SCHEME AND SYLLABUS FOR THE POST OF MANAGERS (ENGINEERING) IN HYDERABAD METROPOLITAN WATER SUPPLY & SEWERAGE BOARD

SCHEME
(Degree standard)

PART-A: WRITTEN (OBJECTIVE TYPE) EXAMINATION				
Paper-1	General Studies & Mental Ability	150 Marks	150 Minutes	150 Questions
Paper-2	Concerned Engineering subject i.e., Mechanical OR Civil OR Electrical OR Electronics & Communication Engineering	300 Marks	150 Minutes	150 Questions
PART-B:	INTERVIEW	50 Marks		

SYLLABUS

PAPER-1.: *GENERAL STUDIES MENTAL ABILITY*

1. General Science – Contemporary developments in Science and Technology and their implications including matters of every day observation and experience, as may be expected of a well-educated person who has not made a special study of any scientific discipline.

2. Current events of national and international importance.

3. History of India – emphasis will be on broad general understanding of the subject in its social, economic, cultural and political aspects with a focus on AP Indian National Movement.

4. World Geography and Geography of India with a focus on AP.

5. Indian polity and Economy – including the country's political system- rural development – Planning and economic reforms in India.

6. Mental ability reasoning and inferences

PAPER -2 - MECHANICAL ENGINEERING

Theory of Machines

Constrained motion, plane mechanisms, velocity and acceleration analyses, instantaneous centre, flywheels and their applications, balancing of reciprocating and rotating masses, planar cams and followers, tooth profiles, types of gears, fixed axis and planetary gear, drives principles of gyroscope vibration of free and forced one degree of freedom systems with and without damping, transmissibility and vibration isolation, critical speed of shaft.

Mechanics of solids

Stress and strain in two dimensions, Mohr's circle theories of failure. Bending moment and shear force diagrams. Deflection of simple beams, buckling of columns, torsion in shafts, thin and thick cylinders, shrink fit and thermal stresses.

Machine design

Material and manufacturing considerations in design, design for static and dynamic loading, fatigue strength, stress concentration, factor of safety, design of bolted riveted and welded joints, power screws, helical springs, hydrodynamic lubrication and journal bearing, rolling element bearings, design of spur gears, design of shifts, keys and couplings, clutches and brakes, belt and rope drives.

Manufacturing process

Classification of manufacturing process. Casting - casting defects, investment casting, die casting, centrifugal and continuous casting. Metal forming: hot and cold working. Unconventional machining and forming methods. Powder metallurgy. Welding. Jigs and fixtures, gauges and comparators. Metal cutting: Mechanics of orthogonal cutting, machinability, economics of machining, chip formation, forces, power and surface finish in turning, milling and shaping operations. Grinding, wheel wear mechanism in grinding.

Metallurgy and Material Science

Phase diagram of Binaryalloys, Iron-Iron Carbide diagram. Construction and Interpretation of T.T.T. curve for steels. Case hardening, Age hardening. Alloy steels. Mechanism of fatigue and creep. Types of failures Diffusion.

Production management

Production planning and control, Forecasting assembly line balancing Product, development. Production control charts. Break-even-analysis, PERT and CPM. Control operations: Inventory control – ABC analysis, EOQ model. MRP-II, JIT work study, value engineering. Linear programming, graphical and simplex methods and queuing (Single server, Poisson Queue) theory. Maintenance engineering Quality assurance control charts for variables and attributes.

Thermodynamics

Reversible and irreversible processes. Thermodynamic systems. Applications of First and Second law of thermodynamics. Concept of entropy. Availability and unavailable energies.

Tds relations, Properties of pure substances.

I.C. Engines. Fuels and Combustion

Thermodynamic analysis of cycles. SI and CI engines. 4 stroke and 2 stroke engines. Performance testing and heat balance of IC engines. Detonation and knocking phenomena in I.C. engines. Carburetion and fuel injection systems. Engine emissions and control.

Heat Transfer, Refrigeration and Air Conditioning.

