Indicative Syllabus

Discipline: Electrical Engineering

01. **Electric Circuits and Fields:** Network graph, KCL, KVL, node and mesh analysis, transient response of dc and ac networks; sinusoidal steady-state analysis, resonance, basic filter concepts; ideal current and voltage sources, Thevenin's, Norton's and Superposition and Maximum Power Transfer theorems, two-port networks, three phase circuits; Gauss Theorem, electric field and potential due to point, line, plane and spherical charge distributions; Ampere's and Biot-Savart's laws; inductance; dielectrics; capacitance.

02. **Signals and Systems:** Representation of continuous and discrete-time signals; shifting and scaling operations; linear, time-invariant and causal systems; Fourier series representation of continuous periodic signals; sampling theorem; Fourier, Laplace and Z transforms.

03. **Electrical Machines:** Single phase transformer - equivalent circuit, phasor diagram, tests, regulation and efficiency; three phase transformers - connections, parallel operation; auto-transformer; energy conversion principles; DC machines - types, windings, generator characteristics, armature reaction and commutation, starting and speed control of motors; three phase induction motors - principles, types, performance characteristics, starting and speed control; single phase induction motors; synchronous machines - performance, regulation and parallel operation of generators, motor starting, characteristics and applications; servo and stepper motors.

04. **Power Systems:** Basic power generation concepts; transmission line models and performance; cable performance, insulation; corona and radio interference; distribution systems; per-unit quantities; bus impedance and admittance matrices; load flow; voltage control; power factor correction; economic operation; symmetrical components; fault analysis; principles of over-current, differential and distance protection; solid state relays and digital protection; circuit breakers; system stability concepts, swing curves and equal area criterion; HVDC transmission and FACTS concepts. Numeric Relays.

05. **Control Systems:** Principles of feedback; transfer function; block diagrams; steady-state errors; Routh and Niquist techniques; Bode plots; root loci; lag, lead and lead-lag compensation; state space model; state transition matrix, controllability and observability.

06. **Electrical and Electronic Measurements:** Bridges and potentiometers; PMMC, moving iron, dynamometer and induction type instruments; measurement of voltage, current, power, energy and power factor;

instrument transformers; digital voltmeters and multimeters; phase, time and frequency measurement; Q-meters; oscilloscopes; error analysis.

07. **Analog and Digital Electronics:** Characteristics of diodes, BJT, FET; amplifiers - biasing, equivalent circuit and frequency response; oscillators and feedback amplifiers; operational amplifiers - characteristics and applications; simple active filters; VCOs and timers; combinational and sequential logic circuits; multiplexer; Schmitt trigger; multi-vibrators; sample and hold circuits; A/D and D/A converters; 8-bit / 16-bit microprocessor basics, architecture, programming and interfacing.

08. **Power Electronics and Drives:** Semiconductor power diodes, transistors, thyristors, triacs, GTOs, MOSFETs and IGBTs - static characteristics and principles of operation; triggering circuits; phase control rectifiers; bridge converters - fully controlled and half controlled; principles of choppers and inverters; basis concepts of adjustable speed dc and ac drives. Variable speed control of AC machines.

Indicative Syllabus

Discipline: Mechanical Engineering

01. **Engineering Mechanics:** Free body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion, including impulse and momentum (linear and angular) and energy formulations; impact.

02. **Engineering Materials**: Structure and properties of engineering materials and their applications, heat treatment, stress-strain diagrams for engineering materials.

03. **Strength of Materials:** Stress and strain, stress-strain relationship and elastic constants, Mohr's circle for plane stress and plane strain, thin cylinders, thick-walled vessels; shear force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular members; columns and struts; strain energy and impact loading; thermal stresses; Rotating Rims & Discs; Bending of Curved Bars.

04. **Theory of Machines:** Displacement, velocity and acceleration analysis of plane mechanisms, kinematic synthesis of mechanisms; dynamic analysis of slider-crank mechanism; gear trains; flywheels; static and dynamic force analysis; balancing of rotating components; governors.

05. **Thermodynamics:** Thermodynamic system and processes; Zeroth, First and Second laws of thermodynamics;; Carnot cycle. irreversibility and availability; behaviour of pure substances, ideal and real gases; calculation of work and heat in ideal and real processes; Rankine and Brayton cycles with modifications, analysis of thermodynamic cycles related to energy conversion; vapour refrigeration cycle, heat pumps, gas refrigeration, reverse Brayton cycle; moist air: psychrometric chart, basic psychrometric processes.

