, Limit state design of beams: singly reinforced, doubly reinforced and T-beam, Design of slabs, Design of column: axially and uniaxially eccentrically loaded, Design of isolated and combined column footings, Design of retaining walls, Reinforcement in overhead and underground water tanks, Principles of pre-stressed concrete design including materials and methods.
- 8. Fluid Mechanics and Hydraulics:** Properties of Fluid, Hydraulic pressure at a point and its measurement, Buoyancy, conditions of equilibrium of floating bodies; Fluid flow conditions; Bernoulli's Theorem; Navier-Stokes equation, Flow through orifices, notches, and weirs; Laminar & Turbulent flow through pipes, flow through open channels, Hydraulic jump. Hydraulic turbines & pumps.
- 9. Irrigation and Water Resources Engineering:** Introduction, need for harnessing water resources, irrigation practices, Irrigation-its importance and impact on environment, assessment of water requirements for crops, Methods of irrigation, Design principles of irrigation canal, energy dissipation, salient features of diversion head works, Falls, Regulators and cross drainage structures, basic principles for design of dams and spillway, Hydropower, General features and components of a hydropower station.

Hydrological cycle and hydrologic budget, Precipitation; measurement and analysis, Stream flow, Rainfall-Runoff relationship, frequency analysis, Hydrograph analysis, Flood routing, Groundwater hydrology and well irrigation.
- 10. Environmental Engineering:** Water supply: demand, sources, Quality standards, Water treatment: Aeration, coagulation, flocculation, settling, filtration, water softening, Iron, Manganese, Fluoride and Nitrate removal, Electro-dialysis, R.O. and Ion exchange process, Desalination, Water distribution system design and storage, Pumping stations.

Sewerage system: Layout and design, Characteristics of municipal wastewater, Wastewater Treatment: Treatment scheme, activated sludge process, Trickling filters, RBC, UASB, Stabilization ponds and lagoons, Septic tank, sludge handling and disposal. Basics of Air Pollution, various types of air pollutants and its ill effects on human beings. Basics of noise pollution, Measurement of noise, standards, noise abatement. International, National and State pollution control by laws.
- 11. Transportation Engineering:** Highway Engineering: Highway material and testing: properties of subgrade soil, stone aggregate, bituminous material, Highway standard classification, land width, building line centre line, formation width, terrain classification, highway geometric design, Methods of highway construction for different types of roads viz namely earth roads, gravel roads, WBM roads, WMM roads, bituminous road and concrete roads, Design of flexible and rigid pavements. Various features of Express ways and green highway, Transport policy, PMGSY roads, Public private partnership models.

Traffic characteristics, road user characteristics, vehicular characteristics, volume, speed and delay studies origin and destination study, traffic flow characteristics, traffic capacity and parking studies, traffic regulation, traffic control devices, Intersection control, System approach in traffic management.

Introduction to Railway Engineering, Railway track gauges, factors affecting gauges choice, multi gauge, structural and geometrical design of railway track, points and crossings, signalling and interlocking.

12. Estimating and Costing: Various methods of estimation for quantities for various types of construction like building construction, road construction, Rate analysis, Preparation of Tender & contract documents, Centre-line diagram, Building layout, Shuttering plan.

2. COMPUTER SCIENCE

Unit 1: Digital Logic Circuits and Components:

Digital Computers, Logic Gates, Boolean Algebra, Map Simplifications, Combinational Circuits, Flip-Flops, Sequential Circuits, Integrated Circuits, Decoders, Multiplexers, Registers and Counters, Memory Unit.

Data Representation: Data Types, Number Systems and Conversion, Complements, Fixed Point Representation, Floating Point Representation, Error Detection Codes, Computer Arithmetic - Addition, Subtraction, Multiplication and Division Algorithms.

Central Processing Unit: General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, RISC Computer, CISC Computer.

