Syllabus for Recruitment to the post of INSPECTOR OF LEGAL METROLOGY Under Food, Civil Supplies & Consumer Affairs Department,2018

COMPULSORY SUBJECT

(Essay Type & MCQ)

1. General English – I …… 100 Marks
2. General English – II (MCQ) ……..... 100 Marks

OPTIONAL SUBJECT

(MCQ)

1. Physics – I …… 200 Marks
   Physics – II …… 200 Marks
   Physics – III …….. 200 Marks

2. Civil Engineering – I …… 200 Marks
   Civil Engineering – II …… 200 Marks
   Civil Engineering – III ……... 200 Marks

3. Computer Science & Engineering – I ……. 200 Marks
   Computer Science & Engineering – II ……... 200 Marks
   Computer Science & Engineering – III …….……. 200 Marks

4. Electrical Engineering– I …….…… 200 Marks
   Electrical Engineering – II ……... 200 Marks
   Electrical Engineering – III …….. 200 Marks

5. Electrical & Communication Engineering – I.…… 200 Marks
   Electrical & Communication Engineering – II …….. 200 Marks
   Electrical & Communication Engineering – III …….. 200 Marks

6. Mechanical Engineering – I ……. 200 Marks
   Mechanical Engineering – II ……... 200 Marks
   Mechanical Engineering – III ……. 200 Marks

General English Paper - I (3 hours duration)

ESSAY TYPE

(Full Marks : 100)

a) Essay Writing : ……..… 25 Marks
b) Précis Writing : …….. 15 Marks
c) Letter Writing : …… 15 Marks
d) Idioms & Phrases : …… 14 Marks
e) Expansion of passages : …….. 15 Marks
f) Comprehension of given passages : ……. 16 Marks

General English Paper - II (*2 hours duration*)

(MCQ)

(Full Marks : 100)

a) Grammar : Parts of Speech,
Nouns, Adjective, Verb,
Adverb, Preposition, Etc. : …… 40 Marks

b) Compositions : …… 30 Marks

i) Analysis of complex and compound sentences.

ii) Transformation of sentences.

iii) Synthesis of sentences.

d) Correct usage and vocabularies. : …… 30 Marks

PHYSICS

PAPER – I (2 hours duration)
OBJECTIVE TYPE (MCQ)
(Full Marks : 200)

1. Mechanics and Waves (20 Marks): Dimensional analysis. Newton's laws of motion and applications,variable mass systems, projectiles. Rotational dynamics-kinetic energy, angular momentum, theorems of moment of inertia and calculations in simple cases. Gravitational potential and intensity due tospherical objects. Central forces and Kepler's problem, escape velocity and artificial satellites.

Special relativity and Lorentz transformation-length contraction, time dilation, mass-energy relation.

2. Properties of Matters (20 Marks): Elasticity: small deformations, Hooke's law, elastic constants for an isotropic solid, inter relations of elastic constants, torsion of a cylinder, Kinematics of moving fluids, rate of flow, equations of continuity, Bernoulli's theorem, viscous fluids, viscosity and coefficient of viscosity, streamline and turbulent flow. Poiseulle's law, Capillary tube flow, Reynold's number, Stokes law.

Surface tension and surface energy, molecular interpretation of surface tension, pressure on a curved liquids surface, angle of contact, capillarity, determination of surface tension by capillary rise method.

3. Oscillation and Waves (30 Marks): Differential equation of Harmonic oscillations and its solution, kinetic and potential energy, examples of simple harmonic oscillations, spring and mass system, simple and compound pendulum. Superposition of two simple harmonic motions of the same frequency, superposition of two mutually perpendicular simple harmonic vibrations of the same frequency, Lissajous figures.

Free and forced vibration: conditions of maximum amplitude, resonance and condition of resonance, sharpness of resonance.

4. Thermodynamics (30 Marks): Kinetic interpretation of temperature, estimation of rms speeds of molecules, Equipartition of energy, specific heat of mono, di and tri-atomic gases, Van der Waals gas, equation of state, nature of van der Waals forces, comparison with experimental P-V curves, The critical constants, Reduced equation of state.

First law of thermodynamics, Reversible and irreversible changes, Carnot cycle and its efficiency, Carnot theorem and the second law of thermodynamics, Entropy, principle of

increase of entropy, The thermodynamic scale of temperature; its identity with the perfect gas scale, Impossibility of attaining the absolute zero; third law of thermodynamics.

PAPER – II (2 hours duration)
OBJECTIVE TYPE (MCQ)
(Full Marks : 200)

1. **Electromagnetism (20 Marks):** Gauss's law and its application for finding E for symmetric charge distributions, electrostatic field energy, force per unit area on the surface of a conductor in an electric field, Dielectrics, Parallel plate capacitor with a dielectric, dielectric constant.

Alternating currents: complex impedance, reactance, LCR series and parallel circuits, resonance, Q factor, power dissipation and power factor.

Electromagnetic Induction: Faraday's laws (integral and differential form), Displacement current, Modified Ampere's law and its application.

2. Optics(20 Marks): Thick lens: Cardinal points, image formed by thick lens, relation between the distances of cardinal points, object and image-distance from principal planes, cardinal points of Ramsden and Huygens' eyepieces.

Principle of superpositions, Young's two-slit interference, Production of Interference by Fresnel biprism, determination of wavelength of light, theory of Newton's ring and its application. Michelson interferometer, its application for precision determination of wavelength, wavelength difference and the width of spectral lines.

Polarization of light: production of polarized light by reflection and refraction.

Laser system: Einstein's A and B coefficients, spontaneous and induced emissions, conditions for laser action, population inversion.

3. **Atomic, Nuclear Physics(30 Marks):** Bohr's theory of H-like atoms, Pauli's exclusion principle, quantum number for atomic orbitals and degeneracy.