Modes of heat transfer, One dimensional steady and unsteady conduction, Heat transfer with fins, Convective heat transfer, Forced Convection over flat plate and through tubes, Free Convection over vertical flat plate and cylinders, Radiative heat transfer – Black and Gray surfaces, Shape factors. Heat Exchanger performance – LMTD and NTU method.

Refrigeration cycles and systems. Vapour compression, Vapourabsorption and Air Refrigeration systems. COP of a Refrigerator. Condensers, Evaporators and Expansion devices and Controls.

Psychrometry and Psychrometric processes. Comfort conditions. Estimation of cooling and heating load.

Fluid mechanics and turbo machinery

Continuity, Momentum and Energy equations. Adiabatic and isentropic flow. Flow through turbo machinery passages. Classification of turbo machines. Fans, Blowers and Compressors. Axial and Centrifugal machines. Steam and Gas Turbines. Pumps and Hydraulic Turbines. Model tests. Work done and Efficiencies. Specific speed.

Energy Systems

Types of Power plants. Thermal, Hydro, Nuclear and gas Turbine Power plants. Layout and Selection of a Power plant. Power plant Economics. Cost of electrical energy. Importance of Renewable Energy sources. Solar, Wind, Bio-mass and Ocean Energy Technologies, Solar thermal and Solar photovoltaic power generation.

PAPER -2 - CIVIL ENGINEERING

Section (A): Strength of Materials, Theory of Structures and Designs.

a) Strength of materials: Simple stresses and strains, principal stresses and strains, shear force and binding moment of beams, Derivation of $M/I = f_b/y=E/R$, Deflection of beams, Direct and bending stresses, torsion of circular shafts, columns and struts.

b) Theory of structures: Castigliano's I and II theorems, slope deflection, moment distribution and Kani's methods of analysis applied for indeterminate beams and rigid frames.
Rolling loads: Propositions for the maximum bending moment at any given section and under any given load, Equivalent uniformly distributed load, influence line for uniformly distributed load shorter than span for maximum bending moment and shear force, Maximum bending moment for series of point loads travelling the girder, Influence lines for tresses.
Arches: Three hinged and two hinged parabolic arches influence lines for three hinged arches.

c) Steel structures: Design of simple, compound beams and laced and batened columns. Design of column bases and footings, Design of highway and railway bridges through and deck type plate girders, warren girders and pratt truss.

d) Limit state method: Design of singly, doubly reinforced and T-beams, Design of lintel one way and two way slab, Design of long and short columns, design of rectangular and combined footings.

e) Pre-stressing concrete: Methods of pre-stressing, pre-tensioned and post-tensioned numbers, analysis and design of sections for flexures, losses in pre-stressing.

Section (B) Soil Mechanics and Foundation Engineering

a) Soil Mechanics: Definitions and relationships, particle size distribution, Atterburg limits, Permeability and permeability tests, Seepage pressure, quick sand condition, Laplace equation, Flow net, construction, properties, uses and applications.

b) One dimensional consolidation, co-efficient of compressibility consolidation settlement, pre-consolidation pressure, one dimensional consolidation equation, consolidation test, compaction, Field compaction method, proctor's and modified compaction test, field compaction control, factors affecting compaction.

c) Shear strength, Moher's Coulomb failure theory, effective stress, Direct shear test, Triaxial compression test and vane shear test, Rankine's theory of active and passive earth, pressures, Retaining walls, Horizontal and sloping back fill, Coulomb's Wedge theory and Rohban's construction.

d) Infinite and finite slopes, Swedish circle method, Friction circle method, Taylor's Stability number, Bearing capacity, definations, Terzaghi's analysis for shallow footing, general and local shear failure, Terzaghi's semi empirical equations for square and circular footings, effect of water table on bearing capacity.

e) Types of selection of footing, Raft, pile and floating foundations, settlement, computation for immediate and consolidation settlement, Boussarlugy equation for stress under point load and uniformly distributed load, pressure bulb, vertical pressure under uniformly distributed load on circular area, New mark influence chart.

