SYLLABUS FOR WRITTEN EXAM OF PART TIME LECTURER

01. CIVIL ENGINEERING

Engineering Mathematics

Linear Algebra: Matrix algebra, Systems of linear equations, Eigen values and eigenvectors.

Differential equations: First order equations (linear and nonlinear), higher order linear differential equations with constant coefficients, Cauchy's and Euler's equations, Initial and boundary value problems, Laplace transforms, Solutions of one dimensional heat and wave equations and Laplace equation.

Probability and Statistics: Definitions of probability and sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Poisson, Normal and Binomial distributions.

STRUCTURAL ENGINEERING

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.

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.

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.

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.

GEOTECHNICAL ENGINEERING

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

Foundation Engineering: Sub-surface investigations- scope, drilling bore holes, sampling, penetration tests, and 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 & clays. Deep foundations–pile types, dynamic & static formulae, load capacity of piles in sands & clays, negative skin friction.

WATER RESOURCES ENGINEERING

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 modelling. Kinematics of flow, velocity triangles and specific speed of pumps and turbines.

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

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.

ENVIRONMENTAL ENGINEERING

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.

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

TRANSPORTATION ENGINEERING

Highway Planning: Geometric design of highways, testing and specifications of paving materials, design of flexible and rigid pavements.

Traffic Engineering: Traffic characteristics, theory of traffic flow, intersection design, traffic signs and signal design, highway capacity.

SURVEYING

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

02. ELECTRICAL ENGINEERING

Engineering Mathematics

Linear Algebra: Matrix Algebra, Systems of linear equations, Eigen values and Eigen vectors.

Differential equations: First order equation (linear and nonlinear), higher order linear differential equations with constant coefficients, Method of variation of parameters, Cauchy's and Euler's equations, Initial and boundary value problems, Partial Differential Equations and variable separable method.

Transform Theory: Fourier transform, Laplace transform, Z-transform.

Electrical Engineering

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.

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 induct ion 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.

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.

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.

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 millimeters; phase, time and frequency measurement; Q-meters; oscilloscopes; potentiometric recorders; error analysis.

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 microprocessor basics, architecture, programming and interfacing.

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.

Instrumentation and process control: Basic Instrumentation System and characteristics, Need of instrumentation, Block diagram of a generalized instrumentation system and their functions– Measure, sensing, signal conditioning, data transmission, display and control aspect**,** Characteristics of an instrumentation system, Static characteristics - Accuracy, precision, error, resolution, linearity, reproducibility, repeatability, threshold, dead-zone, sensitivity, drift, distortion, Dynamic characteristics - Fidelity, bandwidth**,** response time, time constant, settling time, Overshoot, dynamic error**.** Transducers: Concepts, importance and characteristics**,** Sensors and transducers. Classification of transducers .Construction, fundamental working principle and applications of Bourdon tube,LVDT,Strain Gauge, Thermocouple, Resistance and TemperatureDetector(RTD),Thermistor,Piezo electric,Resistive,Inductive and Capacitive.

Measurement of Non-Electrical quantities: Measurement of Temperature- using Thermocouple, RTD, Thermistor and Pyrometer. Measurement of Pressure-using Pirani Gauge, LVDT Strain Gauge, and Capacitive Transducer. Measurement of speed using, Tachometer, Stroboscope Measurement of Flow – using electromagnetic pick-up, turbine flow meter, Measurement of liquid level – using capacitive transducer.Material Analysis-Measurement of pH, Humidity, types of Hygrometer. Measurement of position, object detection using proximity transducers, Measurement of distance, water level and obstacle detection using ultrasonic transducer.

Utilization of electrical energy and traction system: Electric Heating and Welding**:** Advantages of Electrical heating Essential Requirements of a good heating element, materials of heating element, causes of failure of heating element. Methods of electric heating – resistance heating, arc heating, high frequency heating, induction heating, dielectric heating.

Types of resistance welding, choice of welding time, electric arc welding, Types of welding electrodes, Welding transformers.

Illumination: Introduction: Terms used in illumination, laws of illumination. Types of sources of illumination - Electric arc, incandescent, gaseous discharge, fluorescent.

Arc lamps, incandescent lamps, laser, LED, neon, Tungsten-Halogen and Sodium Vapor lamps, Fluorescent lamps. Types of lighting schemes: direct, semi direct, Semi-indirect, Indirect lighting and general lighting schemes. General ideas about street lighting, factory lighting and flood Lighting.

Electric Traction Drives: Requirements of ideal traction system, advantages and disadvantages of electric traction System of track electrification – DC system, single phase AC system, three phase AC system, Composite system**,** Special mechanical and electrical features of traction motors, current collectors**,** Traction motors: DC series, Three phase induction motors

Types of electric braking: Plugging, Rheostat or Dynamic braking, Regenerative braking. Types of service-Main line services, urban services, suburban services. Speed-time and speed distance curves for main line service, suburban service and urban and city, service**.** Basic definitions: Crest speed, average speed, schedule speed, schedule time, Factors affecting the schedule speed of a train, Factors affecting the schedule speed of a train, Simplified trapezoidal and quadrilateral speed time curves, Tractive effort. Specific energy consumption, dead weight, accelerating weight, adhesive weight, coefficient of adhesion, advantages and disadvantages of regenerative braking**.**

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03.ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Engineering Mathematics

Probability and Statistics: Sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Discrete and continuous distributions, Poisson, Normal and Binomial distribution, Correlation and regression analysis.

