परिशिष्ट—दो, ''पाठ्यक्रम''

"PAPER-I"
सामान्य अध्ययन

भाग—1 सामान्य अध्ययन :—

1. भारत का इतिहास, स्वतंत्रता आंदोलन एवं भारत का भूगोल।

2. भारत का संविधान, लोक प्रशासन एवं विधि।

3. भारत की अर्थव्यवस्था, पर्यावरण, जल, खनिज एवं वन संसाधन।

4. समसामयिक घटनाएं एवं खेलकूद।

5. सामान्य विज्ञान एवं कम्प्यूटर संबंधी सामान्य ज्ञान।

भाग—2 छत्तीसगढ़ का सामान्य ज्ञान:—

1. छत्तीसगढ़ का इतिहास एवं स्वतंत्रता आंदोलन में छत्तीसगढ़ का योगदान।

2. छत्तीसगढ़ का भूगोल, जल, खनिज संसाधन, जलवायु एवं भौतिक दशायें।

3. छत्तीसगढ़ की साहित्य, संगीत, नृत्य, कला एवं संस्कृति।

4. छत्तीसगढ़ की जनजातियां, बोली, तीज एवं त्यौहार।

5. छत्तीसगढ़ की अर्थव्यवस्था, वन एवं कृषि।

6. छत्तीसगढ़ का प्रशासनिक ढांचा, स्थानीय शासन एवं पंचायती राज।

7. छत्तीसगढ़ में मानव संसाधन एवं ऊर्जा संसाधन।

8. छत्तीसगढ़ में शिक्षा, स्वास्थ्य एवं समसामयिक घटनाएं।

भाग—3 बुद्धिमता परीक्षण:—

1. गणितीय योग्यता, बुद्धिमता परीक्षण एवं आंकड़ों का विश्लेषण।

"PAPER-II"

(01) CIVIL ENGINEERING

PART-I

UNIT-1 Solid Mechanics :

Units and Dimensions. First & Second Moments of Area, Mass, Moment of Inertia. Concept of Forces, Free body diagrams & Conditions of Static Equilibrium. Principle of Virtual Work. Elastic Constants, Stresses, Plane Stress, Mohr's Circle of Stresses. Strains, Plane Strain, Mohr's Circle of Strains. Combined Stresses. Elastic Theories of failures. Bending moment and shear force diagrams for simple structures. Bending stress & Shear Stress variation and Torsion of Circular & Rectangular sections. Unsymmetrical Bending & torsion. Beams of Uniform Strength. Elastic Stability of Columns, Euler's, Rankine's and Secant Formulae.

UNIT-2 Structural Analysis :

Analysis of Determinate Structures: Calculation of deflection by Macaulay Method, Moment Area Theorems, Conjugate Beam Method, Unit load methods. Analysis of Simple Plane Trusses and deflection computation. Determination of degree of indeterminacy.

Analysis of Indeterminate structures; Castigliano's Theorem I and II, Method of Consistent Deformation, Moment Distribution, Slope Deflection, Kani's method and Column Analogy method, Stiffness & Flexibility Matrix methods.

Rolling Loads & Influence lines for Determinate and Indeterminate Structures.

UNIT-3 Design of RCC & Prestress Structures :

Limit State Design for bending, shear, axial compression and combined forces. Codal provisions for Slabs, Beams, Walls, Staircases & Footings. Working stress method of Design of RC Members. Design of Cantilever and Counter-fort Retuning Walls. Design of RCC Slab & Beam Bridges.

Principles of Prestressed Concrete Design, Materials, Methods of Prestressing, Losses in Prestressing, Design of simple members and determinate structures.

UNIT-4 Design of Steel Structures :

Factor of Safety and Load Factors, Design of Steel Tension & Compression Members. Design of Beams & Columns (Rolled and Built up Sections). Simple Rivetted and Welded Connections. Design of Base Plate and Grillage Foundation. Design of Plate Girders and Gantry Girders.

Plastic Design of Beams & Frames. Theory of Plastic bending, Plastic analysis, Statical and mechanism methods. Introduction to Design of Steel Bridges.