Section (C) Fluid Mechanics:

Fluid properties, Fluid Statics – Forces on flat plate and curved surfaces.

Kinematics and Dynamics of Fluid flow, stream lines, equation of continuity, stream function and velocity potential function, flow nets, types of flows.

Euler's equation of motion, Energy and Momentum equations and their applications to pipe flow, free and forced vertices, venturimeters, and Notches & Weirs.

Laminar flow through circular tubes, Reynold's experiments, Flow through pipes, hydraulic gradient and total energy lines, pipes in series and parallel, syphom, Minor losses in pipes.

Open channel Flow, uniform and non-uniform flows, best hydraulic sections, specific energy and critical depth, Rapidly varied flow – hydraulic jump and its applications, Gradually varied flow – differential equations, classification of surface profiles.

Boundary layers – development of b.L. flow, laminar and turbulent boundary layers, laminar sub-layer, smooth and rough boundaries, drag and lift.

Dimensional analysis and similitude: Types of similarities, model studies, undistorted and distorted models, Bukingham II-theorem – applications.

Section (D): Computer Programming:

Type of computers – components of computer, historical development of computing systems. Different languages, Flow charts.

Fortran/Basic programming, constants & Variables, expressions, arithmetic statements, library functions.

Control statements, GO TO statements – Un conditional and computed, IF statements, DO statements.

Subroutines and Function sub-programmes – Arguments, CALL statement RETURN statement, Declaration statements.

Input and output statements, and Quoted Formats, FORMAT statements, Field specification, Stop and END statements.

Subscripted Variables, Arrays, DIMENSION statement, Simple applications of computer programming in civil engineering.

Note: A candidate shall answer questions from any two parts.

PART–A: Building Materials, Construction and Surveying:

Building materials: Timber, stones, bricks, sand, limes, cement, paints, varnishes and damp proofing material.

Brick work for walls, types of brick bonds, design of brick masonry walls as per IS code, detailing of walls, floors, roofs, ceilings, stair cases, doors and windows, finishing of buildings – plastering, pointing and painting – IS codes.

Use of Ferro cement, fiber – reinforced and polymer concrete in construction, building estimates and specifications.

Construction Scheduling, PERT and CPM methods.

General surveying – chain and compass survey, plane table survey – in combination with one another.

Levelling and contouring:- Fly levelling, reciprocal levelling, net levels, Reduction of levels, curvature and refraction corrections, characteristics of contours – estimation of earth work.

Theodolite survey: Temporary and Permanent adjustments, Traverse survey, computation of areas by co-ordinate system, theory of simple circular curve by linear and instrumental methods.

Tachometry: Stadia wires, Fixed and mobile wires, Tachometric tables, tachometric alidade, Reduction by calculations.

PART–B: Water resources and Irrigation Engineering:

Hydrology: Hydrologic cycle, precipitation, evaporation, transpiration, infiltration. Run-off hydrograph, unit hydrograph, flood estimation frequency analysis.

Ground Water: Ground water resources, specific yield, storage coefficient of permeability, confined and unconfined aquifers, radial flow into a well under confined and unconfined conditions, recuperation tests.

Water Resources Planning: Single and multipurpose projects, storage capacity, zones of storage, reservoir losses, reservoir sedimentation, flood routing through reservoirs, economics of water resources projects.

Water Requirement of Crops: Consumptive use of water, Duty and Delta, frequency of irrigation, efficiency of irrigation, Irrigation methods.

Storage Works: Types of Dams and their characteristics, Gravity dams principles of design, criteria for stability, control of seepage, Earth dams – Design principles, spillways – types and their suitability, energy dissipation, crest gates.

Canals: Alignment of canals types of canals, design of unlined canals Lacey's regime theory, cross masanry works – canal falls, Cross Drainage works – Aqueducts and super passages.

Diversion Works: Components of Diversion scheme, Weirs on permeable foundations – Bligh's and Khosla's theories – Design principles.

