Public Service Commission, West Bengal

161A, S. P. Mukherjee Road, Kolkata -700 026

Scheme and Syllabi of Screening Test to be held on the 23rd July, 2023 for recruitment to theposts of Assistant Professor in Civil Engineering, Electrical Engineering, Electronics & Communication Engineering And Mechanical Engineering for Govt. Engineering & Technological colleges in W.B.G.S. under the Department of Higher Education, Government of West Bengal vide Advt. No. 7/2021, Item nos. II, IV, V & VIII.

Scheme

1. Type of examination: - MCQ type test. The test will consist of questions on relevant Engineering Subject as well as English & General Awareness.

2. No. of questions: - 100 [30 questions on English & General Awareness and 70 questions on relevant Engineering Subject- each question carrying equal marks]

3. Full Marks: - 100
   - English – 20 Marks
   - General Awareness- 10 Marks
   - Relevant Engineering Subject- 70 Marks

   [1/3 mark will be deducted for each wrong answer]

4. Duration: - 1 hour and 30 minutes

By order of the Commission

SYLLABUS FOR SCREENING TEST FOR RECRUITMENT FOR THE POST OF ASSISTANT PROFESSOR IN CIVILENGINEERING FOR GOVERNMENT ENGINEERING AND TECHNOLOGICAL COLLEGES IN W.B.G.S UNDER THE DEPARTMENT OF HIGHER EDUCATION, GOVERNMENT OF WEST BENGAL:

I. Theory and Design of Structure

(a) Theory of structure and strength of materials:-

(i) Solid Mechanics – properties of material, Mohr's circle of stress-strain, plain stress & strain, Combined bending and direct stresses,Elastic theories of failure, simple bending, shear,torsion of circular and rectangular sections, columns and struts, moving loads and influence lines for shear force and bending moment for –simple and continuous beams and frames.

(ii) Structural analysis – Analysis of determinate structures. Different methods ofanalysis of indeterminate structure – moment distribution, slope-deflection,Matrix methods of structural analysis,columnanalogy, strain energy method, three moment theorem. Muller Breslau principle and application, etc. Analysis of determinate and indeterminate arches, Free Vibrations of undamped SDOF system.

(b) Steel Design – (Design of Steel Structure) :-

Limit state design concepts, Design of all types of connection, simple members, Built up sections and frames. Design of Industrial structures and Multistoried frames, Design of steel bridges andTanks of different types, Design of tubular structures, codal provisions for design ofall those steel structures including foundation,Connections - simple and eccentric, Principle of ultimate load design, plastic design of continuous frames and portals.

(c) Design of Reinforced Concrete and Masonry Structures: -Limit state method of design. Codal provisions for design, working stress method of design.Concrete mix design & Quality control. Principles of prestressed concrete design, materials, methods of prestressing, losses in prestressing, anchorages. Design of Brick masonry as per I.S. codes.

II. Fluid Mechanics and Hydraulics

Fluid properties and definitions, Dimensional Analysis, flow kinematics, continuity momentum and energy equations applicable to fluid flow, Bernouli's theorem, flow

through open channels,Hydraulic jump, flow through pipes and losses in pipe flows, siphons, pipe network, Forces in pipe ends, hydraulic energy grade line, water hammer, viscosity, definitionof ideal fluid, Concept of boundary layer and its growth; Concept of lift and drag, Forces on immersed bodies, Water surface profiles.

III. Soil Mechanics and Foundation Engineering :-

(1) Properties of soils, classifications and interrelationship, definitions of terms used; Soil testing in laboratory and in-situ, compaction behavior, methods of compactionand their choice; permeability and seepage, flow nets, flow underhydraulic structure, uplift and quicks and condition inverted filters, unconfined and direct shear stress, tri axial test, shearing resistance, Earth pressure theories, stability ofslopes; compressibility and consolidation. Stress-Strain characteristics of clays and sand; Stress paths. Theories of consolidation, pressure distribution in soils, soil stabilization, soil exploration and penetration tests, pore water pressure, Stress distribution in soils – Boussinesq theory; Pressure bulbs, Pile under lateral loading.