UNIT-5 Building Materials, Construction Practices, Planning & Management :

Aggregates, Bricks & Cement : Types, Classification, Standard Tests as per BIS, Manufacturing of Bricks & Cement. Cement Mortar : Ingredients, Proportions, Mortars for Plastering & Masonry. Concrete : Ingredients, Importance of W/c Ratio, Workability, Standard Tests for Fresh & Hardened Concrete, Admixtures, Methods of Concrete Mix Design.

Planning, Design & Preparation of Drawing, Orientation, Circulation, Light & Ventilation. Construction of Building Components: Ma- sonry, Roofs, Footing, Staircase, Doors & Windows, Lintel, Chhajja. Plastering, Pointing & Painting. Building estimates & Specifications, Rate Analysis, Current Schedule of Rates. Valuation, Contract Conditions & Agreements.

Construction Scheduling, Bar Charts, CPM, PERT & other techniques. Construction Machinery viz. Mixtures, Excavators, Vibrators etc.

PART- II

UNIT-1 Fluid Mechanics :

Fluid Properties, Pressure, Thrust, Buoyancy, Pressure Measurement, Hydrostatics.

Fluid Kinematics, Continuity Equation, Types of Flows, Flow Net, Fluid Dynamics, Momentum & Energy Equations, Bernoulli's Theorem & its application.

Dimensional Analysis & Model Studies, Similitude, Model Laws & Scale Ratios. Pipe flow, Laminar & Tubulent flow. Pipe flow Systems, Losses in Pipes, Boundary Layer & Control, Drag & Lift, Water Hammer & Surges. Pipe Network Analysis, Open Channel Flows, classification, Gradually varied & Rapidly varied flows, Hydraulic Jump.

Flow Measurement in Pipes & Open Channels, Introduction to fluid Machinery viz. Pumps, Turbines etc.

UNIT-2 Hydrology & Water Resources Engineering:

Hydrological Cycle, Precipitation & Analysis of Precipitation Data, Dependability Analysis, DA, DAD, DD Curves, Design Storm. Runoff : its estimation, Maximum Rate of Runoff, Estimation of flood, Hydrograph Analysis, Unit and Synthetic Hydrograph, Design Flood, Flood Frequency Analysis, Flood Routing.

Ground Water Concepts, Well Hydraulics, Estimation of Ground Water, Recharge Techniques.

Irrigation, Soil Water Plant relationship. Methods of Irrigation, Crop Water Requirement, Duty, Delta, Base Period, Evaporation, Transpiration, Crop Rotation.

Reservoir Planning, Gravity & Earthen Dams : their Design Concepts, Spillway and Energy Dissipators, Types & Design Considerations. Canals, Classification, alignment, Design of Unlined Canals, Kennedy's & Lacey's Theory, Design of Lined Canals.

Bligh's and Khosla's Theories of Design of Structures on Pervious formation. Design of Hydraulic Structures like Weirs, Barrages, Head & Cross Regulators, Canal Falls, Cross Drainage Works etc.

Water logging : Causes, Effects & Remedial Measures.

UNIT-3 Environmental Engineering:

Estimation of Surface and Ground Water Resources; Quality of water from different Sources, Quantity of Water, Water Requirement for various uses, Demand & Fluctuation in Demand; Population Forecast; Impurities of water & their significance; Intake Structures, Conveyance of water, pipe materials, Pumps, Operation of Pumping Stations; Water Treatment Methods : Sedimentation, Coagulation, Filtration, Disinfection, Aeration & Water Softening. Water Quality aspects, affects & treatment methods for Fluoride, Iron etc. Rural Water Supply, Institution & Industrial Water Supply.

Urban Rainwater disposal, Systems of sewage collection & disposal. Design of Sewers & Sewerage Systems, Pumping, Characteristics of Sewage. Waste Water Treatment : Aerobic & Anaerobic treatment processes, Disposal of Products of Sewage treatment, Stream flow rejuvenation, Institutional & Industrial Sewage Management, Plumbing Systems, Rural & Semi Urban Sanitation. Solid Waste : Disposal Methods, Recycling & its management.

Sources and effects of Air Pollution, Monitoring, Noise Pollution Standards, Ecological Chain & balance. Introduction to Environmental Impact Assessment.