PART–C: Environmental Engineering:

a) Water Supply: Protected Water Supply Scheme, Rate of demand, Population forecast, Analysis of water, Hydrogen-ion concentration, Sedimentation, Coagulation Chlorination, Methods of disinfection, Break point chlorination, Slow sand, Rapid sand and Pressure filters.

b) Hardness of Water: Removal of temporary and permanent hardness, Distribution systems of water, pipe appurtenances, Analysis of distribution system using Hardy cross method, general principle of optimal design based on cost and head loss ratio criterion, Maintenances of distribution systems, pumping station and their operation.

c) Sanitary Engineering: Methods of carrying refuses, systems of swarage, Sewers of different materials and shapes, self cleansing velocity, purification of natural streams, empirical formulae used in the design of sewers, deep man holes and their location, Automatic flushing tank, Different types of traps and classification.

d) Quality of Sewage: Primary treatment to sewage, carbon cycle, B.O.D., C.O.D., and dissolved oxygen, Grit chamber, Detritus tank, skimming tank, sludge digestion process, contact beds, septic tank, imhoff tank, Activated sludge process, sludge volume index.

e) Sources, effects and remedial measures of water, Air and Noise pollutions, particulate and Dust collection devices like internal separators, wet collection devices and electrostatic precipitators.

PART–D: Transportation Engineering:

a) Road development in India, Road planning, High way alignments, width of pavement, camber, types of gradient, Resistance to traction, sight distances, Super elevation and centrifugal ratio, circular, compound, vertical, reverse and transition curves.
b) Types of Road: Water Bound Macadam Road, Bituminous and cement concrete Roads, Flexible and rigid pavements, types of study for traffic, Road parking, Road accidents and traffic regulation, inter sections and rotary.
c) Permanent Ways: Rails, creep of rails, blast, sleepers, Fastings and Fixtures, Gauges, Trunouts, Crossings, Types of crossings, Railway track, drainage, Maintenance of track components, Traffic signals.
d) Station yards and Machinery, station buildings, Platform sidings, turn tables, signal and inter locking, level crossing and necessary precautions.
e) Development of Air Port: Take off and landing distances, characteristics of jet air craft, selection of site for air port, Survey for selection of site, Wind rose diagram, Run way width, length and design criteria, standard for general aviation.

PAPER -2 - ELECTRICAL ENGINEERING

I. Electrical Circuits:

Basic electrical laws, Analysis of DC networks, transient response of RLC networks excited by impulse, step, ramp and sinusoidal excitations. Transform methods, transfer functions, poles and zeros steady state AC networks, frequency domain analysis, resonance, coupled circuits, two port networks, three phase networks, power in a.c. networks, power measurement in 3-phase networks.

II. E.M. Theory:

Electro static and electro magnetic fields, vector methods, Fields in dielectric, conducting and magnetic materials, Laplace and Poisson's equation. Time varying fields, Maxwell's equation, Poynting Theory, properties of transmission lines.

III. Electrical measurement and Instruments:

Electrical standards, Error analysis, Measurement of current, voltage, power, energy, power factor, resistance, inductance capacitance frequency and loss angle. Indicating instruments, extension of range of instruments, DC and AC bridges. Electronic measuring instruments. Electronic multimeter, CRO, frequency counter, digital voltmeter, transducers, Thermocouples, Thermistor, LVDT, strain gauges, Piezo electric crystal, Measurement of non-electrical quantities like, pressure, velocity, temperature, flow rate, displacement acceleration and strain.

IV. Control Systems

Open and closed loop control systems, Mathematical modeling, block diagram, signal flow graphs, time response and frequency response of linerar systems, error constants and series Rootlocus technique, Bodeplot, polar plot, M-circles, N-circles, Nichol's charts, stability, Routh Hurwitz criteria. Nyquist stability criteria, compensators, design in frequency domain. Control system components. Servo motors, synchros, tacho generator, error detector. State variable approach, modeling, state transition matrix, transfer function, response.