(2) Types foundation, selection criteria, bearing capacity, settlement laboratory and field tests, codal provisions in all types of foundation including testing of piles etc. Types of piles and their design and layout; Foundations on expansive soils, swelling and its prevention,Design of retaining walls, wells, sheet piles and caissons, Reinforced earth technique and its use.

IV. Surveying:-

Classification of surveys, scales, accuracy, Measurement of distance-by direct and indirect methods, optical and electronic devices, Measurement of directions, prismatic compass, local attractions; Theodolites-types, Measurement of elevations, trigonometric leveling, contours. Establishment of control by triangulations and traversing. Measurements and adjustment of observation, Computation of coordinates; Errors and their corrections of measurement of length, bearing horizontal and vertical angles and leveling operation, Correction due to refraction and curvatures, Nap preparation by plane tabling and photogrammetry, Field astronomy, concept substitutes, Setting out directions and grade; typesof curves, setting out of curves and excavation lines for building foundation, Remote sensing and GIS.

V. Construction Materials, practices, Planning and Management:-

(1) Building Materials specifications, tests, uses and codal provisions.

(2) Concrete technology – Cement its properties, classification and specification-provisions in I.S. code. Properties of coarse and fine aggregates- provisions in I.S.

code, concrete mix design, Laboratory concrete. Ready mixed concrete, field tests for quality control of concrete, concreting equipments.

(3) Earth moving machineries and pile driving equipment.

(4) Construction planning and management – Bar chart, linked bar chart, work break down structures. Activity-on-arrow diagrams, critical path, probabilistic activity durations, Event-based network, PERT Network Time cost study, crashing, Resource allocation,Rescheduling of construction programme.

(5)Quantity surveying, Methods of valuation, pricing and measurement of works,Rudiments of legal and technical aspects of engineering contracts.

VI. Highway Engineering including Traffic Engg.

Planning of Highway systems, its classifications, object and principles, Geometric design of Highway alignment, gradients, super-elevation, camber sight distances etc. Horizental and Vertical curves, Transition curves, grade separations, segregation of traffic and intersection design. Materials of highway construction its properties and tests. Subgrade and pavement components, Types of pavements & Road drainage. Principles of highway financing, Design of Flexible andRigid Pavements following Indian Standards, evaluation of pavement failure and strengthening Construction methods andqualitycontrol measures for highway embankment, subgrade, pavement courses and bituminous surfacings. Elements of Design and Construction of highway – Bridges and Culverts including their maintenance. Principles of transportation planning, forecasting techniques, origin and destination study; Highway capacity, Arterial routes, one-way roads and bye-pass roads, Ribbon development; Traffic control devices; Traffic study and parking surveys, speed, volume and delay studies; Accident characteristics, Traffic signal, Traffic projection factor,Permanent Way and its components, Geometric design of railway Track – Speed and Cant, Crossings and Signals.

VII. WATER RESOURCES ENGINEERING

(1) Hydrology – Hydrologic cycle, Measurements, computations and statistics; Run off and stream flow, measuring techniques and Computation; Hydrogaphs, Computation and interpretation, ground water, Estimation, Measurement, Characteristics.

(2) Irrigation Engineering – Types of irrigation systems and their detail description, soil-water-crop relationship, types of soils, water requirement of crops; Delta and duty.

Classification of rivers, River Regime Theory, Effects of dams on river regime, River training works.

Irrigation Channels, Design principles of irrigation canals, Drainage channels and Navigation canals linings.

Water logging and salt efflorescence, land reclamation.

(3) Hydraulic structures – Storage Reservoirs, Different types of dams and their design principles, weirs, barrages and their design principles; spillways, Energy dissipationby hydraulic jump, different types of energy dissipation. Head works; cross drainage works; Falls and Regulators.