Unit 2: Discrete Mathematics:

Propositional and Predicate Logic, Propositional Equivalences, Normal Forms, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference. Sets and Relations: Set Operations, Representation and Properties of Relations, Equivalence Relations, Partially Ordering. Counting, Mathematical Induction and Discrete Probability: Basics of Counting, Pigeonhole Principle, Permutations and Combinations, Inclusion- Exclusion Principle, Mathematical Induction, Probability, Bayes' Theorem. Graph Theory: Simple Graph, Multigraph, Weighted Graph, Paths and Circuits, Shortest Paths in Weighted Graphs.

Unit 3: Computer Organization and Architecture:

RAM and ROM, Machine instructions, Addressing modes, Memory interface, I/O interface (Interrupt and DMA mode), Microcontrollers, Interfacing, Instruction pipelining, Cache and main memory, Secondary storage.

Unit 4: Programming:

Programming in C++: Tokens, Identifiers, Variables and Constants; Data types, Operators, Control statements, Functions Parameter Passing, Virtual Functions, Class and Objects; Constructors and Destructors; Overloading, Inheritance, Templates, Exception and Event Handling; Streams and Files; Multifile Programs, Object, Class, Inheritance, Polymorphism, Dynamic binding, access modifier.

Unit 5: Data Structures and Algorithms:

Asymptotic notation, Notions of space and time complexity, Worst and average case analysis; Arrays and their Applications; Sparse Matrix, Stacks, Queues, Priority Queues, Linked Lists, Trees, Forest, Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree, B Tree, B+ Tree, B* Tree, Graphs, Sorting (Bubble, Heapsort, insertion, Selection, Quicksort) and Searching Algorithms; Hashing.

Divide and Conquer; Dynamic Programming, Greedy Algorithms, Backtracking, Branch and Bound, Graph Algorithms: Breadth-First Search, Depth-First Search, Shortest Paths, Maximum Flow, Minimum Spanning Trees.

Unit 6: Operating System:

Operating System Structure, Operations and Services; System Calls, Operating-System Design and Implementation; System Boot.

Process Management: Process Scheduling and Operations; Inter-process Communication, Communication in Client-Server Systems, Process Synchronization, Critical-Section

Problem, Semaphores, Synchronization. Threads: Multicore Programming, Multithreading Models, Threading Issues.

CPU Scheduling: Scheduling Criteria and Algorithms; Thread Scheduling. Deadlocks: Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Avoidance and Detection; Recovery from Deadlock. Memory Management: Contiguous Memory Allocation, Swapping, Paging, Segmentation, Demand Paging, Page Replacement, Allocation of Frames, Thrashing, Memory-Mapped Files. Storage Management: Mass-Storage Structure, Disk Structure, Scheduling and Management, RAID Structure.

Unit 7: Database System Concepts and Architecture:

Data Models, Schemas, and Instances; Three-Schema Architecture and Data Independence; Database Languages and Interfaces.

Data Modeling: Entity-Relationship Diagram, Relational Model - Constraints, Languages, Design, and Programming, Relational Database Schemas, Update Operations and Dealing with Constraint Violations;

SQL: Data Definition and Data Types; Constraints, Queries, Insert, Delete, and Update Statements; Views, Stored Procedures and Functions; Database Triggers, SQL Injection. Normalization for Relational Databases: Functional Dependencies and Normalization; Algorithms for Query Processing and Optimization; Transaction Processing, Concurrency Control Techniques, Database Recovery Techniques, Object and Object-Relational Databases; Database Security and Authorization.

Unit 8: Software Engineering:

Process and Life cycle Models, information gathering, requirement and feasibility analysis, data flow diagrams, UML, process specifications, input/output design, planning and managing the project, design, coding, testing, implementation, maintenance, Introduction to Agile technology.

Unit 9: Data Communication:

Components of a Data Communication System, Simplex, Half Duplex and Duplex Modes of Communication; Analog and Digital Signals; Noiseless and Noisy Channels; Bandwidth, Throughput and Latency;

Digital and Analog Transmission; Data Encoding and Modulation Techniques; Broadband and Baseband Transmission; Multiplexing, Transmission Media, Transmission Errors, Error Handling Mechanisms.

Computer Networks: Network Topologies, Local Area Networks, Metropolitan Area Networks, Wide Area Network, Wireless Networks, Internet.