Positive rays: Thomson's parabola method, isotopes, isobars, Aston's mass spectrograph, Bainbridge mass spectrograph.

General properties of Nucleus: Nuclear size, nuclear mass, nuclear density, nuclear charge, Binding energy, stability of nucleus and binding energy, packing fraction.
Nuclear fission: Discovery, energy released in fission, secondary neutrons and their importance, multiplication factor, chain reaction.
Nuclear fusion: origin of stellar energy, calculation of fusion energy.

4. **Solid State Physics (30 Marks):** Fundamental types of lattices in 2 and 3-dimensions, Crystal planes, simple crystal structure: NaCl and Diamond structure, Miller indices, coordination numbers, atomic packing factor.
X-ray diffraction by crystal planes, Bragg's law of diffraction, Laue's equations, Reciprocal Lattice and lattice vectors, properties of reciprocal lattice vectors, Relation between direct and reciprocal lattice vectors.
Thermal properties: Specific heat of solid, Deduction of Dulong and Petit law from the harmonic oscillator concept, Einstein's theory of specific heat and its failures, Debye T^3 law of specific heat,
Thermal conductivity, Weidmann-Franz law, Fermi energy, Energy levels and density of states in one and three dimensions.

PAPER – III (2 hours duration)
OBJECTIVE TYPE (MCQ)
(Full Marks : 200)

1. Electronics(20 Marks): Semiconductors: Instrinsic semiconductors, electrons and holes, Doping; impurity states, n and p type semiconductors, conductivity, mobility, Hall effect, Hall coefficient.
p-n junction diode, majority and minority carriers, Zener diode, Diode rectification, ripple factor, Zener diode as a voltage stabilizer, characteristics of a transistor in CB, CE and CC mode,Logic gates and truth tables,
Threeterminal devices (UJT and FETs): (i) UJT: its Characteristics and Equivalent Circuit, Relaxation Oscillator, (ii) JFET: Its Characteristics and Equivalent Circuit.

2. **Quantum Mechanics(20 Marks):** Origin of the quantum theory: Failure of classical physics to explain the phenomena such as black-body spectrum, photoelectric effect, Planck's radiation law. Wave-particle duality and uncertainty principle, de Broglie's hypothesis for matter waves; the concept of wave and group velocities, evidence for diffraction and interference of particle, experimental demonstration of matter waves,Heisenberg's uncertainty relation for p and x, its extension to energy and time, Consequence of the uncertainty relation: gamma ray microscope, diffraction at a slit.

Schrodinger equations, physical meaning of ψ, conditions to be satisfied by Schrodinger equation as an operator equation, Particle in a box with rigid walls, concept of a potential well, wave functions and energies for the ground and excited states; quantization of energy.

3. **Mathematical Physics(30 Marks):** Matrix addition and multiplications, Transpose and conjugate transpose of a matrix, Adjoint and inverse of a matrix, Transpose and inverse of product of two matrices.

Special matrices: Singular matrices, symmetric and skew symmetric matrices, Hermitian and skew Hermitian matrices, orthogonal and unitary matrices.

Characteristic equation, eigen values, eigen vectors, calculation of eigen values and eigen vectors of (2x2) matrices.

Fourier Series, expansion of a function of x in a series of sines and cosines of multiple of x, Fourier series for the interval $(-\pi, \pi)$, $(0, \pi)$ and $(0, 2\pi)$, Fourier series for half wave and full wave rectifier.

4. **Classical Mechanics (30 Marks):** Reduction of two body problem to one body problem, reduced mass, Motion under a central force, Kepler's law, Deduction of Newton's laws of gravitation from Kepler's laws of planetary motion and Kepler's laws form Newton's laws.

Constraints and generalized co-ordinates, Principle of virtual work, D'Alembert's principle, Lagrangian and Lagrange's equations for simple pendulum, Keplerian motion. Hamilton's canonical equation from Lagrange's equation, Hamilton's equation of motion for a simple pendulum.

5. **Aptitude (50 Mark)** :

(a) Numerical And Figurework Tests: (4 Marks)

These tests are reflections of fluency with numbers and calculations. It shows how easily a person can think with numbers. The subject will be given a series of

numbers. His/Her task is to see how the numbers go together to form a relationship with each other. He/She has to choose a number which would go next in the series.

(b) Verbal Analysis And Vocabulary Tests: (6 Marks)

These tests measure the degree of comfort and fluency with the English language. These tests will measure how a person will reason with words. The subject will be given questions with alternative answers, that will reflect his/her command of the rule and use of English language.

(c) Visual And Spatial/3-D Ability Tests: (4 Marks)

These tests are used to measure perceptual speed and acuity. The subject will be shown pictures where he/she is asked to identify the odd one out; or which comes next in the sequence or explores how easily he/she can see and turn around objects in space.

(d) Abstract Reasoning Tests: (6 Marks)

This test measures the ability to analyse information and solve problems on a complex, thought based level. It measures a person's ability to quickly identify patterns, logical rules and trends in new data, integrate this information, and apply it to solve problems**.**

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CIVIL ENGINEERING

PAPER – I (2 hours duration)
OBJECTIVE TYPE (MCQ)

(Full Marks : 200)

1. Building Materials and Constructions

Engineering Materials: Physical properties of construction materials: stones, bricks, timber, sand, tiles, lime, surkhi, mortar, concrete, varnishes, plastics, rubber, damp-proofing materials, termite treatment materials, materials for low cost buildings, seasoning and preservation of timber.

Building Construction: Building components and their functions : walls, floors, roofs, ceilings, staircase, doors and windows, ventilation, air-conditioning, lighting & acoustics etc. Finishing of buildings:plastering, pointing, painting, use of building codes.