VIII. ENVIRONMENTAL ENGINEERING

(1) Water Supply Engineering:-Water uses; Quantity requirements; ~~portable~~ potable water quality, sources of water, ground water hydraulics, Development of surface source, Reservoir volume, Transmission of water.

Treatment of waters; Typical flow-sheets for surface and ground surfaces; sedimentation, coagulation and flocculation, filtration, disinfection, hardness and chemical softening,Rudiments of Ion-exchange; Elements of rural water supply andremoval of iron, Arsenic and salinity from water.

Principles and methods of design of distribution systems, service reservoirs, and Intakes from urban and rural water supply.

(2) Waster water Engineering: Sanitary water andstorm water run off, quality estimation, sewerage system and their design principles; sewer construction materials; structural design of sewers, sewer appurtenances, characteristics of domestic ~~sewage~~ sewage; typical flow –sheets for primary and secondary treatments; Design principles of screen, grit-removal, sedimentation, bio-filter, activated sludge process and septic tank, elements of industrial sewage and its treatment, rural sanitation: its principles and practices.

(3) Environmental pollution and control: Atmospheric pollution; types of pollution, natural and man-made sources, effect of air pollution,Air quality standards, Air quality Index and limits, unit system rudiments of control method, elements of noise pollution.

Community solid waste; sources, quality and characteristics, methods of disposals, reuse and cycling.

Water quality management; quality criteria for major use of water;Applied stream sanitation,

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- **Circuit Theory:** KCL, KVL, Node and mesh analysis; Network theorems: Superposition, Thevenin's, Norton's, Maximum power transfer theorem, Reciprocity theorem, Millman's theorem, Telegen's Theorem; Transient analysis of dc and ac networks; Sinusoidal steady-state analysis; Resonance; Magnetically coupled circuit; Two port networks. Balanced three phase circuits: Graph theory applied to electrical network.

- **Fields Theory:** Co-ordinate System. Vector calculus. Coulomb's law: Electric Field intensity; Electric flux density; Gauss's law; Electric field and potential due to point, line, plane and spherical charge distributions; Electric dipole, Energy in Electrostatic field, Poisson's & Laplace's Equation, Boundary Conditions, Effect of dielectric medium; Capacitance of simple configurations; Basic laws: Biot-Savart's law, Ampere's law, Faraday's law, Maxwell's field equations. Lorentz force: Magnetic vector & scalar potential, Inductance. Magnetomotive force. Reluctance; Magnetic circuits; Self and mutual inductance of simple configurations; Magnetic Energy. Magnetic material, Boundary conditions, Electromagnetic wave propagation: Poynting theorem, Wave equation, Reflection of a plane wave at normal incidence, reflection of a plane wave at oblique incidence. Polarisation. Transmission lines.

- **Electrical Machines:** Single phase transformer: Equivalent circuit, Phasor diagram, Open circuit and short circuit tests. Regulation and efficiency. Parallel operation of single phase transformer; Three-phase transformers: Connections, Vector groups, Parallel operation of three phase transformer; Auto-transformer; Electromechanical energy conversion principles; DC machines: Separately excited, series, shunt and compound machines; motoring and generating mode of operation and their characteristics; Speed control of dc motors; Starting and braking of DC motor, Three-phase induction machines: Principle of operation, types, performance, Torque-speed characteristics, No-load and blocked-rotor tests, Equivalent circuit, Starting and speed control; Single-phase induction motors: Operating principle, Method of starting, Torque-speed characteristics, No-load and blocked-rotor tests, Equivalent circuit; Synchronous machines: Cylindrical and salient pole machines, Performance analysis and characteristics, Regulation and parallel operation of generators, Starting of synchronous motors; AC series motor; Special machine: Hysteresis motor, reluctance motor, permanent magnet motor, stepper motor, brushless DC motors.