Network Models: Layered Architecture, OSI Reference Model and its Protocols; TCP/IP Protocol Suite, Physical, Logical, Port and Specific Addresses; Switching Techniques. Functions of OSI and TCP/IP Layers: Framing, Error Detection and Correction; Flow and Error Control; Sliding Window Protocol, HDLC, Multiple Access – CSMA/CD, CSMA/CA, Reservation, Polling, Token Passing, FDMA, CDMA, TDMA, Network Devices, Backbone Networks, Virtual LANs. IPv4 Structure and Address Space; Classful and Classless Addressing; Datagram, Fragmentation and Checksum; IPv6 Packet Format, Mapping Logical to Physical Address (ARP).

Unit 10: Current Technologies:

Network Security- Malwares, Cryptography and Steganography; Secret-Key Algorithms, Public-Key Algorithms, Digital Signature, Virtual Private Networks, Firewalls.

Mobile Technology: GSM and CDMA; Services and Architecture of GSM and Mobile Computing; Middleware and Gateway for Mobile Computing; Mobile IP and Mobile Communication Protocol.

Cloud Computing and IoT: SaaS, PaaS, IaaS, Public and Private Cloud; Virtualization, Virtual Server, Cloud Storage, Database Storage, Resource Management, Service Level Agreement, Basics of IoT.

Introduction to AI, Knowledge representation, Fuzzy Logic, Natural Language Processing.

3. ELECTRICAL ENGINEERING

UNIT – 1: Generation of emf & torque in rotating machines; energy-conversion principles; D.C. Motors & Generators: types, construction & principle, windings, general characteristics & applications; speed control methods of D.C. motors. Fractional kilowatt motors; Single-phase and Three-phase induction motor equivalent circuits, crawling, cogging, starting & speed control methods of three phase induction motor; Synchronous motors & alternators construction, principle, winding, hunting, applications. Single-phase Transformer: equivalent circuits, phasor diagram, tests, losses, regulation and efficiency. Three-phase Transformer: general introduction, Parallel operation, auto transformer, tap-changing transformer.

UNIT – 2: DC networks; AC fundamentals; Steady state analysis of DC and AC networks; Electrostatics, magnetism and electromagnetism; KVL/ KCL Laws; Network Theorems -- Thevenin, Norton, Superposition, Maximum power transfer theorems, Millman's theorem, Source transformation; Resonance; mutual coupled circuits, two port networks, Laplace transform, transient response, network functions, network synthesis; Three-phase networks.

UNIT – 3: Open & close loop systems, mathematical modeling of dynamic linear systems, transfer functions, block diagrams, signal flow graph; Time Response Analysis: 1st & 2nd systems, initial & final value theorems; stability of control systems: general introduction, Routh-Hurwitz criteria; compensating networks, concept of controllability & observability under state variable analysis.

UNIT – 4: Types of AC and DC distribution systems; Electrical Measurements: Errors and statistical calculations, types of instruments; measurement of voltage, current, power, energy, resistance, inductance, capacitance, frequency, time, phase; current and potential instrument transformers, Indicating instruments, AC bridges.

UNIT – 5: Semiconductor devices -- Diodes, Zener Diode, BJT, FET, MOSFET, Amplifiers, SCR; Analysis of semiconductor devices circuits; clipping and clamping, oscillators and feedback amplifiers, modulation and demodulation circuits; wave shaping circuits and time base generators; multi-vibrators. Binary system, logic gates, flip-flops, registers, counters, combinational and sequential circuits.

UNIT – 6: Power generating plant, renewable power generating plants types and basic introduction, micro grid and smart grid, energy storage devices, transmission & distribution systems, load curves, tariffs, power system economics, power factor improvement, energy management, energy audit, planning and reliability, selection of sites for plants, estimating and costing of building wiring, illumination concepts; basic ideas of power system stability, equal area criterion; Earthing.

UNIT – 7: Power system protection: grid substations, overcurrent, distance and differential relays basic principles; static relay advantages, AC and DC circuit breakers: general introduction, types, principle, voltage & frequency control; Symmetrical & non-symmetrical fault analysis, sequence networks.