Functional Planning of building: Building orientation. circulation, grouping of areas, privacy concept and design of energy efficient building, provision of building codes and building regulations.

2. Design of Structures

Design of RC Structures : Concept of mix design; Limit State and Working Stress method of design; Recommendations of I.S Codes of one way and two-way slabs, staircase, simple and continuous beams of rectangular T and L sections, compression members under direct load with or without eccentricity, isolated and combined footings, elevated and underground water tanks; Methods and systems of prestressing, anchorages, losses in prestress; design of prestress girder; Design of Cantilever and Counterford type retaining walls.

Design of Steel Structures: Factors of safety and load factor; Riveted, bolted and welded connections. Design of tension and compression and flexural members, beams of built up section, riveted and welded plate girders, gantry girders, stanchions with battens and lacings, slab and gusseted column bases. Design of highway and railway bridges, warren girder,Pratt truss; Design of industrial roof and multi-storey buildings; water tanks; plastic design of continuous frames and portals.

3. Engineering Mechanics

Static : Coplaner and multiplaner system; Varignon's theorem, free body diagrams, conditions of equilibrium; second moment of plane figure; force and funicular polygon; principle of virtual work; suspension systems of catenary.

Dynamic: Units and dimensions; Gravitational and absolute systems; MKS & S.I. Units; Vectors, concept of force, concept of particle and rigid body.

Kinematics: Rectilinear and Curvilinear motion; relative motion; instantaneous centre.

Kinetics: Mass moment of inertia; simple harmonic motion, momentum and impulse; equation of motion of rigid body rotating about a fixed axis.

4. Strength of Materials

Simple Stress and strain; Elastic constants; tension and compression in one direction; riveted and welded joints.

Shear force and bending moment; Theory of simple bending; shear stress distribution in cross sectionof beams; beams of uniform strength; Strain energy in direct stress, bending and shear.

Deflection of beams; Maculay's method, Mohr's moment area method, conjugate beam method, unit load method. Torsion of shafts, transmission of power, close coiled helical springs.
Theories of column and struts; Euler's, Rankine's and Secant formulae. Principal stress and strain;simple theories of failure; Mohr's circle.
Thin and thick cylinders; stresses due to internal and external pressure.

5. Structural Analysis:
Analysis of determinate structures - different methods including graphical methods; reciprocal theorem, unsymmetrical bending; moment of inertia.
Analysis of indeterminate skeletal frames - moment distribution, slope-deflection, stiffness and force methods, energy methods, column analogy method and Kani's method.
Plastic analysis of indeterminate beams and simple frames - shape factor. Matrix methods of analysis.
Moving loads-shearing force and bending moment diagrams; influence lines for simple and continuous beams and frames

PAPER – II (2 hours duration)
OBJECTIVE TYPE (MCQ)

(Full Marks : 200)

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1. Fluid Mechanics and Hydraulic Engineering

Dynamics of fluid flow: Equation of continuity; energy and momentum Bernoulli's theorem; cavitation, velocity potential and stream function; rotational and irrotational flow, free and forced vortices; flow net

Dimentional analysis and its application to practical problems

Viscous flow: Flow between static and moving parallel plates, flow through circular tubes; film lubrication; velocity distribution in laminar and turbulent flow;boundary layer.

Incompressible flow through pipes: Laminar and turbulent flow, critical velocity; losses, stamton diagram; hydraulic and energy gradelines; siphon pipe network; forces on pipe bends

Compressible flow: Adiabatic and isenthropic flow; subsonic and supersonic velocity; mach number, shock waves; water hammer.

Open channel flow: Uniform and non-uniform flow; best hydraulic cross-section; specific energy and critical depth gradually varied flow, classification of surface profiles; control sections; standing wave flume; surges and waves; hydraulic jump.

2. Water Resources Engineering:

Hydrology: Hydrological cycle, precipitation evaporation; transpiration; depression storage;infiltration; overland flow; hrydograph; flood frequency analysis; flood estimation; flood routing through a reservoir; channel flow routing- Muskingam method.

Ground water flow: Specific yield; storage coefficient; coefficient of permeability; confined and unconfined aquifers; radial flow into well under confined and unconfined conditions; tube wells; pumping land recuperation tests; ground water potential.

Planning of water resources: Ground and surface water resources; surface flows; single and multipurpose projects; storage capacity; reservoir losses; reservoir silting; flood routing; benefit-cost ratio; general principles of optimization.

3. Sanitation and Water Supply (Environmental Engineering):

Sanitation: Site and orientation of buildings; ventilation and damp proof course; house drainage; conservancy and water-borne systems of waste disposal; sanitary appliances; latrines and urinals.

Disposal of sanitary sewage: Industrial waste; domestic waste; storm sewage-separate and combined systems; flow through sewers; design of sewers; sewer appurtenances-manholes, inletjunctions, siphon, ejections etc.

Sewer treatment: Working principles; units, chambers; sedimentation tanks; trickling filters;oxidation ponds; activated sludge; recycling of waste water; septic tanks; soak pit; disposal of sludge.

Environmental pollution and ecology: Sustainable development; radio-active waste and disposal; environtmental impact assessment for thermal power plants; mines, river valley projects; air pollution and pollution control acts.

Water Supply: Estimation of water resources; ground water hydraulics; predicting demand of water; Impurities of water-physical, chemical and bacteriological analysis, water borne diseases.

Intake of water: Pumping and gravity schemes; water treatment-principles of setting, coagulation, flocculation and sedimentation, slow, rapid and pressure filters, softening; removal of taste, odour and salinity.

Water storage and distribution: Storage and balancing reservoirs, types, locations and capacity. Distribution system-layouts hydraulics of pipelines; pipe fittings; meters; analysis of distribution system; leak detection; maintenance of distribution system; pumping stations and their operations.