Cycloconverter: Electric Drives: Speed control of DC and AC motor drives , starting and braking of DC and AC motor drives.

- **Microprocessor & Microcontroller**: Microprocessor architecture, Address/data & control lines, timing diagram, Internal registers, Instruction set and assembly language programming, interrupt mechanism, memory interfacing, I/O interfacing, programmable peripheral devices, Microcontrollers and embedded processors.

- **Power System:** Transmission line parameters: Resistance, Inductance, Capacitance and Conductance; Inductance of single phase line; Inductance of three phase line with symmetrical and unsymmetrical spacing; Concept of GMD and GMR; Models and performance of overhead transmission lines and underground cables; Sag and tension of overhead lines; Series and shunt compensation; Electric field distribution and insulators; Distribution systems; Per-unit quantities; Load flow Analysis: Bus admittance matrix, Gauss- Seidel method and Newton-Raphson method; Voltage and Frequency control; Power factor correction; Symmetrical components; Symmetrical and unsymmetrical fault analysis; Principles of over-current, differential, directional and distance protection; Transformer Protection, Busbar Protection, Circuit breakers; System stability concepts; Equal area criterion; Economic Load Dispatch by Lambda iteration method with and without considering transmission losses.

- **Control System:** Mathematical modeling and block diagrams representation of systems; Feedback principle; Open loop and closed loop systems; transfer function; Signal flow graphs; Transient and Steady-state analysis of linear time invariant systems; Stability analysis using Routh-Hurwitz and Nyquist criteria; Bode plots; Root loci; Lag, Lead and Lead-Lag compensators; P, PI and PID controllers; State space model; Solution of state equations of linear time invariant systems.

- **Electrical and Electronic Measurements**: Measurement System, Error analysis, Bridges and Potentiometers; Analog Meters; Measurement of voltage, current, power, energy, power factor, resistance, inductance, capacitance and frequency; Instrument transformers (CT & PT); Digital voltmeters and multimeters, Digital frequency meter, Signal generator, Digital storage oscilloscope, Phase, Time and Frequency measurement; Oscilloscopes; Sensor & transducers; Temperature transducers; LVDT; Strain-gauge; Flow measurement using magnetic flow measurement.

- **Analog and Digital Electronics**: Simple diode circuits: clipping, clamping, rectifiers; Amplifiers: biasing, equivalent circuit and frequency response; Oscillators and feedback amplifiers; Operational amplifiers: Characteristics and applications; Single stage active filters; Active Filters: Sallen Key, Butterwoth, VCOs and timers; Combinatorial and sequential logic circuits; Multiplexers, demultiplexers, Schmitt triggers, sample and hold circuits, A/D and D/A converters.

- **Power Electronics and drives:** V-I, switching Characteristics and working principle of diode, transistor, thyristor, TRIAC, GTO and Static induction device (SID); Firing and Commutation circuits for Thyristor, MOSFET, IGBT; Protection of Thyristor; Chopper: Buck, Boost and Buck-Boost Converters; Types of chopper (quadrant based); Voltage and Current commutated Thyristor based chopper; Phase controlled rectifiers: Single and three-phase configuration of uncontrolled and controlled rectifiers; Bidirectional ac to dc voltage source converters; Magnitude and Phase of line current harmonics for uncontrolled and thyristor based converters; Inverters: Single-phase and three-phase voltage and current source inverters; PWM inverters; Cycloconverter: Step-up and Down

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- **Circuit Theory:** KCL, KVL, Node and mesh analysis; Network theorems: Superposition, Thevenin's, Norton's, Maximum power transfer theorem, Reciprocity theorem. Millman's theorem, Telegen's Theorem; Transient analysis of dc and ac networks: Sinusoidal steady-state analysis; Resonance;Magnetically coupled circuit;Two port networks; Balanced three phase circuits; Graph theory applied to electrical network. Laplace transforms and properties: Partial fractions, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions. Behaviors of series and parallel resonant circuits. Introduction to band pass, low pass, high pass and band reject filters.