UNIT-8: Thyristors, HVDC transmission: basic introduction, converter concepts, controlled rectifiers and inverter, choppers, speed control techniques for drives & traction systems; FACTS Devices.

Fundamentals of microprocessors, introduction to 8085/8086 microprocessor, overview of 8051 family, computer architecture: memory organization, input–output organization; MATLAB programming: commands, vectors, matrix and array operations, function files, global variables, loops, branches, control flow.

4. Electronics & Communication Engineering

Unit 1: Electronic Devices & Circuits:

Semiconductor Devices: intrinsic and extrinsic semiconductors and their properties. p- n junction diode, Zenner diode, Tunnel diode, BJT, JFET, MOS, MOSFET, LED, PIN and Avalanche photo diode. Power Switching Devices: SCR, GTO, Power MOSFET, Basics of Optoelectronics. Simple diode circuits, clipping, clamping, rectifier. Amplifiers: single-and multi-stage, differential and operational, feedback, and power. Simple op-amp circuits. Filters. Sinusoidal oscillators; criterion for oscillation; single-transistor and op-amp configurations. Function generators and wave-shaping circuits, 555 Timer. Power supplies.

Unit 2: Digital circuits:

Boolean algebra, minimization of Boolean functions; logic gates; digital IC families (DTL, TTL, ECL, MOS, CMOS). Combinational circuits: arithmetic circuits, code converters, multiplexers, decoders, PROMs and PLAs. Sequential circuits: latches and flip-flops, counters and shift-registers. Sample and hold circuits, ADCs, DACs. Semiconductor memories. Microprocessor (8085): architecture, programming, memory and I/O interfacing.

Unit 3: Electronic Measurement and Instrumentation:

Basic Concepts, Standards and error Analysis: Measurement of basic Electrical quantities and parameters; Electronic Measuring Instruments and their Principles of Working; analog and digital measurements, Comparison, Characteristics, Applications. Transducers, Electronic Measurements of Non-Electrical Quantities like Temperature, Pressure, Humidity etc. Basics of Telemetry for Industrial use. Introduction to Biomedical instrumentation.

Unit 4: Network Theory:

Nodal and mesh analysis. Network theorems: Superposition, Thevenin's and Norton's Theorem, Maximum power transfer Theorem, Wye-Delta transformation. Solution of network equations using Laplace transform: frequency domain analysis of RLC circuits. 2-port network parameters: driving point and transfer functions. State equations for networks.

Unit 5: Electromagnetics:

Elements of vector calculus; Gauss' and Stokes' theorems, Maxwell's equations, Wave equation, Poynting vector. Plane waves: skin depth. Transmission lines: characteristic impedance; impedance transformation; Smith chart; impedance matching; S parameters, pulse excitation. Waveguides: modes in rectangular waveguides; boundary conditions; cut-off frequencies.

Unit 6: Signals and Systems:

Definitions and properties of Laplace transform, continuous-time and discrete-time Fourier series, and Fourier Transform, DFT and FFT, z- transform. Sampling theorem. Linear Time-Invariant (LTI) Systems: definitions and properties; causality, stability, impulse response, convolution, parallel and cascade structure, frequency response, group delay, phase delay. Signal transmission through LTI systems. Random signals and noise: probability, random variables, probability density function, autocorrelation, power spectral den

Unit 7: Control Systems:

Basic control system components; block diagram description, Open loop and closed loop (feedback) systems and stability analysis of these systems. Signal flow graphs and their use

in determining transfer functions of systems; transient and steady state analysis of LTI control systems and frequency response. Tools and techniques for LTI control system analysis: root loci, Routh-Hurwitz criterion, Bode and Nyquist plots. Elements of lead and lag compensation, elements of Proportional-Integral-Derivative (PID), PD, PI Control Systems. State variable representation and solution of state equation of LTI control systems.