4. Hydraulic Machines and Hydropower

Hydraulic pumps: Type, characteristics, net positive suction height (NPSH), specific speed; pumps in parallel

Reciprocating pumps : Air vessels, hydraulic ram, efficiency parameters, rotary and positive displacement pumps, diaphragm and jet pumps.

Hydraulic turbines : Type, classification, choice of turbines; Performance parameters, control, characteristics, specific speed.

Principles of hydropower development : Types of dams, layouts and component works; Gates and valves; Intake structures, Tunnels, Penstocks; Surge tanks- types and choice. Flow duration curves and dependable flow. storage and pondage. Pumped storage plants. Layout of power stations. Specific features of mini, micro-hydel plants.

5. Irrigation Engineering

Water requirement for crops: Quality of irrigation water; consumptive use of water ; water depth and frequency in irrigation; duty of water; irrigation methods and their efficiencies.

Distribution system for canal irrigation: Determination of require canal capacity; canal losses; alignment of main and distributory canals

Design of canals : Unlined canals in alluvium; the critical tractive stress; principles of sediment transport; regime theories, lined canals; hydraulic design and cost analysis; drainage behind lining.

Canal structures: Design of regulation works; cross drainage and communication works-cross regulators, head regulators, canal aqueducts, metering flumes etc; canal outlets.
Water logging; Its causes and control; design of drainage system; soil salinity

Diversion headworks: Principle and design of weirs of permeable and impermeable foundations; Khola's theory; energy dissipation; stilling basin; sediment excluders

Storage works: Types of dams including earth dam and their characteristics; principles of design; criteria for stability; foundation treatment; joint and galleries; control of seepage.

Spillways: Different types and their suitability; energy dissipation; spillway crest gates.

River training: Objectives of river training; methods of river training

PAPER – III (2 hours duration)
OBJECTIVE TYPE (MCQ)

(Full Marks : 200)

a . Soil Mechanics and Foundation Engineering (*Geo-Technical Engineering*)

Soil Mechanics : Properties and Classification of soils; Atterburg limits; void ratio; moisture content; permeability-laboratory and field tests (Darcy's Law); seepage and flow nets; flow underhydraulic structures; uplift and quick sand condition; unconfined and direct shear test; triaxial test; earth pressure theories (Rankine's theory and Coulomb's wedge theory); stability of slopes; theories of soil consolidation (Terzaghi's theory); compaction of soil; rate of settlement; total and effective stress analysis; pressure distribution of soils; Boussinesque and Waterguard theories; soil stabilization.

Foundation Engineering : Sub-surface exploration; methods of boring; Bearing capacity of footings; Essential features of foundation; Types of foundation- shallow foundation and deep foundations; choice of foundations; design criteria; Foundation for bridges; ground improvement techniques.

b. Surveying, Estimation & Costing

Surveying : General principles; surveying instruments and their adjustments; recording of survey observations; plotting of maps and sections; errors and their adjustments. Measurement of distances, direction and heights; correction to measured lengths and bearings; correction for local attraction; measurement of horizontal and vertical angles; leveling operations; refraction and curvature correction. Chain and compass survey; theodolite and techeometric traversing; traverse computation; plan table survey; solution of two and three points problems; contour surveying. Setting out directions and grades; types of curves; setting out of curves and excavation lines for building foundations. Field astronomy; concept of global positioning system; remote sensing concepts; map substitute.

Estimating and costing : Estimating quantities of various items of civil works like roads, bridges, building, water supply structures, dams, irrigation canals, hydro-power structures, airports, railwaysetc. estimating the costs of various items of works on the basis of prevalent market rates, analysis of rates of civil works items.

c . Transportation Engineering

Airports : Layout and orientation; runway and taxiway; design and drainage management; zoning laws; visual aids and air traffic control; helipads, hangers and service equipments.

Harbours : Layout; shipping lanes; anchoring; location indentification, littoral transport with erosion and deposition; sounding methods; dry and wet docks; components and operational tidal dataand analysis.

Railways : Planning railway system; terminology; crossing and turnouts, setting out points; controls; transits; tractive power and track modernization; maintenance of tracks; superelevation; creep of rail; ruling gradient; station yards and machinery; station buildings; platform sidings; signals and interlocking.

Roads : Classification of roads; planning of highway systems; alignment and geometric design; horizontal and vertical curves; grade separation. Road construction materials; types of pavements, design of pavements and pavement structures; construction methods; evaluation of pavement failure and strengthening. Maintenance of roads. Drainage system-surface and sub-surface drainages. Traffic engineering : Forcasting techniques, traffic survey- origin and destination survey; highway capacity; channelised and unchannelised intersections; traffic signs and road safety measures. Principles of highway financing.

Tunnelling : Alignment; methods of construction; disposal of muck; drainage; lighting & ventilation; traffic control; emergency management.

d. Construction Planning & Management

Earthwork equipments: Excavators; bulldozers; power shovels; trailers; dumpers; tractors; air-compressors & drills; rollers

Concreting equipments: Weight batcher, mixer, vibrator, batching plant, concrete pump etc.

Planning & Management: Construction activity; schedules; job layout; bar charts; organization of contracting firms; project control and supervision; cost reduction measures; roles of employer; engineer and contractor in a project.

Network Analysis: Critical Path Method (CPM) and Programme Evaluation and Review Technique (PERT) analysis; float times; crashing of activities; contraction of network for cost optimization; time-cost study; cost analysis and resource allocation.

e . Design of Masonry Structures.

Material: Stone masonry and Brick masonry; Physical characteristics; General specifications.