- **Electronics Devices:** : Energy Bands theory in crystals (Qualitative Analysis). Metals. Semiconductors, & Insulators, Fermi-Level, Intrinsic and Extrinsic Semiconductors. diffusion and drift of carriers, continuity equation, Generation and recombination of carriers: Poisson and continuity equation. p-n junction, Basic device technologies for fabrication of a p-n junction, I-V characteristics, and small signal switching models; Avalanche breakdown, Zener diode, Schottky diode. Bipolar Junction Transistor: Basic Construction, I-V characteristics. MOSFET: MOS capacitor, C-V characteristics. MOSFET. I-V characteristics, and small signal models of MOS transistor. Opto-Electronics devices: photovoltaic effects, solar cells (pn junction), Photoconductors Photodiode, PIN photodiode, Avalanche photodiode, Phototransistor. LED. Semiconductor Laser (p-n junction). Integrated circuit: fabrication process: oxidation. diffusion. ion implantation, photolithography, etching, chemical vapor deposition, sputtering, twin-tub CMOS process.
- **Analog Electronic Circuits:** Simple diode circuits: clipping, clamping, rectifiers: Amplifiers: biasing, equivalent circuit and frequency response; Schmitt trigger and Oscillators, feedback amplifiers; Operational amplifiers: Characteristics and applications; Single stage active filters; Active Filters: Butterwoth, VCOs, timers, Phase lock loop;

- **Digital Electronic circuits:** Number System, Boolean Algebra and De Morgan's Theorem. SOP & POS forms, Canonical forms, Karnaugh's map, Multiplexers. Encoder, Decoder, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Fast adders, Barrel shifter and ALU. Sequential Logic Design: Building blocks

like S-R. JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters. Shift registers, Finite state machines, TTL. ECL. CMOS families Semiconductor Memories. Different types of A/D and D/A conversion techniques. Sample & Hold Circuit.

- **Signal and systems:** Energy and power signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift invariance. causality, stability, realizability. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. Fourier Transform. Laplace Transform , Z-transform (single sided and Double sided) The Laplace Transform. region of convergence, poles and zeros of system, , solution to differential equations and system behavior using Laplace Transformation The z-Transform for discrete time signals and systems- Eigen functions, region of convergence, z-domain analysis. The Sampling Theorem and its implications- Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold, and so on. Aliasing and its effects.

- **Communication system:** Random processes: autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems .Analog communications: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, super heterodyne receivers. Information theory: entropy, mutual information and channel capacity theorem. Digital communications: PCM, DPCM, digital modulation schemes (ASK, PSK, FSK.• QAM), bandwidth, inter-symbol interference, MAP, ML detection, matched filter receiver, SNR and BER. Fundamentals of error correction, Hamming codes, CRC.

- **Electromagnetic waves:** Maxwell's equations: differential and integral forms and their interpretation, boundary conditions, wave equation, Pointing vector. Plane waves and properties: reflection and refraction, polarization, phase and group velocity, propagation through various media, skin depth. Transmission lines: equations, characteristic impedance, impedance matching, impedance transformation, S-parameters, Smith chart. Rectangular and circular waveguides, light propagation in optical fibers, dipole and monopole antennas, linear antenna arrays.

- **Microprocessor & Microcontroller:** Microprocessor (8085 and 8086) architecture. Address/data & control lines, timing diagram, Internal registers, Instruction set and assembly language programming, interrupt mechanism, memory interfacing, I/O interfacing, programmable peripheral devices. Microcontrollers and embedded processors.
- **Computer architecture:** Basic Structure of Computers, Functional units, software. performance issues software, machine instructions and programs. Types of instructions. Instruction sets: Instruction formats, Assembly language, Stacks, Ques, Subroutines. Processor organization, Information representation, number formats. Multiplication &

division. ALU design, Floating Point arithmetic, Instruction sequencing, RAM, ROM, Memory management, Concept of Cache & associative memories, Virtual memory. Input - Output systems, Interrupt, DMA, Standard I/O interfaces Concept of parallel processing, Pipelining.