Unit 8: Analog & Digital Communication:

Analog communication systems: amplitude and angle modulation and demodulation systems, superheterodyne receivers; signal-to-noise ratio (SNR) calculations for amplitude modulation (AM) and frequency modulation (FM) for low noise conditions.

Digital communication systems: pulse code modulation (PCM), differential pulse code modulation (DPCM), digital modulation schemes: amplitude, phase and frequency shift keying schemes (ASK, PSK, FSK), matched filter receivers, bandwidth consideration and probability of error calculations for these schemes. Fundamentals of information theory and Coding. Basics of FDMA, TDMA and CDMA.

Unit 9: Mobile Communication and Networks

Cellular concepts- Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 1G, 2G, 3G, 4G and 5G cellular standards. Fading channels- Multipath and small-scale fading- Doppler shift, statistical multipath channel models, narrowband and wideband fading models, power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading. System examples- GSM, EDGE, GPRS, IS-95, CDMA 2000, WCDMA, Local area networks, Wi-Fi networks, Bluetooth Technology.

Unit 10: Optical Fiber Communication

Introduction to vector nature of light, propagation of light, propagation of light in a cylindrical dielectric rod, Ray model, wave model. Different types of optical fibers, Modal analysis of a step index fiber. Signal degradation on optical fiber due to dispersion and attenuation. Fabrication of fibers and measurement techniques like OTDR. Optical sources - LEDs and Lasers, Photo-detectors - pin-diodes, APDs, detector responsivity and noise. Optical receivers, optical switches, optical couplers and optical amplifiers. WDM and DWDM systems.

Unit 11: Satellite Communication

Introduction to Satellite Communication: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications and frequency bands used for satellite communication. Orbital Mechanics: Orbital equations, Kepler's laws, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc. of a satellite, concepts of Solar day and Sidereal day. Satellite sub-systems: Study of Architecture and Roles of various subsystems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems etc. Concept and working of Direct to Home (DTH) TV. Introduction of Global Position System (GPS) and its applications.

Unit 12: Antenna and Signal Propagation

Fundamental Concepts-Physical concept of radiation, Radiation pattern, near-and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, Broadband Antennas-Log-periodic and Yagi-Uda antennas, frequency independent antennas, broadcast antennas. Antennas for mobile terminal monopole antennas, PIFA, base station antennas and arrays. Micro strip Antennas-Basic characteristics of micro strip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas. Basic concept of smart antennas and it's benefits. Signal propagation- mechanism- reflection, refraction, diffraction and scattering.

5. INFORMATION TECHNOLOGY (I.T.)

Unit 1: Computer Organization & Architecture

Digital Logic Family: Logic Gates, Logic functions, Boolean Algebra, Map Simplifications, Design of Sequential and Combinational Logic Circuits, Number System and data representation, Logic Gates, Flip-Flops, Integrated Circuits, Decoders, Multiplexers, Memory Organization, DMA.

Unit 2: Programming and Data Structures

Programming in C: Tokens, Identifiers, Data Types, Sequence Control, Loops, Array, Function, Recursion, Structure, File.

Data Structure: Stack, Queue, Linked List, Binary and Linear Search, Tree, Graph, Sorting (Bubble, Heap, Quick, Insertion, Selection sort).

Unit 3: Operating System:

Processes, Threads, Inter Process Communication, Semaphores, Concurrency, Synchronization, Deadlock, CPU Scheduling, Memory Management and Virtual Memory, File System.

Linux Operating Systems: Design Principles, Kernel Modules, Process Management, Scheduling, Memory Management, File Systems, Input and Output; Inter-process Communication, Network Structure.

Unit 4: Computer Networks:

Data Communication Model, Data Transmission (analog and digital), modulation, multiplexing., Wired and Wireless Transmission Media, LAN, MAN, WAN, Routing Protocols, Network Technologies (ATM, Frame Relay, DSL, ISDN), MANET, Wireless network and technologies.

IPv4 Structure and Address Space; Classful and Classless Addressing; Datagram, Fragmentation and Checksum; IPv6 Packet Format, Mapping Logical to Physical Address (ARP), Routing Algorithms, TCP and UDP Protocols; Flow Control, Error Control and Congestion Control in TCP.