UNIT-4 Geotechnical Engineering :

Properties of Soil : Physical & Index, Soil Classification, Soil Structure & Clay Mineralogy, Permeability, Capillarity, Seepage Analysis, Flow nets, Stress Distribution in Soils, Compaction, Compressibility and Consolidation, Shearing resistance, Stresses and Failure, Soil Testing in Laboratory & in-situ. Earth Pressures, Retaining Walls, Stability of Slopes, Site Investigations, Soil Exploration, Samplers. Bearing Capacity : its determination, Settlement Analysis, Load Tests, Penetration Tests.

Principles of design of Shallow & Deep foundations. Piles and Caissons, Coffer dams, Elements of Machine Foundation. Engineering Classification of Rocks, Selection of Foundation for Dams, Bridges in

different geologic terrains.

UNIT-5 Surveying & Transportation Engineering :

Surveying : Chain, Compass & Plane Table Surveying, Theodolite Traversing, Tacheometric Surveying, Trignometrical levelling, Contours, Methods of Contouring, Curves, Triangulation, Geodetic Adjustment, Theory of Errors, Aerial Photogrammetry, Cadastral Survey, Use of GIS & Remote Sensing, Total Station, Use of EDM, Concept of Global Positioning System, Hydrographic Surveying : Soundings, Method of observations, Computations & Plotting.

Transportation Engineering : Planning of Highway Systems, Alignment & Geometric Design, Horizontal & Vertical Curves, Grade Separation, Materials of Construction, Design of Flexible & Rigid Pavements, Construction Methods, Drainage, Pavement Evaluation & Strengthening.Traffic Surveys, Intersections, Signalling, Mass Transit System, Accessibility, Networking.

Planning of Railway Systems, Terminology & Designs relating to Gauge, Track, Controls, Transits, Rolling Stock, Tractive Power & Track Modernisation.

Airports : layout & orientation; Runway & Taxiway Designs, Drainage Aspects, Air Traffic Control, Helipads, Hangers & Service Equipments.

(2) MECHANICAL ENGINEERING

PART - I

UNIT-1 : Engineering Mechanics and Mechanics of Solids

Equilibrium and resultant of system of forces and couples, Free body Diagram; Centre of gravity and moment of Inertia, Kinematics and dynamics of particles and bodies, Analysis of Trusses and Frames, Work, Power and Energy, Stress Strain Relationship with Elastic Constants, Stress-Strain diagram, Stress and Strains in Two Dimensions; Principal Stresses and Strain; Mohr's Circle for stress and strain; Strain Energy, Castigliano's theory, Bending Moment and Shear Force Diagram of Beams; Bending and Shear Stress Distribution in beams; Deflection of Beams, Combined Stresses; Axial, Bending and Torsion; Torsion of Circular Shafts; Thin and Thick Walled Pressure Vessels; Theory of Column; Columns with different end conditions.

UNIT-2 : Theory of Machines

Higher and Lower pairs, Inversion, Steering Mechanisms, Hooks Joint, Velocity and Acceleration of links, Inertia- Forces, Cams, Conjugate action of Gearing and Interference, Types of Gears – Spur, helical, bevel and worm. Gear Trains, Epicyclic Gears, Belt drives, Brakes, Clutches, Dynamometers, Fly wheels, Governors, Balancing of Rotating and Reciprocating Masses. Free Forced and Damped Vibrations for a single degree of freedom. Critical speed and Whirling of Shafts, Gyroscope.

UNIT-3 : Design of Machine Element

Design for Static and Dynamic loading; Stress Concentration Factors; Theories of Failures; Fatigue Strength and S-N diagram; Design of Threaded, Riveted and Welded joints, Eccentric Loading, Design of Machine elements – Keys & Couplings, Shafts, Spur Gears, Hydrodynamic Bearing, Rolling and Sliding contact bearings, Brakes and Clutches, Power Screw.

UNIT-4 : Production Engineering

Structure and Properties of Engineering Materials, Metal and Non-metals, Plastics, Iron-Carbon Equilibrium diagram, Heat Treatment of Steel. Merchant's Force Analysis, Tool life and Tool wear; Cutting fluids, Machinability and Machining Economics; Metal Cutting Processes - Turning, Drilling, Boring, Milling, Gear Cutting and Grinding; Un-Conventional Machining Processes – EDM, ECM, USM & LBM; Limits, Fits and Tolerances; Measurement of Surface Roughness; Interferometry. Metal Casting-Patterns, Moulds and Cores; Solidification and Cooling; Riser, Runner and Gate. Hot and Cold working Processes; Metal Forming Processes – Forging, Rolling, Extrusion, Drawing. Joining Processes – Welding, Brazing and Soldering; Principles of Powder Metallurgy.