06. **Energy Conversion:** Fuels and combustion; high pressure steam boilers; flow through nozzles; Gas turbines with intercooling, reheat and regenerators, Steam turbines, velocity diagram, power output and efficiency, maximum blade efficiency of single stage impulse turbine, blade friction, compounding of impulse turbine; reaction turbine, degree of reaction, velocity diagram, power output, efficiency; losses in steam turbines, stage efficiency, overall efficiency and reheat factor; governing of steam turbines; steam condensers, condenser vacuum, sources of air leakage & its disadvantages.

07. **Heat-Transfer:** Modes of heat transfer; one dimensional heat conduction, resistance concept, electrical analogy, unsteady heat conduction, fins; dimensionless parameters in free and forced convective heat transfer, various correlations for heat transfer in flow over flat plates and through pipes; thermal boundary layer; effect of

turbulence; radiative heat transfer, black and grey surfaces, shape factors, network analysis; heat exchanger performance, LMTD and NTU methods.

08. **Fluid Mechanics:** Fluid properties; fluid statics, manometry, buoyancy; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; viscous flow of incompressible fluids; boundary layer; elementary turbulent flow; flow through pipes, head losses in pipes, bends etc.

09. **Vibrations:** Free and forced vibration of single degree of freedom systems; effect of damping; harmonically excited and transient vibrations; introduction to multi-degree of freedom systems; vibration isolation; resonance, critical speeds of shafts.

10. **Design:** Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; *principles* of the design of machine elements such as bolted, riveted and welded joints, shafts, spur gears, rolling and sliding contact bearings, keys, couplings, brakes and clutches; Selection of Materials.

11. **Fluid Machines:** Pelton, Francis, propeller and Kaplan turbines; performance characteristics and governing of hydraulic turbines; introduction to Deriaz and Bulb turbines; selection of turbines; Centrifugal & axial pumps and fans, reciprocating pumps.

12. **Joining:** Chemistry of welding, design of welding joints, pre- and post-heat treatment of welded joints; brazing and soldering; adhesive bonding.

13. **Machining and Machine Tool Operations:** Mechanics of metal cutting and chip formation, single and multi-point cutting tools, tool geometry and materials, tool life and wear; principles of non-conventional machining processes; principles of work clamping, principles of design of jigs and fixtures.

14. **Metrology and Inspection:** Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly.

15. **Computer Integrated Manufacturing:** Basic concepts of CAD/CAM and their integration tools.

16. **Production Planning and Control:** Forecasting models, aggregate production planning, scheduling, materials requirement planning.

17. **Inventory Control:** Deterministic and probabilistic models; safety stock inventory control systems, economic order quantity.

18. **Operations Research:** Linear programming, simplex and duplex method, transportation, assignment, network flow models, simple queuing models, PERT and CPM.

19. **Product Design and Development:** Principles of good product design, tolerance design; quality and cost considerations; product life cycle; standardization, simplification, diversification, value engineering and analysis, concurrent engineering.

20. **Industrial Safety**: Introduction, types of accidents, causes and common sources of accidents, methods of safety, first aid.

21. **Engineering Economy and Costing:** Elementary cost accounting and methods of depreciation; break-even analysis, techniques for evaluation of capital investments, financial statements.

22. **Management Information System:** Value of information; information storage and retrieval system - database and data structures; knowledge based systems.

Indicative Syllabus

Discipline: Civil Engineering

01. **Mechanics:** Bending moment and shear force in statically determinate beams. Simple stress and strain relationship: Stress and strain in two dimensions, principal stresses, stress transformation, Mohr's circle. Simple bending theory, flexural and shear stresses, unsymmetrical bending, shear centre. Thin walled pressure vessels, uniform torsion, buckling of column, combined and direct bending stresses.

02. **Structural Analysis:** Analysis of statically determinate trusses, arches, beams, cables and frames, displacements in statically determinate structures and analysis of statically indeterminate structures by force/ energy methods, analysis by displacement methods (slope deflection and moment distribution methods), influence lines for determinate and indeterminate structures. Basic concepts of matrix methods of structural analysis.