V. Electronics:

Solid state devices and circuits. Small and large signal-amplifiers with and without feedback at audio and radio frequency, multistage amplifiers. Operational amplifiers and applications. Integrated circuits oscillators, RC, LC and crystal oscillators wave form generators, multi-vibrators – Digital circuits, Logic gates, Boolean algebra combinational and sequential circuits. A to D and D to A converters Micro processors (8085) instruction set, memories, interfacing programmable peripheral devices – Number system flow charts – expressions and statements in C – language – simple programs for engineering application.

VI. D.C. ELECTRICAL MACHINES:

Fundamentals of electro mechanical energy conversion, constructional features of D.C. Machines, emf equation types and characteristics of generators application, Torque in DC motor, types of DC motors, applications. Testing of D.C. motors, efficiency, and starting and speed control.

VII. TRANSFORMERS:

Construction – Principle of operation of 1-phase transformers – Vector diagram on No Load and – Load – Parallel operation – Regulation – efficiency – Equivalent circuit 3 phase transformer connections – Scott connection.

VIII. INDUCTION MOTORS:

Production of rotating magnetic field, production of torque types of motors equivalent circuits, Circle diagram, torque slip characteristics, starting and maximum torque, speed control, principle of single phase induction motors, Applications.

IX. SYNCHRONOUS MACHINES:

Generation of emf in 3 phase AC Generator, Armature reaction, regulation by Synchronous inpedance and Ampere turn methods, parallel operation, transient and sub-transiat reactances, theory of salient pole machines.

Synchronous Motor: Torque production, performance characteristics, methods of starting, V-Curves, synchronous condenser.

Special Machines: Stepper motor, Methods of operation, Amplidyne and metadyne-applications.

X. ELECTRICAL POWER GENERATION:

General layout – Types of power stations, economics of different types, base load and peak load stations, load factor and its effects, pumped storage schemes.

XI. POWER TRANSMISSION:

Calculation of line parameters, concepts of short, medium and long transmission lines, ABCD parameters, insulators, Corona, P.U. quantities, fault calculations, symmetrical components load flow analysis using Gauss Seidal, New-ton Raphson, methods, economic operation, stability, steady state and transient stability, equal area criterion, ALFC and AVR control for real time operation of interconnected systems.

XII. POWER SYSTEM PROTECTION:

Principles of arc quenching, circuit breaker classification, Recovery and restriking voltages, relaying principles over current, directional over current relays-generator and transformer protection using differential relays-line protection using distance relays Surgeo phenomena in transmission lines – Travelling wave theory, protection against surges.

XIII. UTILISATION:

Industrial Drives – Motors for various drives – Braking methods – Speed control of motors – Economics of rail traction – Mechanics of train movement – Estimation of power and energy requirements – Illumination – Laws Factory lighting – Street lighting – Induction and dielectric heating.

PAPER -2 - ELECTRONICS & COMMUNICATIONS ENGINEERING

I) Computer Programming: Number systems, Binary, Octal, Hexadecimal, Decimal and their conversions, fixed and floating point representation of numbers; concept of flow charts and Algorithms, Control and Decision Statements, Loops, Subroutines.

II) Network Theory: Kircheff's Laws, Node and Loop analysis, Ideal sources, Network Theorems, Thevinins's, Norton's Reciprocity, Superposition and Max. Power Transfer Theorems, Applications to simple R.L.C. Networks.

Linear time invariant circuits, Integro differential equations equations in RLC networks, Initial conditions for inductors and capacitors, Response of networks to step, impulse, sinusoidal and exponential exitations, steady state analysis, Vector representation, series and parallel resonance, Quality factor and bandwidth.

Problems with initial conditions and switches, zero input and zero state response, Time constants for RC and RL networks.

III) Network solutions using laplace Transform Techniques, complex frequency, properties of Laplace Transforms, initial and final value theorems, Laplace Transforms of periodic signals, Inverse Laplace Transform.