Types of structures: Load bearing wall; column; pier; pillar; buttress; foundations; arch; return walls; wing wall; retaining walls; breast walls; toe walls; revetment walls; walling for buildings etc.

Types of stone masonry; terms of masonry structures; design of masonry structures; functions
of masonry walls; Construction procedure; drainage in masonry structures.

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COMPUTER SCIENCE & ENGINEERING

PAPER – I (2 hours duration)
OBJECTIVE TYPE (MCQ)

(Full Marks : 200)

1. Discrete Mathematics:

Set Theory foundation mapping (bijective, surjective, injective); Relations – equivalence; Poset; Lattice; Mathematical Induction; Proposional Logic; Logical Equivalence; Permutation and Combination;generation functions; Recurrence relation; Concept of Graph Theory (Sub-Graphs; Cyclic Graphs);Trees (Spanning Trees); Algorithms (Kruskal's, Prim's, Dijstra's, Flyod's, Warshall's, DFS, BFS); Isomorphism; Homomorphism of Graphs; Finite Automata (Construction & Conversion of NFA,DFA, State minimization, Mealy machine, Moore machine); Definition of Grammars (Type 0,1,2,3); Fuzzy sets – Basic properties.

2. Digital Electronics Circuit:

Transistor as switching element; Boolean Algebra, simplification of Boolean functions, Karnaugh map and applications; IC Logic gates and their characteristics; IC logic families: DTL, TTL, ECL, NMOS, PMOS and CMOS gates and their comparison; Combinational logic circuits; Half adder, Full adder; Digital Comparator; Multiplexer, Demultiplexer; ROM and their applications; Flip flops; R-S, J-K, D and T flip flops; Different types of counters and registers Waveform generators; A/D and D/A converters; Semiconductor memories.

3. Computer Architecture and Organisation:

Digital Computer - Introduction, General Organisation, Functional Units, Basic Computer Organisation and Design; Computer Registers, Register Transfer, Micro Operation, Bus System, Timing And control Signals, Generation of Control Signals, Instruction Cycle; Determination and Execution of different types of Instructions; Machine Language; Assembly Language; Assembler; Program Loops and Subroutines; Control Unit (Hardware and Microprogrammed Control); Elements of the Design of control unit from Control Flow Diagram; Signed Magnitude Representation; Floating Point Representation of numbers; BCD Representation; Addition; Subtraction; Multiplication and Division of numbers in different types of representation; General register Organisation, Stack Organisation; Instruction Formats; Addressing Modes; RISC; Input/Output; Peripheral Devices; Necessity of Interfacing; Asynchronous function of I/O and I/O bus; Modes of I/O transfer; Memory Hierarchy, Main Memory, Virtual Memory System; Pipeline and Vector Processing; Parallel processing; Arithmetic and instruction Pipelining; Vector Processing-array processor.

4. Data Structures and Algorithm

Array and Strings; Packing; Space array; Algorithm development; complexity; simple example of Algorithm development; recursion; Sequential Search; Divide and conquer binary search; selection and insertion sort; merge sort; quick sort; complexity of sorting; Linear list; Stack; Stack use – postfix notation, recursion removal; operation on stack; Arithmetic Expression Evaluation; Recursion; Queue; Implementation of Queue in Computer memory; Queue as an Abstract data type; operation on queue; Application of Queue; dequeue; Priority Queue; Graphs and Representation Sets – UNION and FIND operations; Graph Algorithms; Optimisation and Greedy Method; minimum spanning tree; Shortest path; Trees; AVL Trees; threaded trees; heap sort; trees and B-trees; external search.

PAPER – II (2 hours duration)
OBJECTIVE TYPE (MCQ)

(Full Marks : 200)

1. Operating System

Introduction of OS objective and function; The Evaluation of OS; Batch; interactive; time-sharing and real time system; Protection; OS Structure; System components; OS service; System Structure; Concurrent Processes; Process Concept; Principles of concurrency; The Producer/consumer problem; The critical section problem; Semaphore; Classical problems on concurrency; interprocess Communication; Process Generation; Process Scheduling; CPU Scheduling; Scheduling Concepts; Performance Criteria; Scheduling Algorithms; Algorithm evaluation; multiprocessor scheduling; Deadlocks; System model; Deadlock characterization; Prevention; avoidance and detection; Recovery from deadlock combined approach; Memory management; Base Machine; Resident Monitor; Multiprogramming with fixed partitions; Multiprogramming with variable partitions; Multiple Based Registers; Paging; segmentation; Virtual Memory concept; Demand paging; Performance; Page replacement algorithm; Allocation of frames; Thrashing; cache memory organization; impact performance; I/O Management and Disk Scheduling: I/O devices and the organisation of the I/O function; I/O buffering; Disk I/O; Operating System Design issues; File system; File concept- File Organisation and access mechanism; File directories

2. Object Oriented Programming

Introduction of OOP; application of OOP; process of OOP; Classes and Objects; Overview of Classes and Objects; Class definition; class specifiers; defining member functions; Memory allocation for objects; array of objects; constructor; destructor; Polymorphism; Function of Overloading; uses in program; operator overloading; defining operator overloading; limitations of operator overloading; overloading unary and binary operators; Inheritance and its types with examples; virtual functions; pointers to object; pure Virtual Functions and its implementation in program; managing I/O operations; I/O streams; File handling with OOP; Error handling in file operations; random file access; exception handling methods; throwing mechanism; catching mechanism; string characteristics and uses.

