Department of Technology

Savitribai Phule Pune University

Name of course – Post Graduate Diploma in Electric Mobility

Syllabus for Entrance Examination

Part – A

General Aptitude

- Test of Reasoning
- Verbal Analogies
- Numerical Ability
- English Grammar
- Verbal Deductions
- Word Groups
- Structural Orientation

Part – B

Differential equations - Linear and nonlinear, Euler-Cauchy equation; higher-order linear differential equations with constant coefficients, initial and boundary value problems; solutions of heat, wave and Laplace's equations; Laplace transforms. valuation of definite and improper integrals; Functions of single variable, limit, continuity and differentiability, mean value theorem, indeterminate forms; double and triple integrals; total derivative, partial derivatives, maxima and minima, Taylor series (in one and two variables), Fourier series; divergence and curl, gradient, vector identities, line, directional derivatives,

Elastic constants, Stress and strain, Poisson's ratio, thin cylinders, Mohr's circle for plane stress and plane strain, shear force and bending moment diagrams, deflection of beams, bending and shear stresses, torsion of circular shafts, energy methods, Euler's theory of columns, thermal stresses, testing of materials with universal testing machine, strain gauges and rosettes, testing of hardness and impact strength. Theory of Machines - Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of linkages; cams; gears and gear trains; flywheels and governors; balancing of reciprocating and rotating masses; gyroscope.

Machine Design - Design for static and dynamic loading, Failure theories, fatigue strength and the S-N diagram, gears, shafts, rolling and sliding contact bearings, springs, brakes and clutches, principles of the design of machine elements like riveted, bolted and welded joints

Vibrations - Effect of damping, Free and forced vibration of single degree of freedom systems, resonance, vibration isolation, critical speeds of shafts.
Fluid statics, properties, manometry, buoyancy, stability of floating bodies, forces on submerged bodies, control-volume analysis of mass, fluid acceleration, momentum and energy, differential equations of continuity and momentum, dimensional analysis, Bernoulli's equation, viscous flow of incompressible fluids, elementary turbulent flow, boundary layer, flow through pipes, bends and

fittings and head losses in pipesProperties of pure substances, thermodynamic systems and processes, the behaviour of ideal and real gases, calculation of work and heat in various processes, zeroth and first laws of thermodynamics, the second law of thermodynamics, thermodynamic relations and thermodynamic property charts and tables, availability and irreversibility.

Circuit elements, network graph, KCL, KVL, Node and Mesh analysis, ideal current and voltage sources, Thevenin's, Norton's, Superposition and Maximum Power Transfer theorems, transient response of DC and AC networks, Sinusoidal steady state analysis, basic filter concepts, two-port networks, three phase circuits, Magnetically coupled 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; Maxwell's equations. Principles of measurement, accuracy, precision and standards; Bridges and potentiometers; moving coil, moving iron, dynamometer and induction type instruments, measurement of voltage, current, power, energy and power factor, instrument transformers, digital voltmeters and multi-meters, phase, time and frequency measurement, Q-meters, oscilloscopes, potentiometric recorders, error analysis, Basics of sensors, Transducers, basics of data acquisition systems

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, DC-DC switched mode converters, DC-AC switched mode converters, resonant converters, high frequency inductors and transformers, power supplies.

Electrical Machines :

Single phase transformers, 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, Induction motors - principles, types, performance characteristics, starting and speed control, Synchronous machines - performance, regulation, parallel operation of generators, motor starting, characteristics and applications, servo and stepper motors.

Control Systems:

Principles of feedback, transfer function, block diagrams and signal flow graphs, steady-state errors, transforms and their applications; Routh-hurwitz criterion, Nyquist techniques, Bode plots, root loci, lag, lead and lead-lag compensation, stability analysis, transient and frequency response analysis, state space model, state transition matrix, controllability and observability, linear state variable feedback, PID and industrial controllers.

Analog and Digital Circuits:

Small signal equivalent circuits of diodes, BJTS and FETs; Diode circuits for different uses; Biasing & stability of BJT & JFET amplifier circuits; Analysis/design of amplifier- single/multi-stage; Feedback& uses; Active filters, timers, multipliers, wave shaping, A/D-D/A converters; Boolean Algebra& uses; Logic gates, Digital IC families, Combinatorial/sequential circuits; Basics of multiplexers, counters/registers/ memories /microprocessors, design& applications.