Fourier series, Exponential and Trignometric Fourier series, Fourier Transforms, Properties, Parseval's Theorem.

Convolution integral, Response to arbitrary excitation, Graphical representation of convolution integral.

Two port network parameters, Z, Y, Z ABCD parameters, applications to Network Analysis, Interconnection of two port networks, services parallel and cascade connections.

Network Functions, Driving point and Transfer functions, properties, Time domain response from pole zero plot. Complex frequency(s) plane.

Characteristic impedance, image impedance, image transfer constant, inserties loss.

IV) Semi Conductor Devices:

PN Junction, NPN and PNP transistors, small signal model determination of h-parameters, Analysis using h-parameters, CE, CB and CC configurations, Transistor biasing circuits, Transistor as a switch.

Field effect Transistor, JFET, MOSFET, Cathod. Ray Oscilloscope and applications. Transistor as amplifier, Gain Bandwidth, Three amplifier configurations, Multi stage amplifiers. Operational amplifiers, principles, characteristics, Comparator, Integrator, Differentiator, Summing, Adder, Subtractor, log amplifier.

V) Electromagnetic theory

Coulomb's Law, Gauss's Law, Electric field due to charge, Electric flux density, Poisson's and Laplace's equations, Energy and potential, conductors, Dielectric, Boundary conditions.
Biot Savort's Law, Amper's Law, Stokes Theorem, Faraday's Law.
Maxwell's equations, interprelation, uniform plane wave, wave motion in free space, pointing vector.

VI) Pulse and Digital Circuits :

Wave shaping, RC RL circuits, Non-linear diode wave shaping circuits, diode clamping.
Multivibrator circuits, Astable, Monostable Schmitt Trigger Circuits, Blocking Oscillator.
Sweep Generator, Bootstrap and Miller Voltage Sweep Circuits, Linear current sweeps.
Logic Circuits : AND, OR, NOT, NAND and NOR gate circuits, DTL, TTL, MOS, CMOS, NAND, NOR circuits, realization of various flip flops.
Square wave generator, pulse generator.

VII) Communication Systems:

Modulation techniques, Amplitude, Modulation, generation and demodulation, DSB Waves.
Phase and Frequency modulation, narrow band and wide band FM, transmission bandwidth, generation and demodulation of FM Waves.
Pulse Modulation, Sampling, TDM, PPM, PCM, Characteristics of ASK, FSK, PSK, Signals.
AM and FM Transmitters and Receiver circuits, communication receivers, SSB transmitters and receivers, super hetrodyne receivers, IF, AGC, tracking and alignment, receiver measurements.

VIII) Control Systems:

Open loop and closed loop systems, signal flow graphs, Transfer functions and impulse reponse.
Routh Hurwitz criterion for stability, Root locus, techniques, effect of location of roots in system response.
Frequency Response Plots, Bode Plots, Nyguist criterion for stability. Gain and phase margin, Compensation, using Bode Plots, Lag and Lead compensation.
Effect of feed back, sensitivity. Control system components; potentio meters, servomotors, synchros, error-sensing devices.

IX) Transmission Lines & Antennas:

Reflection of E.M. Waves, standing waves, transmission line equations, Input impedance, reflection coefficient, VSWR, properties of $\lambda/4$, $\lambda/2$ lines, short-circuited stubs, impedance matching.
Principle of radiation, Vector potential, Linear Arrays, Broad Side and End fire Array, multiplication of Antenna patters.
Antenna characteristics – Gain, radiation pattern, side lobe level directivity.

X) Microwaves:

Propagation of E.W.Waves through parallel plate and rectangular, circular wave guides, T.E., T.M., modes cavity, Resonators, Resonant frequency and quality factors.
Microwave Tubes, Klystron Amplifier, Reflex, Klystron, Magnetron, Travelling wave Tube.
Microwave components – Directional couplers, circulators, isolators, Ferrite Components.
Microwave Measurements – VSWR, Impedance and Reflection measurements, slotted line techniques.

Sd/-
Secretary
19/02/2008