03. **Concrete Structures:** Concrete Technology- properties of concrete, basics of mix design. Concrete design- basic working stress and limit state design concepts, analysis of ultimate load capacity and design of members subjected to flexure, shear, compression and torsion by limit state methods. Basic elements of prestressed concrete, analysis of beam sections at transfer and service loads.

04. **Steel Structures:** Analysis and design of tension and compression members, beams and beam- columns, column bases. Connections- simple and eccentric, beam-column connections, plate girders and trusses. Plastic analysis of beams and frames.

05. **Soil Mechanics:** Origin of soils, soil classification, three - phase system, fundamental definitions, relationship and interrelationships, permeability and seepage, effective stress principle, consolidation, compaction, shear strength.

06. **Foundation Engineering:** Sub-surface investigations- scope, drilling bore holes, sampling, penetration tests, plate load test. Earth pressure theories, effect of water table, layered soils. Stability of slopes- infinite slopes, finite slopes. Foundation types- foundation design requirements. Shallow foundations- bearing capacity, effect of shape, water table and other factors, stress distribution, settlement analysis in sands and clays. Deep foundations -pile types, dynamic and static formulae, load capacity of piles in sands and clays, negative skin friction.

07. **Fluid Mechanics and Hydraulics:** Properties of fluids, principle of conservation of mass, momentum, energy and corresponding equations, potential flow, applications of momentum and Bernoulli's

equation, laminar and turbulent flow, flow in pipes, pipe networks. Concept of boundary layer and its growth. Uniform flow, critical flow and gradually varied flow in channels, specific energy concept, hydraulic jump. Forces on immersed bodies, flow measurements in channels, tanks and pipes. Dimensional analysis and hydraulic modeling. Kinematics of flow, velocity triangles and specific speed of pumps and turbines.

08. **Hydrology:** Hydrologic cycle, rainfall, evaporation, infiltration, stage discharge relationships, unit hydrographs, flood estimation, reservoir capacity, reservoir and channel routing. Well hydraulics.

09. **Irrigation:** Duty, delta, estimation of evapo-transpiration. Crop water requirements. Design of: lined and unlined canals, waterways, head works, gravity dams and spillways. Design of weirs on permeable foundation. Types of irrigation system, irrigation methods. Water logging and drainage, sodic soils.

10. **Water requirements:** Quality standards, basic unit processes and operations for water treatment. Drinking water standards, water requirements, basic unit operations and unit processes for surface water treatment, distribution of water. Sewage and sewerage treatment, quantity and characteristics of wastewater. Primary, secondary and tertiary treatment of wastewater, sludge disposal, effluent discharge standards. Domestic wastewater treatment, quantity of characteristics of domestic wastewater, primary and secondary treatment Unit operations and unit processes of domestic wastewater, sludge disposal.

11. **Air Pollution:** Types of pollutants, their sources and impacts, air pollution meteorology, air pollution control, air quality standards and limits.

12. **Municipal Solid Wastes:** Characteristics, generation, collection and transportation of solid wastes, engineered systems for solid waste management (reuse/ recycle, energy recovery, treatment and disposal).

13. **Noise Pollution:** Impacts of noise, permissible limits of noise pollution, measurement of noise and control of noise pollution.

14. **Surveying**: Importance of surveying, principles and classifications, mapping concepts, coordinate system, map projections, measurements of distance and directions, leveling, theodolite traversing, plane table surveying, errors and adjustments, curves.

Indicative Syllabus

Discipline: Control & Instrumentation

01. **Basics of Circuits and Measurement Systems:** Kirchoff's laws, mesh and nodal Analysis. Circuit theorems. One-port and two-port Network Functions. Static and dynamic characteristics of Measurement Systems. Error and uncertainty analysis. Statistical analysis of data and curve fitting.

02. **Transducers, Mechanical Measurement and Industrial Instrumentation:** Resistive, Capacitive, Inductive and piezoelectric transducers and their signal conditioning. Measurement of displacement, velocity and acceleration (translational and rotational), force, vibration and shock. Measurement of pressure, flow, temperature and liquid level. Measurement of pH, conductivity, humidity, hydrazine, silica, dissolved O_2. Units and standards of measurement.