UNIT-5 : Industrial Engineering and Production Management

Work Study - Method Study & Work Measurement, Job Evaluation and Wage Incentive Plans, Production Planning and control; Forecasting Models; Aggregate Production Planning, Scheduling; Material Requirement Planning; Inventory Control- ABC Analysis, EOQ Model; Linear Programming – Simplex Method, Transportation and Assignment Model; Queuing Theory; PERT and CPM; Statastical Quality Control, Control Charts for Variables and Attributes, Total Quality Management.

PART - II

UNIT-1 : Thermodynamics

Open and Close systems, Heat and Work, Zeroth Law, First and Second Law, Its Application to non-flow and flow processes. Entropy, Availability, Irreversibility and T-ds relations. Claperyron and real gas equations, Properties of ideal gases and vapours, Power Cycles – Otto, Diesel, Dual & Rankine Cycle. C.I and S.I. Engines, Pre-ignition, Detonation and Knocking, Fuel injection and Carburation, Supercharging. Turbo-Prop and Rocket engines, Engine Cooling, Emission & Control, Flue gas analysis, Measurement of Calorific values.

UNIT-2 : Fluid Mechanics

Properties and classification of fluids, Manometry, Forces on immersed surfaces, Center of pressure, Buoyancy, Stability of floating bodies. Irrotational and incompressible flow. Inviscid flow. Stream

Functions & Velocity Potential, Continuity Equation, Bernoulli's Theorem, Measurement of Fluid Flow & Pressure Drop – Venturimeter, Orificemeter, Notches, Pitot tube, Flow through pipes, Reynold's number. Laminar and Tubulent flows, Separations. Flow over weirs and notches. Open channel flow, Hydraulic jump. Boundary layer theory, Di mensionless numbers, Dimensional analysis, Similitude and modelling.

UNIT-3 : Energy Conversion System

Hydraulic Pumps – Reciprocating & Centrifugal, Uses of Air Vessels, Seperation & Cavitation. Hydraulic Turbine – Pelton, Francis & Kaplan. Classification of steam turbines, Impulse and Reaction Turbine. Specific Speed, Velocity Triangles; Open and Close Cycle Gas Turbines. Performance.

UNIT-4 : Heat and Mass Transfer

Modes of heat transfer. One dimensional steady and unsteady conduction. Composite slab and Equivalent Resistence. Critical Thickness of insulation, Fins, Heat exchangers, Effectiveness, LMTD & NTU Methods. Overall heat transfer coefficient, Free and forced Convection, Thermal boundary layer over a flat plate. Dimensionless numbers, Black body, Boiling & Condensation, Radiation, Enclosure theory, Shape factor. Fundamentals of diffusive and convective mass transfer.

UNIT-5 : Refrigeration & Air Conditioning

Refrigerating effect, C.O.P., Heat Pump and Regrigeration Cycles and Systems, Properties of Refrigerants, Ozone Free refrigerent, Air Refrigeration – Reverse Carnot Cycle, Bell Coleman Cycle. Vapour Compression and Vapour Absorption Refrigerations, Condensors, Evaporators and Expansion devices. Solar refrigeration, Psychometry, Psychometric Charts and its application in air conditioning. Sensible heating and cooling, Effective temperature, comfort indices, Load calculations.

(3) ELECTRICAL ENGINEERING

PART - I

UNIT-1: Electromagnetic Field Theory

Co-ordinate system, Scalar and Vector fields, Stokes's theorem, Coulomb's law, Laplace's & Poisson's equations, solution of Laplace's equation, Biot-Savart's law, Ampere's circuital law. Magnetic Boundary conditions. Scalar magnetic potiential, Vector magnetic potential, Self and Mutual inductances, Faraday's Law, Maxwell's equations, Wave equation and solution, Pointing Vector.