3. Computer Graphics

Points, Lines, Planes, Vectors, Pixels, Frame Buffers, Vectors and character Generation; Graphic Primitives – Display device, Primitive Operations, Display Files Structure, Display Control Text; Polygons – Polygons Representation, entering polygons, Filling polygons; transformations – Metrics transformations, Transformation Routines, Display Procedures; Segments – Segments Table, Creating, Deleting and renaming a segment visibility, image transformation; Windowing and Clipping – Viewing transformation, Clipping, Generalised Clipping, multiple windowing; Interaction – Hardware input device handling algorithms, Event handling Echoing, interactive techniques; Three Dimensions – 3-D Geometry Primitives, Transformations, Projection, Clipping; Hidden line and Surfaces – Back-face Removal Algorithms, Hidden line Methoods, Rendering and Illumination, introduction to curve generation, Bezier, Hermite and B-spline algorithms and comparisons.

PAPER – III (2 hours duration)
OBJECTIVE TYPE (MCQ)

(Full Marks : 200)

1. Database Management Systems

Introduction to Database System concepts and Architecture; data models; schemes and instances; data independence; Database language and interface; Data Modelling using the Entity-Relationship model; ER Model concepts; Notation for ER diagram; Extended ER Model; Relationship of Higher degree; Relationship data model and language; Relation Data concepts; constraints; relational algebra; Relational calculus; tuple and Domain calculus; SQL; Basic Query Statement; Database Design; Functional dependencies; Normal forms; First, second, third, fourth and BCNF; Inclusion dependencies; Query Processing and Optimisation; Algorithm for executing query Operations; Heuristics for query optimization; Transaction processing Concepts; transaction and system concepts; Schedules and Recoverability; serializability of schedules; Concurring Control Techniques; Locking techniques for concurrency control; Time Stamping and concurrency control.

2. Computer Networks

Introduction to Networks and Layered Architecture – Protocol Hierarchies; Design issues for
the layers, Data Communication Concepts; Serial and Parallel Communication; Simplex; Half duplex and Full duplex Communication;

Multiplexing – TDM; FDM; Demand Multiplexing; Error detection and correction; Forward and Backward error correction; Checksum Automatic Repeat Request; Protocols; Relationship of Services to Protocols; NETBIOS; TCP/IP; SMTP; FTP; TELNET; IPX; SPX; NETBEUL;

Transmission Media – Advantages and disadvantages of Transmission Media; Modem; Principles and Techniques; Amplitude; Frequency Shift Keying; Phase Shift Keying; Operating Speed; Network Topology; Star; Ring; Bus & Tree; Physical and logical topologies; Guidelines to select a topology; Access Methods and Topologies, Ethernet Concepts, Token Ring Media ground rules, LAN, HUBS, etc., FDDI;

Network Operating System – Selection Criteria, Performance, fault Tolerence, Application compability, Security Manageability, memory requirement, client support, internetworking capabilities, OS support, Database Services, IBM'S LAN Server, Windows for Workgroup and Windows NT, Peer-to-Peer LAN; LAN Management – Simple Network Management Protocol, Remote Monitoring Performance management, Security Management Access control; LAN administrator Network reliability – Modelling, Standards, fault analysis and Rectification, Introduction to ISDN.

3. Software Engineering

Introduction to Software Engineering; Software development life-cycle; Requirements analysis; Software design; coding; testing; maintenance; Software Requirements Specification; Waterfall Model; prototyping; interactive enhancement; spiral model, Role of management in software development; Role of Metrices and measurement; Problem analysis requirement specification, validation, metrics, monitoring and control; System design – Problem partitioning, abstraction, top-down and bottom-up design, Structured approached, Functional versus Object Oriented approach; design specification and verification metrices;

monitoring and control; Coding - Top-down and bottom-up, structure programming, information hiding, programming style and internal documentation, verification, metrices, monitoring and control; Testing – Levels of testing, functional testing, structural testing, test plane, test cases specification reliability assessment; Software Project Management – Cost estimation, Project scheduling, Staffing, Software configuration management, Quality assurance, Project Monitoring, Risk Management.

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ELECTRICAL ENGINEERING

PAPER – I (2 hours duration)
OBJECTIVE TYPE (MCQ)

(Full Marks : 200)

a . EM Theory
Electric and magnetic fields, Gauss's Law and Amperes Law, Fields in dielectrics, conductors and magnetic materials. Maxwell's equations. Time varying fields. Plane – Wave propagating in dielectric and conducting media. Transmission lines.

b. Electrical Materials
Band Theory, Conductors, Semi-conductors and Insulators, Super-conductivity, Insulators for electrical and electronic applications. Magnetic materials. Ferro and ferri magnetism, Ceramics, Properties and applications. Hall effect and its applications. Special semi conductors.

c . Electrical Circuits
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, Three phase circuits, Two-port networks, Elements of two-element network synthesis.

d. 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. Date acquisition systems, A/D and D/A converters.

PAPER – II (2 hours duration)
OBJECTIVE TYPE (MCQ)

(Full Marks : 200)

1. Control Systems
Mathematical modeling of physical 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 concepts of compensator design, State variable matrix design. Sampled data system and performance of such a system with the samples in the error channel. Stability of sampled data system. Elements of non-linear control analysis, Control system components, electromechanical, hydraulic, pneumatic components.

2. Electrical Machines and Power Transformers
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.
B.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, Principle of operation, Rotating Fields, Characteristics and performance analysis, Determination of Circuit model, Circle diagram, Starting and speed control
.
Fractional KW motors. Single-phase synchronous and induction motors.

3. 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, Z-Bus 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, HVDC transmission.

PAPER – III (2 hours duration)
OBJECTIVE TYPE (MCQ)

(Full Marks : 200)

1. 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, biasing circuits, frequency response and improvement, multistage amplifiers and feed-back amplifiers, D.C. amplifiers, coupling methods, push pull amplifiers, operational amplifiers, wave shaping circuits, Multivibrators and flip-flops and their applications. Digital logic gage families, universal gates combinational circuits for arithmetic and logic operational, sequential logic circuits. Counters, Registers, RAM and ROMs.