Unit 5: Database Management System

Basic DBMS Terminology, Database System versus File System, Keys, Entity Relationship Model, Relational Model, Distributed Database System.

SQL: Data Definition and Data Types; Constraints, Queries, Insert, Delete, and Update Statements; Views, Stored Procedures and Functions; Database Triggers, SQL Injection. Normalization for Relational Databases: Functional Dependencies and Normalization; Algorithms for Query Processing and Optimization; Transaction Processing, Concurrency Control Techniques, Database Recovery Techniques, Database Security and Authorization.

Unit 6: Information Security:

Network Attacks, IPsec, Network Scanning, Security of web Browsers and Servers, Firewalls and Intrusion Detection System. Malwares, Cryptography and Steganography, Encryption Algorithms (DES & RSA), Secret-Key Algorithms, Public-Key Algorithms,

Digital Signature, Virtual Private Networks.

Unit 7: Software Engineering:

Software Requirement Specification, Software Process and Design Models, Modularity, Information Hiding, Functional Independence, Cohesion and Coupling; Object-Oriented Design, Data Design, Architectural Design, User Interface Design, Component Level Design.

Software Testing: Verification and Validation; Error, Fault, Bug and Failure; Unit and Integration Testing; White-box and Black-box Testing; Basis Path Testing, Control Structure Testing, Deriving Test Cases, Alpha and Beta Testing; Regression Testing, Performance Testing, Stress Testing.

Unit 8: Data Warehousing & Mining:

Data Warehousing: Introduction, Architecture, Implementation, OLAP, Data Cleaning, Data Reduction, Data Integration and Transformation, Data Compression.

Data Mining: Data Mining Concepts, Architecture of Data Mining System, Mining Class Comparison, Mining Descriptive Statistical Measures, Associative Rule Mining, Apriori algorithm, Supervised and Un-supervised algorithms related to data mining, Classification and Prediction.

Unit 9: Web Design and Development:

World Wide Web (WWW): Uniform Resource Locator (URL), Domain Name Service (DNS), Resolution - Mapping Names to Addresses and Addresses to Names; Electronic Mail Architecture, SMTP, POP and IMAP; TELNET and FTP, HTML, DHTML, XHTML, Java Script, Python and PHP.

Unit 10: Emerging Technologies in the field of IT:

Fundamentals and Applications of AI, E-Commerce, Multimedia, Expert Systems, Digital marketing, Introduction to mobile application development, Concept of Cyber security, Basics of IoT.

6. Mechanical Engineering

Unit 1: Engineering Thermodynamics and Heat Transfer-

Thermodynamic systems and processes, Zeroth law of thermodynamics, Properties of pure substances, First law of thermodynamics applied to closed and open systems, Second law of thermodynamics and their applications, Carnot, Otto, Diesel and Dual cycles, Properties of steam, Rankine cycle, Modified Rankine and Reheat cycle, Regenerative cycle.

Conduction: One- dimensional steady state heat conduction, Heat conduction through composite walls, Critical thickness of insulation, Heat transfer from finned surfaces, fin efficiency and effectiveness. Convection: Free and forced convection, Dimensional analysis, Heat transfer correlations, Hydrodynamic and thermal boundary layers, boundary layer equations and their solutions for flat plates and pipes. Radiation: Planck's distribution law, Radiation properties, Kirchoff's law, diffuse radiation, Lambert's law, Intensity of radiation, Heat exchange between two black surfaces, Heat exchange between gray surfaces, radiation shield, Electrical analogy. Boiling and Condensation: different regimes of boiling heat transfer, Correlations of boiling heat transfer, Film wise and Drop wise condensation. Heat Exchangers: Different types of heat exchangers, Logarithmic mean temperature difference and effectiveness for parallel flow and counter flow heat exchangers, Correction factor and fouling factor, Heat exchanger design by LMTD and effectiveness NTU methods.