Network Analysis – Circuit elements, Voltage and current sources, DC Circuits analysis. AC circuits under sinusoidal steady state. KCL and KVL analysis, magnetically coupled circuits, initial conditions, Network topology.

Network Theorems for AC & DC circuits Frequency domain analysis – Laplace transform, transform of waveform. Network Theorems in transform domain, Fourier series. Network function. Two port parameters, Interconnection of two ports networks.

UNIT-2   Electronics

Electronics Devices & Circuits, Semiconductor diodes, circuit & frequency response, analysis of diode circuits, diode applications.

Transistor Characteristics : Construction, principles of operation, V-I characteristics, applications, limitations and specifications of different types.

Amplifiers : Fixing operating point, h-parameters, voltage gain current gain, input impedance, output impedance, coupled amplifier – cascaded amplifiers. High frequency model of transistor, bandwidth of amplifiers.

Feedback Amplifiers and Oscillators: Negative & positive feedback, Power Amplifiers and Tuned Amplifiers, staibility consideration.

Number Systems and Codes, Alphanumeric codes : Boolean Algebra, Demorgon's theorem, Boolean expression & logic diagram. Truth table & maps,

Combinational Circuits : Design procedure, comparator, Decoder, Demultiplexer, Encoders, Multiplexer.

Sequential Logic Circuit : Clocked sequential circuit, state equations, Registers and Counters. Random Access Memory, Timing waveform, Programmable Logic Array (PLA). Analog to digital conversion, Digital to Analog convertors.

16-bit 8086 microprocessors, Instruction set, Addressing mode, machine language programming, Interfacing to 16-bit microprocessor.

Microcontroller – Architecture of 8051, Interfacing to ADC and DAC.

UNIT-3 Power Electronics Circuits

Application and Characteristics of power electronic devices, Commutation techniques, firing of SCR.

Rating & protection of SCR, series and parallel operation of SCR, Operation and analysis of rectifier circuits.

Voltage source & current source inverter, Harmonics & their reduction techniques.

Principle of chopper operation, Various control strategies in chopper, commutation of chopper, Cyclo convertor.

UNIT-4 Electrical Instrumentation

Measuring Instrument types, Accuracy and precision, Error & Error analysis, Testing & calibration, Operating, Damping and Controlling

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torque, Extension of range of instruments.

Instrument transformers, Measurement of power and energy, Energy meters, Tri-vector meter – Maximum demand meter, Amperehour meter, Power factor meter, Frequency meter, Ohmmeter, Multimeter, Megger & Ratio meter. Earth resistance measurement, Magnetic Measurements.

Bridges & Measurement with bridge circuits, Sources of errors in Bridges. Transducers, Classification, Characteristic & Choice of Transducers, Digital data acquisition systems, Signal Generators, Wave analyser, Digital instruments, resolution and sensitivity of Digital meters, Digital display system and indicators, Analog recorders, X-Y recorders.

UNIT-5 Control Engineering

Modeling of dynamic systems : Electrical, Mechanical and hydraulic systems, transfer function, Open and closed loop systems, Signal flow graph, Mason's formula, Components of control systems: Error detectors (Synchros & Potentiometer), Servomotors (AC & DC), techo generators, Power amplifier, steper motors.

Time – domain analysis of closed loop systems : Time response of first and second order systems, Steady state error & error constants. Feedback control actions : stability analysis. Characteristics equation of closed loop system, root loci, Stability by root loci. Frequency- Domain analysis, Bode plots, Nyquist stability analysis, Relative stability. Frequency - Domain compensation : Design of compensating networks. Sate- space Analysis, observability, optimal control.

P A R T - II

UNIT-1 POWER SYSTEM

Structure and components of power network. Power generation – conventional, non – conventional & generation, Effect of transmission voltage on power system economy. Problems associated with modern large interconnected power system., HVAC and HVDC Systems, Plant Economics.

Transmission Line Components & Under Ground Cabling Transmission line Parameters, Underground Cable – Grading of cables, ionization. Heating of cables, phenomena of dielectric losses and sheath loss in cables, Thermal resistance of cables.

Transmission systems & performance of transmission line Short, Medium & long transmission line and their representation, Surge Impedance, loading, Interpretation of long line equation and its equivalent equation. Power flow through transmission line, Method of voltage control, Static & rotating VAR generator, transformer control.