- **Digital signal processing:** Discrete Fourier Transform (DFT), Fast Fourier Transform Algorithm, Implementation of Discrete Time Systems, Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low pass, Band pass, Band stop and High pass filters. Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Introduction to multirate signal processing. Application of DSP.

- **Control System and instrumentation:** Mathematical modeling and block diagrams representation of systems; Feedback principle; Open loop and closed loop systems;transfer function; Signal flow graphs; Transient and Steady-state analysis of linear time invariant systems; Stability analysis using Routh-Hurwitz and Nyquist criteria; Bode plots; Root loci; Lag, Lead and Lead-Lag compensators; P, PI and PID controllers; State space model; Solution of state equations of linear time invariant systems. CRO- measurement with it and its function with block diagram representation. Wave and Spectrum analyzers- requirements of these instruments and their functions with block diagrams. LVDT. DC and AC servomotors, tacho generators, electro hydraulic valves, hydraulic servomotors, electro pneumatic valves, pneumatic actuators.

- **Computer network** Data communications: components, data representation , direction of data flow: network criteria, physical structure, categories of network (LAN, MAN,WAN): OSI reference model, TCP/IP reference model, their comparative study. Physical Layer. Time division & space division switch, TDM bus; Telephone Network; Data link Layer: Types of errors, framing, error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back- N ARQ, Selective repeat ARQ, HDLC; Medium Access sub layer: Point to Point Protocol, LCP, NCP, Token Ring; Reservation, Polling, Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA Traditional Ethernet, fast Ethernet; Network layer: Internetworking & devices: Repeaters, Hubs, Bridges, Switches, Router, Gateway; Addressing : IP addressing, subnetting: Routing : techniques, static vs. dynamic routing , Unicast Routing Protocols: RIP, OSPF, BGP; Other Procols: ARP, IP, ICMP, IPV6;. Transport layer: Process to Process delivery: UDP; TCP; Congestion Control: Open Loop, Closed Loop choke packets; Quality of service: techniques to improve QoS: Leaky bucket algorithm, Token bucket algorithm. Application Layer: Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW: Security: Cryptography (Public, Private Key based), Digital Signature, Firewalls. ISDN services & ATM, DSL technology, Cable Modem: Architecture & Operation in brief Wireless LAN: IEEE 802.11, Introduction to blue-tooth.

SYLLABUS FOR SCREENING TEST FOR RECRUITMENT FOR THE POST OF ASSISTANT PROFESSOR IN MECHANICAL ENGINEERING FOR GOVERNMENT ENGINEERING AND TECHNOLOGICAL COLLEGES IN W.B.G.S UNDER THE DEPARTMENT OF HIGHER EDUCATION, GOVERNMENT OF WEST BENGAL:

1. ELECTRICAL TECHNOLOGY

Electrical Units,and dimensions, Electro magnetism,Magnetic circuits, D.C. generatorsand motors. speedcontrol. Starters. Electrical measuring instruments, principles of operation and construction, A.C machines and Transformer, Basic Electronics.

2. MATHEMATICS

Function of a single variable, Successive differentiation, Molle's theorem. Mean value theorems. Taylor's theorem and Maclaurin' series, Maxima and Minima. Indeterminate forms. Tangent, normal and curvature.

Functions of several variables. limit and continuity. Partial derivatives. Differentials. Partial derivatives of a compositefunction. Implicit function. Jacobian.Taylor's theorem.Maxima ana Minima. Lagrange's method.

Reimann integration, Definition, Properties,Fundamentaltheorem of integral calculus.Improper integrals. Gamma and Beta functions.