03. **Analog Electronics:** Characteristics of diode, BJT, JFET and MOSFET. Diode circuits. Transistors at low and high frequencies, Amplifiers, single and multi-stage. Feedback amplifiers. Operational amplifiers, characteristics and circuit configurations. Instrumentation amplifier. Precision rectifier. V-to-I and I-to-V converter. Op-Amp based active filters. Oscillators and signal generators. Voltage stabiliser and regulator circuits. Inverter and converter circuits.

04. **Digital Electronics:** Combinational logic circuits, minimization of Boolean functions. IC families, TTL, MOS and CMOS. Arithmetic circuits. Comparators, Schmitt trigger, timers and mono-stable multi-vibrator. Sequential circuits, flip-flops, counters, shift registers. Multiplexer, S/H circuit. Analog-to-Digital and Digital-to-Analog converters. Basics of number system. Microprocessor applications, memory and input-output interfacing. Microcontrollers.

05. **Signals and Systems:** Definitions and properties of Laplace transform, continuous-time and discrete-time Fourier series, continuous-time and discrete-time Fourier Transform, DFT and FFT, z-transform. Sampling theorem. Linear Time-Invariant (LTI) Systems: definitions and properties; causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay. Signal transmission through LTI systems.

06. **Communications:** Random signals and noise: probability, random variables, probability density function, autocorrelation, power spectral density. Analog communication systems: amplitude and angle modulation and demodulation systems, spectral analysis of these operations, superheterodyne receivers; elements of hardware, realizations of analog communication systems; signal-to-noise ratio (SNR) calculations for amplitude modulation (AM) and frequency

modulation (FM) for low noise conditions. Fundamentals of information theory and channel capacity theorem. Digital communication systems: pulse code modulation (PCM), differential pulse code modulation (DPCM), digital modulation schemes: amplitude, phase and frequency shift keying schemes (ASK, PSK, FSK), matched filter receivers, bandwidth consideration and probability of error calculations for these schemes. Basics of TDMA, FDMA and CDMA and GSM. Basic Network topology and Net work hard wares. LAN / WAN configurations. UTP and OFC Links and components. Serial and parallel communication, Shielding and grounding. IEEE standards and broadband.

07. **Electrical and Electronic Measurements:** Bridges and potentiometers, measurement of R,L and C. Measurements of voltage, current, power, power factor and energy. A.C & D.C current probes. Extension of instrument ranges. Q-meter and waveform analyzer. Digital voltmeter and multi-meter. Time, phase and frequency measurements. Cathode ray oscilloscope. Instrument Transformer.

08. **Control Systems and Process Control:** Feedback principles. Signal flow graphs. Transient Response, steady-state-errors. Routh and Nyquist criteria. Bode plot, root loci. Time delay systems. Phase and gain margin. State space representation of systems. Mechanical, hydraulic and pneumatic system components. Synchro pair, servo and step motors. On-off, cascade, P, P-I, P-I-D, feed forward and derivative controller, Fuzzy controllers. Multi-state variable and Adaptative controls. System modeling, Digital controls, Distributed digital controls, control loops based on computers.

09. **Analytical, Optical and Biomedical Instrumentation:** Mass spectrometry. UV, visible and IR spectrometry. X-ray and nuclear radiation measurements. Optical sources and detectors, LED, laser, Photo-diode, photo-resistor and their characteristics. Interferometers, applications in metrology.

Indicative Syllabus

Discipline: Finance

01.   Financial Accounting

01.1. Accounting Standards
01.2. Corporate Accounts
01.3. Indirect & Direct - Tax Management
01.4. Auditing
01.5. Corporate & Industrial Laws

02.   Cost & Management Accounting

02.1. Costing Techniques
02.2. Cost Audit
02.3. Project Planning, Financing, Analysis and Management
02.4. Quantitative Techniques
02.5. Operation & Project Management Control

03.   Financial Management

03.1. Management Science
03.2. International Financial Management
03.3. Risk Management
03.4. Capital Market Analysis
03.5. Financial Derivatives
03.6. Security Analysis and Investment Management

04.   General

04.1. Managerial Economics
04.2. Management Information Systems
04.3. Computer Applications in Business
04.4. Management Control System

Indicative Syllabus

Part-II: Executive Aptitude Test

Executive Aptitude Test is common to all disciplines. This part will be consists of 50 objective type questions on:

01.   Vocabulary

02.   Verbal comprehension

03.   Quantitative aptitude

04.   Reasoning ability

05.   Interpretation of graphs/ charts/ tables

06.   General Awareness