Transform Theory: Fourier transform, Laplace transform, Z-transform

Networks Analysis:

Network Solution methods: Nodal and Mesh analysis. Network theorems: superposition, Thevenin and Norton's maximum power transfer, Wye-Delta transformation. Steady state sinusoidal analysis using phasors. Linear constant coefficient differential equations; time domain analysis of simple RLC circuits, Solution of network equations using Laplace transform: frequency domain analysis of RLC circuits. 2-port network parameters: driving point and transfer functions. State equations for networks.

Electronic Devices:

Energy bands in silicon, intrinsic and extrinsic silicon. Carrier transport in silicon: diffusion current, drift current, mobility, and resistivity. Generation and recombination of carriers. p-n junction diode, Zener diode, tunnel diode, BJT, JFET, MOS capacitor, MOSFET, LED, p-I-n and avalanche photo diode, Basics of LASERs.

Device technology:

Integrated circuits fabrication process, oxidation, diffusion, ion implantation, photolithography, n-tub, p-tub and twin-tub CMOS process.

Analog Circuits:

Small Signal Equivalent circuits of diodes, BJTs, MOSFETs and analog CMOS. Simple diode circuits, rectifier. Biasing and bias stability of transistor and FET amplifiers. Amplifiers: single- and multi-stage, differential and operational, feedback, and power. Simple op-amp circuits. Adder, Subtractor, differentiator, Integrator, Multiplier and Logarithmic Amplifiers using OPAMP, Instrumentation Amplifier, Filters. Sinusoidal oscillators; criterion for oscillation; single transistor and op-amp configurations. Function generators and wave shaping circuits, 555 Timers. Power supplies.

Digital circuits: Boolean algebra, minimization of Boolean functions; logic gates; digital IC families (DTL, TTL, ECL, MOS, CMOS). Combinational circuits: arithmetic circuits, code converters, multiplexers, decoders,Sequential circuits: latches and flip-flops, counters and shift- registers. Sample and hold circuits, ADCs, DACs. Semiconductor memories.

Microcontroller(8051)

Basics of 8051 Microcontroller, Types of buses, Harvard and Von Neuman architecture, 8051 microcontroller: Architecture, Pin configuration, stack, memory organization , Addressing modes, Instruction sets, Timer/Counters: SFRs: TMOD, TCON, Timer / Counter - Logic and modes, Interrupts-SFRs: - IE, IP, Serial communication-SFRs: - SCON,SBUF,PCON, Modes of serial communication, Simple programs on serial communication, I/O port structure and configuration-P0,P1,P2,P3.

Communication Systems :

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, super heterodyne 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.

Optical Fibre Communication : Elements of an Optical Fibre Transmission link, Ray theory of propagation of light, refractive index, numerical aperture, fibre cable structure: core and cladding, modes of light transmission through step index fiber and graded index fiber, Fiber materials-Glass fibers, and plastic fibers Types of losses and attenuation in optical fibers, Optical sources, Optical detectors, Fibre coupler, circulator and isolator, Optical Fibre link design: Power budget analysis, Basics of OTDR.

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Electromagnetics: Elements of vector calculus: divergence and curl; Gauss' and Stokes' theorems, Maxwell's equations: differential and integral forms. Wave equation, Poynting vector. Plane waves: propagation through various media; reflection and refraction; phase and group velocity; skin depth. Transmission lines: characteristic impedance; impedance matching, impedance transformation; S parameters, pulse excitation. Waveguides: modes in rectangular waveguides; boundary conditions; cut-off frequencies; dispersion relations. Basics of propagation in dielectric waveguide. Basics of Antennas, Isotropic, Endfire & Broadside array, Dipole antennas; radiation pattern; antenna gain.Microwave components : E-plane, H-plane, Magic Tee,Directional ,Coupler, Attenuator, Isolator, Circulator, joints, bands, phase shifters(Basic idea only)

Satellite and RADAR Communication

Frequency allocations for satellite services, uplink and downlink frequency bands for various services ,synchronous and non-synchronous, Satellite communication orbits , Kepler's law of satellite motion, Basic terminologies related to satellite orbits and satellite: latitude, longitude, look angle, elevation angle, station keeping, propagation delay time , velocity and footprint, satellite time period ,Effect of eclipse on satellite, RADAR Systems: Basic principle of RADAR, RADAR range equation, factors affecting maximum range. Pulse RADAR, Continuous Wave (CW) RADAR, Doppler RADAR, Moving target indicator radar, blind speed, frequency modulated CW RADAR.

Instrumentation, Measurement System and Process control

Basic parameters of measurement system: Static characteristics-Accuracy & Precision, Sensitivity, Linearity, Hysteresis, Resolution, Repeatability, Reliability, Maintainability, Span, Calibration Dynamic characteristic speed of response, fidelity, lag, dynamic error, Definition of error, types of errors, Wheatstone Bridge and Kelvin's bridge for measurement of unknown resistance Maxwell Bridge and Hay's bridge method for measurement of unknown inductance Schering Bridge and Wien bridge method for measurement of unknown capacitance. Transducer fundamentals, Classification of transducer, Strain gauge Resistance wire strain gauge and semiconductor strain gauge, piezo electric crystal, load cell, Temperature: RTD, Thermistor, Thermocouple, Pyrometer, Capacitive transducers, Linear variable differential transducer(LVDT), Photo electric, transducers: photo emissive, photo conductive, and photovoltaic transducer. Basics of PLC**,** Programming basics, ladder rung, Programming execution, Ladder logic and diagram, and Arithmetic instructions, Logical operations. Simple basics of DCS and SCADA system.