Insulator and Mechanical design. Vibration and Vibration dampers. Types of insulator for overhead transmission, String efficiency. Substation layout, substation equipment.

Fault Analysis

Symmetrical components, Sequence networks. Current limiting reactors.

Protective Relays–Primary & backup protection, Electromagnetic relays, Static analog & digital relays.

Circuit Breakers

Principle of arc quenching, recovery & re-striking voltage, Bulk oil, Minimum oil, Air break, Air blast, SF6, Vacuum circuit breakers and DC circuit breakers, HRC fuses, Testing of circuit breaker.

System Protection

Protection of Generators –

Protection of Transformers

Protection of transmission lines

Switching surges, Phenomena of Lightning, Insulation, coordination.

UNIT-2 Problem associated with modern interconnected power Systems.

Power flow studies – Formulation of static power flow equations and solutions, Economic operations of power system. Regulating transformer, line load ability, capability curves of alternator.

MW Frequency control, MVAR Voltage control Problem – Control of load bus voltage, Voltage stability, PV Curve for voltage stability. Power System Stability – Steady state, dynamic and transients stability, Swing equation, solution of swing equation, methods of improving transient stability.

SCADA, Concepts of Smart Grid. Energy Management

Energy audit, Energy auditing instruments.

Load curve analysis

Power factor improvement in power system. Energy Conservation in transportation system, Co-Generation, Energy conservation in Industry and in building, heating and lighting.

UNIT-3 ELECTRICAL MACHINE

Transformer

e.mf. equation, construction, phasor diagrams, equivalent circuit, voltage regulation, losses & testing. Excitation phenomenon, Autotransformer.

Rotating Electrical machine – DC Machine, Emf equation, Torque equation, Armature Reaction, Speed control.

Three phase Induction Motor : Principle, construction,.

Power factor control, Cogging & Crawling, impact of unbalanced supply and harmonics on performance, speed control, braking, In- duction Generator.

Single Phase Induction motor : Construction, Starting Methods,

Comparison with three phases Induction Motor.

Synchronous machines

Synchronous generators, emf equation, harmonics and their elimination. Armature reaction, determination of equivalent circuit parameters, phasor diagram, Effect of excitation variation.

Salient pole machine, Two reaction theory, phasor diagram, Determination of X_d and X_q, Power angle equation. Synchronizing power, Parallel operation.

Synchronous motors : Starting, Pull in torque, armature reaction, V curves, inverted V curves, Hunting & damper winding, efficiency and losses. Analysis under sudden short circuit, determination of transient parameters, Generalized theory of electrical Machines, Kron's Primitive machine, Park's and Inverse park's transformation.

UNIT-4 Special motors – Permanent magnet motors, P.M. synchronous motors, shaded pole motors, Repulsion motor, Universal motors, Hysteresis motor, Reluctance motor, Stepper motor, AC-series motor, Linear induction motors, DC & AC servo motors, Magnetic levitation vehicles, Brush less dc motors.

Control of D.C. motors by converters

Speed and Torque expression, Speed-Torque Characteristics, Four quadrant operation, Closed loop operation of DC motor. Control of D.C. Motors by Choppers.

Control of Induction Motors : Speed torque characteristics, Variable frequency control of induction motor, PWM control, Slip power recovery static Scherbius Drive, Static Kramer Drive.

Control of Synchronous Motors : Operation, Waveform, Speed torque Characteristics.

UNIT-5 Domestic and Industrial Wiring

Illumination Engineering

Nature of light, units, sensitivity of the eye, luminous efficiency, glare, Various types of lamps, lighting calculations.

Heating, Welding and Electrolysis

Electrical heating, methods and applications, power supply and control.

Different methods of electrical welding, and equipment for them. Furnace and welding transformers. Electrolytic principles, laws of electrolysis, electroplating, power supply for electrolytic process.

Traction

Special features of Traction motors, selection of Traction Motor, Different system of electric traction and transmission requirement. Mechanics of train movement, transmission requirement.

Electric Drives

Individual and collective drives- electrical braking, plugging, rheostatic and regenerative braking, load equalization use of fly wheel, criteria for selection of motors for various industrial drives.

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