Unit 2: Fluid Mechanics and Machines-

Basics of fluid mechanics, Buoyant force, stability of floating and submerged bodies, kinematics of Fluid flow, Dynamics of fluid flow, Dimensional Analysis, Viscous flow, Turbulent flow, Concept of boundary layers, Flow through pipes. Impact of Free Jet, Theory of Turbomachines, Classification, Reaction, impulse and mixed flow turbines, Specific speed, their efficiencies, characteristics and principles of governing. Draft tube, cavitation, water hammer and surge tanks. Centrifugal and Reciprocating pumps, air vessels, operating characteristics. Hydraulic accumulator, hydraulic press, lift, ram, coupling and torque converter.

Unit 3: Theory of Machines and Vibrations-

Links and pairs; kinematics chains; Mechanisms and machines; Inversion; Absolute and relative motions; Instantaneous centres: Acceleration analysis; Cam profiles & different types of followers; cams with specified contours; Fundamental laws of gearing; Types of gears, Gears trains, Belts, rope and chain drives. Concept of free body and its equilibrium; Static & Dynamic force analysis; Fluctuation of energy and speed; Fly wheels & governors. Balancing of rotating masses, Power Screw; Brakes and Clutches; Gyroscopic action and Gyroscopic couple, Friction.

Free & Forced vibration with single degree of freedom, Natural frequency, Principle of conservation of energy, Principles of virtual work, Damping, Forced vibrations: Harmonic excitation, Mechanical impedance, Critical speed, Vibration Isolation, Whirling of shafts, Two degree of freedom systems.

Unit 4: Internal Combustion Engines and Refrigeration & Air-conditioning-

Ideal and actual cycles of operation, fuels, Combustion in SI and CI engines, Carburettors and fuel injection systems for SI engines, fuel injection systems for diesel engines, lubrication systems, cooling systems, supercharging, scavenging, engine performance, testing and exhaust emission characteristics, exhaust pollution.

Air refrigeration system, Heat pump, COP, Vapor compression refrigeration cycle, Selection of refrigerants for different applications, Vapor Absorption Refrigeration System, Psychrometry and Psychrometric properties, relations, charts and uses, evaporative cooling, air washers, human comfort, factors affecting comfort.

Unit 5: Automobile Engineering and Power Plant Engineering-

Transmission system, steering system, suspension systems, tyres, springs and shock absorbers, brakes and their actuations, ignition systems, Automotive pollution and its control strategies. Steam Power Plants: Layout and site selections. Fuel storage and handling. Cooling towers. Diesel & Gas Turbine Power Plants: General layout, elements, fields of use, comparison with steam power plants. Nuclear Power Plants: Nuclear materials, waste disposal, fuels, coolants, moderating and reflecting materials, cladding materials, Disposal of nuclear waste, Nuclear reactors, location of nuclear power plants, comparison of nuclear plants with thermal plants. Enrichment, safety and control. Hydro-electric Power Plants, Power Plant Economics, performance and operating characteristics of power plants, Combined cycle plants, Co-generation and tri-generation, peak load and base load power plants.

Unit 6: Mechanics of Solids, Machine Design and Material Science-

Concepts and analysis of stresses and strains; mechanical properties; ductile and brittle materials; members in uni-axial state of stress; Transformation of stresses, members subjected to axi-symmetric, torsional and flexural loads; deflection in beams, members subjected to combined loads; elastic stability of columns. Eccentric loading.

Design for strength, Stress concentration, Introduction of various design considerations like strength, stiffness, weight, cost, factor of safety, space etc; Design of shaft, coupling, springs, clutch, brakes, bearings, Gear, thick and thin cylinder, Concept of fracture in ductile and brittle metals, Creep behaviour in metals.

Crystal structure, Space lattice, Miller indices, Imperfection in crystals, mechanism of plastic deformation, Theory of work hardening and recrystallization, concept of creep, fatigue and fracture, Phase diagrams, Heat treatment of steels, Plain carbon steel, alloy steels, effect of alloying elements in steel, composition, application and properties of common engineering materials.