Control Systems:

Classification of signals and systems; Application of signal and system theory; System realization; Transforms& their applications; Signal flow graphs, Routh-Hurwitz criteria, root loci, Nyquist/Bode plots; Feedback systems-open &close loop types, stability analysis, steady state, transient and

frequency response analysis; Design of control systems, compensators, elements of lead/lag compensation, PID and industrial controllers.

Engineering Mathematics

Linear Algebra: Matrices and Determinants, Systems of Linear Equations, Eigen Values and Eigen Vectors.Calculus: Mean Value Theorems, Theorems of Integral Calculus, Evaluation of Definite and Improper Integrals,

Partial Derivatives, Maxima and Minima, Multiple Integrals, Fourier Series. Vector Identities, Directional Derivatives, Line, Surface and Volume Integrals, Stokes, Gauss and Green's Theorems.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 andBoundary Value Problems, Partial Differential Equations and Variable Separable Method.Complex Variables: Analytic Functions, Cauchy's Integral Theorem and Integral Formula, Taylor's and Laurent's Series, Residue Theorem, Solution Integrals.Transforms: Fourier Series Representation of Continuous Periodic Signals, Sampling Theorem, Fourier, Laplaceand Z-Transforms.Probability and Statistics: Probability and Sampling Theorems, Conditional Probability, Probability Density

Function, Mean, Median, Mode and Standard Deviation, Random Variables, Discrete andContinuousDistributions, Exponential, Poisson, Normal and Binomial Distribution, Correlation and Regression Analysis.Numerical Methods: Solutions of Non-Linear Algebraic Equations, Single and Multi-Step Methods For DifferentialEquations.

Electrical Engineering

Electric circuits and fields: Ideal voltage and current sources, Dependent sources, R, L, C elements, KCL, KVL,Node & Mesh Analysis, Star-delta transformation. Thevenin's, Nortons's, Superposition, Reciprocity & Maximumpower transfer theorems, Transient response of DC & AC Networks, Sinusoidal steady state analysis, Resonance,Networks graph Theory, Two-Port Network, Balanced three phase circuits. Coulomb's law, electrical field intensity& potential due to point, line. Plane and spherical charge distribution. Gauss's Law, Ampere's Law, Biot –Savart's law, Maxwells equations in differential & Integral form, Magnetic circuits, Self and Mutual Inductance,Dielectrics and Capacitance.

Electrical Machines: Single Phase Transformer - Equivalent Circuit, Phasor Diagram, open circuit and shortcircuit tests, Regulation and Efficiency; Three Phase Transformers - Connections, Parallel Operation; AutoTransformer; Electromechanical Energy Conversion Principles; DC Machines - Types, Windings, Generator &

Motor Characteristics, Armature Reaction and Commutation, Starting and Speed Control of DC Motors; ACMachines-Three Phase Induction Motors - Principles, Types, Performance, Torque Speed Characteristics, No loadand blocked rotor tests, Equivalent circuit. Starting and Speed Control; Single Phase Induction Motors;Synchronous Machines – Types, Performance, Regulation and Parallel Operation of Generators, SynchronousMotor Starting, Characteristics and Applications; Servo and Stepper Motors.Power Systems: Basic Power Generation Concepts; Transmission Line Models and Performance; CablePerformance, Insulators; Corona and Radio Interference; Distribution Systems; Per-Unit Quantities; Bus Impedanceand Admittance Matrices; Load Flow Analysis, Voltage and frequency Control; Power Factor Correction;Symmetrical Components; Fault Analysis; Principles of Over-Current, Directional, Differential and DistanceProtection; Solid State Relays and Digital Protection; Circuit Breakers; System Stability Concepts, Swing Curvesand Equal Area Criterion; HVDC Transmission and FACTS Concepts, Economic Load dispatch with & without

Network losses.Control Systems: Mathematical modeling and representation of systems, Feedback principle, transfer function,Block diagrams and 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-Lagcompensators; P, PI and PID controllers; State space model, Solution of state equation, Controllability andObservability.Electrical and Electronic Measurements: Bridges and Potentiometers; PMMC, Moving Iron, Dynamometer andInduction 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. Principle and applications of Mechanical & Electrical Transducers.Analog and Digital Electronics: Characteristics of Diodes, BJT, FET; Amplifiers - Biasing, Equivalent Circuit and

Frequency Response; Oscillators and Feedback Amplifiers; Operational Amplifiers - Characteristics andApplications; 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; 8085 MicroprocessorBasics, Architecture, Programming and Interfacing.