Multiple integrals, Extension of integrals (statement only) Properties ofdouble Integral. Evaluation of double integral. Change ofthe order of integration and change ofvariables.

3. ENGINERING MECHANICS

Laws of Coulomb's friction, equilibrium of rigid bodies, principle of virtual work, application of friction in machines, properties of surfaces, centre of mass, and centreof gravity, shear force and bending moment diagrams, Particle dynamics. plane motion of rigid body.

4. PHYSICS

Angular momentum and torque. Moment of inertia. Parallel and perpendicular axes theorem. Calculation of moment of inertia of some common solids. Rotational dynamics of a rigid body.

Newton's laws of Gravitation, Calculation of gravitational field and potential of a spherical distribution of mass. Motion under a central force. Kepler's laws.

5. THERMODYNAMICS

Microscopic &Macroscopic viewpoints in Thermodynamics; Fundamental concepts of system, control volume, state, properties, equilibrium, processes etc, Zeroth Law; Survey of units & Dimensions: Forms of energy and energy interactions, heat & work;

Ideal &real gases; Equations of state; compressibility Factor; Generalized compressibility chart; First Law of Thermodynamics for closed system, internal energy;

First Law for Control Volumes; Steady flow & unsteady flow applications.

Definitions of Heat Engine, Heat Pump, Thermal Efficiency, COP; Carnot Cycle.

Second Law of Thermodynamics; Statementand Corollaries; Entropy; Concept of Reversibility and irreversibility.

T-ds relations; Maxwellequations; ClapeyronEquation; Clausius-Clapeyron equation, Joule-Thompson Coefficient; Compressibility & expansion co-efficient.

6. MATERIALS & METALLOGRAPHY

Unit cells, packing efficiency and co-ordination number, bonds and bond energy, plastic deformation and mechanical testing of metallic materials.

strengthening mechanism, heat treatment of steels,cast iron and carbon steels, important alloy steels. important non-ferrous alloys.

7. STRENGTH OF MATERIALS

Thin pressure vessels, torsion of circular shafts,close-coiled helical springs, stresses in beams due tobending and shear.

Deflection of beams, combined bending and torsion, concept of elastic stability with particular reference to buckling of columns. Strain energy.

Introduction to elasticity, problems in uni-axial stress field.

Thin-walled beams. unsymmetrical bending, energy principles. Castigliano's theorem, curved beams. thick-walled cylinders under radial pressure. Lame's equation, theories of failure.

Work-energy principle, momentum principle, central force motion,

8. FLUID MCHANICS

Properties of Fluid, Classification of fluid, real and real fluids, Newtonian and Non-Newtonian Fluids.

compressible and Incompressible fluids,

Steady and Unsteady flow, Uniform and non-Uniform flow. Path line, Stream line and stream tube. One, two and three-dimensional flow. Continuity Equation-differential and integrated form. Rotational and Irrotational flow. Vortex motion. Laminar and Turbulent flow,

Darcy-Weisbach equation, Moody's diagram. Flow through non-circular ducts. Minor losses-heat losses at sudden expansions, sudden contractions and bends. Head losses in pipe in series and parallel, pipe line problems.

Dimensional Analysis, similarity etc.to sink and Doublet.

Flowaround symmetrical bodies. Specific speed and classification of fluid machinery. Design methodology of axial and radial flow machines (pumps and fans).

9. DESIGN OF MACHINE ELEMENTS

Introduction to design. factorof safety, calculation of allowable stress under various types of loading. Stresa concentration, endurance diagram and design criteria. Review of stress calculation in various situation-direct, bending and torsional loads and their combined effect. Buckling

Design of pin-joint. cotter-joint etc.

Transmission screws.

Screw-joints. pre-loaded bolts, etc.

Rivets and riveted joints, etc.

Design of weldments.

Key, shaft and axle.

Belt drive,Flat & V-belt, pulleys.

Rigid and FlexibleCouplings

Toothed gear drive. Spur, straight, and helical tooth.