Unit 7: Manufacturing Technology-

Press working of sheet metal: Types of presses and operations. Die materials, Construction details of die set. Machine tools and operations, cutting tools & materials: single point tool, cutting speed, feed and depth of cut. Metal Cutting: Orthogonal cutting, velocity relationships, force and power. Tool Life, Economics of machining. Capstan and Turret Lathes; boring and

broaching machine. Indexing head; milling operations. Grinding machines and operations; Grinding Wheels. Cutting Fluids, Introduction to NC and CNC machines. FMS. Foundry technology, Welding technology, Metrology: Dimensional and Geometrical accuracy, Standardization, Limits, fits and tolerances, Design of gauges.

Unit 8: Industrial Engineering-

Introduction to Industrial Engineering & productivity, Functions of Management, Organizational Structure, Financial Management, Marketing Management, Personnel Management, Wage, Incentives & Payment Systems, Labour relations & Legislations, Cost & Cost Control. Depreciation, budget and budgetary control. Types of forecasting, Facilities Location & Layout Planning, Scheduling, routing, sequencing, Aggregate Production planning, Capacity planning, Inventory Control, Material requirement Planning, Manufacturing Resource Planning, Enterprise Resource Planning Work Study: Methods study, time study, Work Measurement & Design. Ergonomic aspects in industrial design. Industrial Safety. Work & Job design, Job Evaluation & Merit Rating. CPM and PERT. JIT, Supply Chain, Group Technology, Computer aided process planning.

Unit 9: Product Design and Operations Research-

Principles of modern design, Human factors in design and applied ergonomics. Product design methods. Legal issues in product design and design resources.

General methodology of Operations Research, Linear optimization models, simplex algorithms, duality; dual linear programming, Sensitivity; Integer programming, Assignment models, Transportation problems, Theory of Games, Queuing Theory. Application to industrial problems. Sampling method.

Scheme of examination and syllabus for the post of Vice Principal/Superintendent ITI

(i) Written Examination - 150 Marks

S. No.	Subject	No. of Questions	Total Marks	Examination Duration
1	Civil, Mechanical, Electrical, Information Technology, Computer Science, Electronics & Communication	150	150	2.30 Hours
	Total	150	150	

नोट:- अभ्यर्थी अपनी उपाधि अनुसार जिस विषय (Civil, Mechanical, Electrical, Information Technology, Computer Science, Electronics & Communication) की परीक्षा देना चाहता है, उस विषय का चयन करें।

(ii) Interview- 15 Marks

1. The competitive examination shall carry 150 marks and 150 questions of Multiple Choice Type questions.
2. There shall be one paper. Duration of Paper will be Two hours and Thirty Minutes.
3. Negative marking shall be applicable in the evaluation of answers. For every wrong answer one-third of the marks prescribed for that particular question shall be deducted.

Explanation: - Wrong answer shall mean an incorrect answer or multiple answers.

Syllabus and Scope of Papers: - The Scheme & Syllabus of written examination shall be such as may be decided by the Commission, from time to time.

Note: -The Candidates shall have to appear in the written examination and the candidates who obtained such marks as may be fixed by the Commission in their discretion shall be summoned by the Commission for interview. The candidates summoned by the Commission for interview shall have to appear in interview. The allocation of marks for interview shall not be more than 10% of the total marks taken into account for the purpose of selection.

उक्त पद हेतु आयोजित की जाने वाली परीक्षा के लिए ओ.एम.आर. उत्तरपत्रक में प्रश्नों के विकल्प भरने के संबंध में विशेष निर्देश:-

1. Each question has five options marked as 1, 2, 3, 4, 5. You have to darken only one circle (bubble) indicating the correct answer on the Answer Sheet using BLUE BALL POINT PEN.
2. It is mandatory to fill one option for each question.
3. If you are not attempting a question then you have to darken the circle '5'. If none of the five circles is darkened, one third (1/3) part of the marks of question shall be deducted.
4. After solving question paper, candidate must ascertain that he/she has darkened one of the circles (bubbles) for each of the questions. Extra time of 10 minutes beyond scheduled time, is provided for this.

A candidate who has not darkened any of the five circles in more than 10% questions shall be disqualified.