2. Microprocessors
Microprocessor architecture Instruction set and simple assembly language programming. Interfacing for memory and I/O. Applications of Micro-processors in power system.

3. Communication Systems
Types of modulation; AM, FM and PM. Demodulators, Noise and bandwidth considerations. Digital communication systems, Pulse code modulation and demodulation, Elements of sound and vision broadcasting, Carrier communication. Frequency division and time division multiplexing, Telemetry system in power engineering.

4. Power Electronics
Power Semiconductor devices, Thyristor, Power transistor, GTOs and MOSFETs Characteristics 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.

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ELECTRONICS & COMMUNICATION ENGINEERING

PAPER – I (2 hours duration)
OBJECTIVE TYPE (MCQ)

(Full Marks : 200)

1. Materials and Components:

Structure and properties of Electrical Engineering materials; Conductors, Semiconductors and Insulators, magnetic, Ferroelectric, Piezoelectric, Ceramic, Optical and Super-conducting materials. Passive components and characteristics Resistors, Capacitors and Inductors; Ferrities, Quartz crystal Ceramic resonators, Electromagnetic an Electromechanical components.

2. Physical Electronics, Electron Devices and ICs:

Electrons and holes in semiconductors, Carrier Statistics, Mechanism of current flow in a semiconductor, Hall effect; Junction theory; Different types of diodes and their characteristics; Bipolar Junction transistor; Field effect transistors; Power switching devices like SCRs, CTOs, power MOSFETs; Basics of ICs – bipolar, MOS and CMOS types; basic to Opto Electronics.

3. Signals and Systems

Classification of signals and systems: System modeling in terms of differential and difference equations; State variable representation; Fourier series; Fourier representation; Fourier series; Fourier transforms and their application to system analysis; Laplace transforms and their application to system analysis; Convolution and superposition integrals and their applications; Z-transforms and their

Applications to the analysis and characterization of discrete time systems; Random signals and probability, Correlation functions; Spectral density; Response of linear system to random inputs.

4. Network theory

Network analysis techniques; Network theorems, transient response, steady state sinusoidal response; Network graphs and their applications in network analysis; Tellegen‘s theorem. Two port networks; Z, Y h and transmission parameters. Combination of two ports, analysis of common two ports. Network functions: parts of network functions, obtaining a network function from a given part. Transmission criteria: delay and rise time, Elmore’s and other definitions effect of cascading. Elements of network synthesis.

PAPER – II (2 hours duration)
OBJECTIVE TYPE (MCQ)

(Full Marks : 200)

1. Electromagnetic Theory

Analysis of electrostatic and magnetostatic fields: Laplace's and Piossons's equations; Boundary value problems and their solutions; Maxwell's equations; application to wave propagation in bounded and unbounded media; Transmission lines: basic theory, standing waves, matching applications, misconstrue lines.Basics of wave guides and resonators; Elements of antenna theory.

2. Analog Electronic Circuits:

Transistor biasing and stabilization. Small signal analysis. Power amplifiers. Frequency response. Wide banding techniques. Feedback amplifiers. Tuned amplifiers. Oscillators. Rectifiers and power supplies. Op Amp PLL, other linear integrated circuits and applications. Pulse shaping circuits and waveform generators.

3. Digital Electronic Circuits:

Transistor as a switching element; Boolean algebra, simplification of Boolean functions, Karnaguh map and applications; IC Logic gates and their characteristics; IC logic families: DTL, TTL, ECL, NMOS, PMOS and CMOS gates and their comparison; Combinational logic Circuits; Half adder, Full adder; Digital comparator; Multiplexer Demultiplexer; ROM and their applications. Flip flops. R-S, J.K, D and T flip-flops; Different types of counters and registers Waveform generators. A/D and D/A converters. Semiconductor memories.

4. Control Systems:

Transient and steady state response of control systems; Effect of feedback on stability and sensitivity; Root locus techniques; Frequency response analysis. Concepts of gain and phase margins Constant-M and Constant-N Nichol's Chart; Approximation of transient response from closed loop frequency response; Design of Control Systems, Compensators; Industrial controllers.

PAPER – III (2 hours duration)
OBJECTIVE TYPE (MCQ)

(Full Marks : 200)

1. Communication Systems:

Basic information theory; Modulation and detection in analogue and digital systems; Sampling and data reconstructions; Quantization & coding; Time division and frequency division multiplexing; Equalization; Optical Communication: in free space & fiber optic; Propagation of signals oat HF, VHF, UHF and microwave frequency; Satellite Communication.

2. Microwave Engineering:

Microwave Tubes and solid state devices, Microwave generation and amplifiers, Waveguides and other Microwave Components and Circuits, Misconstrue circuits, Microwave Antennas, Microwave Measurements, Masers, lasers; Microwave propagation. Microwave Communication Systems terrestrial and Satellite based.

3. Computer Engineering:

Number Systems. Data representation; Programming; Elements of a high level programming language PASCAL/C; Use of basic data structures; Fundamentals of computer architecture; Processor design; Control unit design; Memory organization, I/O System Organisation. Microprocessors: Architecture and instruction set of Microprocessors 8085 and 8086, Assembly language Programming. Microprocessor Based system design: typical examples. Personal computers and their typical uses.

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MECHANICAL ENGINEERING

PAPER – I (2 hours duration)
OBJECTIVE TYPE (MCQ)

(Full Marks : 200)

1. Thermodynamics:

Cycles and IC Engines, Basic concepts, Open and Closed systems. Heat and work. Zeroth, First and Second Law, Application to non-Flow and Flow processes. Entropy, Availability, Irreversibility and Tds relations. Claperyron and real gas equations, Properties of ideal gases and vapours. Standard vapour, Gas power and Refrigeration cycles. Two stage compressor. C-I and S.I. Engines. Preignition, Detonation and Diesel-knock, Fuel injection and Carburation, Supercharging. Turbo-prop and Rocket engines, Engine Cooling, Emission & Control, Flue gas analysis, Measurement of Calorific values. Conventional and Nuclear fuels, Elements of Nuclear power production.