Power Electronics and Drives: Semiconductor Power Diodes, Thyristors, Triacs, GTO's, MOSFET's and IGBT'sStatic Characteristics and Principles of Operation; Triggering Circuits; Phase Control Rectifiers; Bridge

Converters - Fully Controlled and Half Controlled; Principles of Choppers, Buck, Boost and Buck-Boostconverters. Inverters-Single Phase and Three Phase voltage and current source inverters, Sinusoidal pulse width

modulation, AC voltage controller; Basic Concepts of Adjustable Speed DC and AC Drive

Fluid Mechanics and Thermal Sciences

Fluid Mechanics: Fluid Properties; Fluid Statics, Manometry, Buoyancy; Forces on submerged bodies, Stability offloating bodies, Fluid Acceleration; Differential Equations of Continuity and Momentum; Bernoulli's Equation;Viscous Flow of Incompressible Fluids; Boundary Layer; Elementary Turbulent Flow; Flow Through Pipes, HeadLosses in Pipes, Bends.

Heat-Transfer: Modes of Heat Transfer; One Dimensional Heat Conduction, Resistance Concept, ElectricalAnalogy, Heat transfer thorough fins, Unsteady Heat Conduction; Lumped parameter system, Heisler charts,Dimensionless Parameters in Free and Forced Convective Heat Transfer, Various Correlations for Heat Transfer inFlow Over Flat Plates and Through Pipes; Thermal Boundary Layer; Effect of Turbulence; Radiative HeatTransfer, Black and Grey Surfaces, Shape Factors, Network Analysis; Heat Exchanger Performance, LMTD andNTU Methods.Thermodynamics: Thermodynamics: Thermodynamic systems and processes; properties of pure substances,behaviour of ideal and real gases; zeroth and first laws of thermodynamics, calculation of work and heat in variousprocesses; second law of thermodynamics; Heat Pump cycles, thermodynamic property charts and tables,

availability and irreversibility; thermodynamic relations.Applications:Air compressors-Reciprocating and rotary compressorsPower Cycles : Rankine, Brayton Cycles with Regeneration and Reheat.I.C. Engines: Air-Standard Otto, Diesel Cycles.Refrigeration and Air-Conditioning: Vapour Compression Cycle, Bellcoleman cycleMoist Air: Psychrometric Chart, Basic Psychrometric Processes.

Turbomachinery: Pelton wheel, Francis and Kaplan Turbines - Impulse and Reaction Principles, VelocityDiagrams, gas turbines.Materials, Manufacturing and Industrial EngineeringEngineering Materials: Structure and Properties of Engineering Materials, Heat Treatment, Stress-StrainDiagrams for Engineering Materials, Iron-Iron Carbide equilibrium diagram.Metal Casting: Different types of castings, design of Patterns, Moulds and Cores; Solidification and Cooling; Riser and Gating Design, Design Considerations.

Metal Forming: Plastic Deformation and Yield Criteria; Fundamentals of Hot and Cold Working Processes; LoadEstimation for Bulk (Forging, Rolling, Extrusion, Drawing) and Sheet (Shearing, Deep Drawing, Bending) Meta lForming Processes; Principles of Powder Metallurgy.Joining Process: Principles of Welding, Brazing and Soldering; Adhesive BondingMachining and Machine Tool Operations: Mechanics of Machining, Basic machine tool, Single and Multi-Point Cutting Tools, Tool Geometry and Materials, Tool Life and Wear; Economics of Machining; Principles of Non traditional Machining Processes; Principles of Work Holding, Principles of Design of Jigs and Fixtures, NC/CNC

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Head
Department of Technology
Savitribai Phule Pune University
Pune - 411 007.