Gears for non-intersecting shafts: Bevel & Hypoid gears. Brakes and clutches, friction clutch, jaw clutch and centrifugal clutch.

Springs: Tension, compression. torsion and leaf springs.

10. DYNAMICS OF MACHINES

Gyroscopic motion. force analysis of machines-analysis of fly-wheels & governors.

Balancing of rotating and reciprocating masses.

Vibration of spring-mass systems, introduction to vibrations of elastic bodies-transverse vibration of beams and critical speed of shafts, Tortional vibration with multiple discs.

11. I. C. ENGINES & GAS TURBINE

Principle of working: basic engine types; comparison of air standard cycles; air cycle analysis with variable specific heats; introduction to fuel air cycle analysis; actual cycles, mep. thermal efficiency.

Combustion calculations related to I.C. Engine fuel, desirable characteristics for fuels for I.C.engine.

Mixture requirement for S. I. Engine; carburetion pressure drop-flow.fuel air-ratio; complete carburator. Petrol injection. Ignition system in S.I.Engine-Battery, Magneto and Electronic ignition systems, ignition timing and spark advance.

Fuel oil injection in C. I.Engine-requirements; fuel injection systems; injection pumps and nozzles.

Supercharging I. C. Engine-requirements: Supercharging limits; Turbocharging. Scavenging of I.C. Engines-two stroke S.I. and C.I.Engines; scavenging parameters, ideal scavenging processes; actual scavenging; scavenging pumps.

12 Manufacturing Engineering

Crystal structure of materials, crystal systems, unit cells and space lattices, miller indices of planes and directions, packing geometry in metallic, ionic and covalent solids. Imperfections in crystalline solids and their role in influencing various properties. Solid solutions, solubility limit, phase rule, binary phase diagrams, intermediate phases, intermetallic compounds, iron-iron carbide phase diagram, heat treatment of steels; cold and hot working of metals; recovery, recrystallization and grain growth; microstrcture, properties and applications of ferrous and non-ferrous alloys.

Introduction to manufacturing Processes, moulding materials properties and mould making; various casting processes; cores, gating and risering; foundry furnaces; Forming-hot and cold working; rolling; forging and forging dies; Welding and joining processes-classification; gas welding; flame cutting; arc welding-electric arc welding, MIG, TIG. Introduction to rapid prototyping; Additive manufacturing, Generative manufacturing processes like stereolithography, selective laser sintering and others

Machining principles, motions required and chief elements in machining; Basic machine tools-Lathe, shaping machine, planning machine, slotting machine, drilling machine, milling machine, broaching machine, and grinding machine; estimation of machining time; job holding devices, indexing and elementary idea about jigs and fixtures; honing, lapping and super-finishing processes, elementary idea of tool geometry, tool wear etc, Numerical control machine tools: basic concepts, field of applications, coordinate system and machine motions, types of NC systems, MCU and other components, NC part programming- manual and computer assisted; engineering analysis; CNC, DNC, Machining accuracy, various types of error, principles of measuring and gauging; accuracy, precision and sensitivity of measuring instruments; line and end standards of measurement; limits, fits and tolerances; Taylor's principle

Materials Management – Inventory – types, different cost, EOQ and EPQ models, Basic ideas of MRP and MRP II, purchasing functions, vendor rating etc., ABC analysis, Basic ideas of supply chain management, Time series analysis and various qualitative and quantitative forecasting techniques, forecasting errors, network scheduling – PERT, CPM, Linear Programming – Fundamentals, formulations, various variables, graphical solutions

13. MACHINE TOOLS

Machine tool design: Features of construction, function and principles involved in the design of machine tool elements layout of speeds for various machine tool drives; hydraulic and electric drives; design of gear boxes for speed and feed changes; rigidity and vibration analysis of machine frames; columns, beds and spindles.

Economics of machine tool selection: economic tool life.