2. Heat Transfer, Refrigeration and Air-Conditioning:

Modes of heat transfer. One dimensional steady and unsteady conduction. Composite slab and Equivalent Resistance. Heat dissipation from extended surfaces, Heat exchangers, Overall heat transfer coefficient, Empirical correlations for heat transfer in laminar and turbulent flows and for free and forced Convection, Thermal boundary layer over a flat plate. Fundamentals of diffusive and connective mass transfer, Black body and basic concepts in Radiation, Enclosure theory, Shape factor, Net work analysis. Heat pump and Refrigeration cycles and systems, Refrigerants. Condensers, Evaporates and Expansion devices, Psychrometry, Charts and application to air conditioning, Sensible heating and cooling, Effective temperature, comfort indices, Load calculations, Solar refrigeration, controls, Duct design.

3. Fluid Mechanics:

Properties and classification of fluids, Manometry, forces on immersed surfaces, Center of pressure, Buoyancy, Elements of stability of floating bodies. Kinematics and Dynamics.

Irrotational and incompressible. Inviscid flow. Velocity potential, Pressure field and Forces on immersed bodies. Bernoulli's equation, Fully developed flow through pipes, Pressure drop calculations, Measurement of flow rate and Pressure drop. Elements of boundary layer theory, Integral approach, Laminar and tubulent flows, Separations. Flow over weirs and notches. Open channel flow, Hydraulic jump. Dimensionless numbers, Dimensional analysis, Similitude and modelling. One-dimensional isentropic flow, Normal shock wave, Flow through convergent - divergent ducts, Oblique shockwave, Rayleigh and Fanno lines.

4. Fluid Machinery and Steam Generators:

Performance, Operation and control of hydraulic Pump and impulse and reaction Turbines, Specific speed, Classification. Energy transfer, Coupling, Power transmission, Steam generators Firetube and water-tube boilers. Flow of steam through Nozzles and

Diffusers, Wetness and condensation. Various types of steam and gas Turbines, Velocity diagrams. Partial admission. Reciprocating, Centrifugal and axial flow Compressors, Multistage compression, role of Mach Number, Reheat, Regeneration, Efficiency, Governance. Design of Pump and Pipelines.

PAPER – II (2 hours duration)
OBJECTIVE TYPE (MCQ)

(Full Marks : 200)

1. Theory of Machines:

Kinematic and dynamic analysis of planer mechanisms. Cams. Gears and gear trains. Flywheels. Governors. Balancing of rigid rotors and field balancing. Balancing of single and multicylinder engines, Linear vibration analysis of mechanical systems. Critical speeds and whirling of shafts Automatic controls.

2. Machine Design:

Design of Joints: cotters, keys, splines, welded joints, threaded fasteners, joints formed by interference fits. Design of friction drives : couplings and clutches, belt and chain drives, power screws.
Design of Power transmission systems: gears and gear drives shaft and axle, wire ropes.
Design of bearings: hydrodynamics bearings and rolling element bearings.

3. Strength of Materials:

Stress and strain in two dimensions, Principal stresses and strains, Mohr's construction, linear elastic materials, isotropy and anisotropy, stress-strain relations, uniaxial loading, thermal stresses. Beams : Bending moment and shear force diagram, bending stresses and deflection of beams. Shear stress distribution. Torsion of shafts, helical springs. Combined stresses, thick-and thin-walled pressure vessels. Struts and columns. Strain energy concepts and theories of failure.

PAPER – III (2 hours duration)
OBJECTIVE TYPE (MCQ)

(Full Marks : 200)

1. Engineering Materials:

Basic concepts on structure of solids. Crystalline maferials. Detects in crystalline materials. Alloys and binary phase diagrams. Structure and properties of common engineering materials. Heat treatment of steels. Plastics, Ceramics and composite materials. Common applications of various materials.

2. Production Engineering:

Metal Forming: Basic Principles of forging, drawing and extrusion; High energy rate forming; Powder metallurgy.

Metal Casting: Die casting, investment casting, Shall Moulding, Centrifugal Casting, Gating & Riser design; melting furnaces.
Fabrication Processes: Principles of Gas, Arc, Shielded arc Welding; Advanced Welding Processes, Weldability: Metallurgy of Welding.
Metal Cutting: Turning, Methods of Screw Production, Drilling, Boring, Milling, Gear Manufacturing, Production of flat surfaces, Grinding & Finishing Processes. Computer Controlled Manufacturing Systems-CNC, DNC, FMS, Automation and Robotics.

Cutting Tools Materials, Tool Geometry, Mechanism of Tool Wear, Tool Life & Machinability; Measurement of cutting forces. Economics of Machining. Unconventional Machining Processes. Jigs and Fixtures. Fits and tolerances, Measurement of surface texture, Comparators Alignment tests and reconditioning of Machine Tools.

3. Industrial Engineering:

Production Planning and Control: Forecasting - Moving average, exponential smoothing, Operations, scheduling; assembly line balancing, Product development, Break-even analysis, Capacity planning, PERT and CPM.

Control Operations: Inventory control ABC analysis, EOQ model, Materials requirement planning. Job design, Job standards, Work measurement, Quality Management - Quality analysis and control. Operations Research : Linear Programming - Graphical and Simplex methods, Transportation and assignment models. Single server queueing model.

Value Engineering: Value analysis for cost/value.

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