SYLLABUS FOR PRILIMINARY SCREENING TEST FOR RECRUITMENT TO THE POST OF LECTURER IN **ELECTRICAL ENGINEERING** FOR GOVT. POLYTECHNICS IN THE W.B.G.S. UNDER THE TECHNICAL EDUCATION & TRAINING DEPARTMENT

Full Mark: 100

Time: 1hr. 30 mins.

1. **ENGINEERING MECHANICS :**

Elements of vector algebra, Basic dimension and units. Idealisation in Mechanics. Newton's Laws, equilibrium equations, frictional forces, properties of surfaces. Elements of vector calculus. Rectilinear and Curvilinear motion of a particle.

Alemberts principle, Methods of momentum, work, power and energy Mass moment of inertia, rotation of rigid bodies, Energy consideration.

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

Relationships among different elastic constants. Bending moment. Cantilever problems. Elastic, Plastic and Visco-elastic behavior of materials.

3. **MATHEMATICS :**

Review of limit, continuity and differentiability. Successive differentiation. Rolle's Theorem. Mean value Theorems.

Limit and continuity. Partial derivatives. Differentials.

Definition and properties. Fundamental Theorem of integral calculus.

4. **APPLIED MECHANICS**

Belt, Pulley and Chain Bodies in rolling contact. Gear Wheels in trains, Epicyclic gear trains, Laws of machines etc. Four-bar linkages-velocity analysis (relative velocity method) acceleration analysis-simple problems.

Stress, Strain, Elasticity, Y.P., Stress-Strain diagram, factor of safety, working stress problems in direct tension, compression-statically determinate cases,Thermal stresses.

Torsion of circular shafts, angle of twist, Torque, power transmission shearing force and bending moment in beams maximum moment and pt. of confraflexture.

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5. ELECTRONICS :

Elementary physics of semiconductor materials, p-n junction semiconductor diode, zener diode, bipolar junction device-transistor, Field effect transistors JFET & MOSFET. Modelling of semiconductor devices-diode, junction transistors and field effect transistors-Hybrid, parameters.

Bipolar transistor biasing, common-emitter, common base and common collector configurations, low frequency response of RC coupled common emitter amplifiers FET biasing, MOSFET biasing. Transistor power amplifiers, class A, class B and class AB amplifier complimentary symmetry amplifiers.

Linear microcircuits : Operational amplifiers, offset voltage and currents, bias currents, common-mode rejection ratio, frequency response, slew rate, uses of operational amplifiers as inverting summing amplifier, integrator, non-inverting amplifier, differential input instrumentation amplifiers and oscillators.

IC voltage regulator : A typical industry standard (e.g. 723 or 3085) and its use as both dissipative and switching regulator, current limiting ordinary feedback.

6. CIRCUIT THEORY

Review of Laplace Transform. Concept of complex frequency, Circuit elements in transient. Transform equivalent, Laplace transform of impulse and step waveforms.

Solutions of RL, RC, LC and RLC circuits in transient with or without stored energy, Concept of natural frequency and damping.

Applications of network theorems in transient domain. Formulation of network equations. Source transformations. Loop variable analysis and mode variable analysis.

Two port networks, Short circuit Admittance parameters, Open circuit Impedance parameters, Transmission parameters, hybrid parameters, series, cascade and parallel connections of two port networks.

7. ELECTRICAL ENGG. MATERIALS :

Atomic structure of materials energy levels and electronic states. Electronic distinction between metals. Insulators and intrinsic semiconductors. Interatomic distance, Cohesive forces and energies Gross electrical and thermal properties of materials in terms of cohesive energies.

States of insulating materials and their applications.

Electrical conductivity of metals-Lorents theory, free electron theory.

Alloys-High resistivity alloys. Thermocouple alloys, Strainguage alloys.

Semiconductor : Intrinsic and impurity semiconductors. Acceptors and donor, p-n diodes and transistors. Temperature dependence of p-n junction.

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8. HYDRAULICS & WATER POWER

Properties of Fluid and Units; Fluid Statics; Fluid Kinetic; Introduction; Ideal Fluid Flow; Viscous Fluid Flow; Flow through pipes; Flow Measurements; Momentum equation and Fluid dynamics.

Fluid Machineries; Reciprocating pumps & Gear Pumps; Centrifugal pumps.

Elementary Hydrology.

9. ELECTRICAL MACHINES :

D.C.Generator : Function of commutator, Commutator and brush system. No load operation of d.c. generator; emf equation.
Excitation systems : Shunt, series and compound excitation, Building up of d.c. shunt generator. D.C.Motor torque equation, Motoring and generating action, Elementary starters for motors.

A.C.Machines : Frequency of the induced emf. mechanical and electrical angles. Elementary winding configuration of three phase machines. D.C.Excitation of alternators. Three phase balanced excitation. Development of rotating magnetic field.

Basic principle of operation of synchronous and Induction machines :
Slip speed and slip of an induction motor. Single phase a.c. excitation, oscillating field. emf induced in a rotating coil in an alternating field. Rotational and speed emf's. Double revolving field. Basic principle of operation of single phase a.c.motors.

Transformers - Constructional details :
Core materials, winding material and insulating materials. Core and, coil construction E.M.F. equation derivation of core losses and leakage reactance. No-load operation, equivalent circuit, phasor diagram under load, dependence of circuit parameters on v and f.
Transformer oil, inhibited oil, dry type transformer, Transformer accessoriesbreather, conservator. Buchlolz's relay, explosion vent, bushing etc. Different types of cooling methods. Regulation, efficiency, all-day efficiency, Parallel operation, O.C. and S.C. test-separation of eddy current and hysteresis loss.

Single-phase auto transformer : Phasordiagram, Comparison of weight, copper loss, equivalent reactance with 2-winding transformer.

10. POWER PLANNING & DISTRIBUTION :

Legal aspects of electricity supply. Electricity acts, rules and codes. Standards followed in power supply. Environmental and safety measures.

Technical aspects of electricity supply. Domestic, Commercial and Industrial wiring, estimation of main, submain and subcircuit wiring. Earthing practice. Testing of installation. Special lighting connections. Fuse, Stranded conductors. Disconnecting devices. Lightning arrester. Lift, Pump, Air conditioning-Basic principle of operations safety & control.
PART-II : Power Distribution : Structure of power system, primary and secondary distribution. Types of conductors and insulators in distribution system.

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11. FIELD THEORY :

Electrostatics :
Coulomb's Law, Field intensity and potential, Potential gradient, Electric displacement, Gauss Law (Integral form) and its applications, Electric images and inversion, Electric dipoles, field and potential, Polarization, Divergence theorem (gauss law in differential form), Poisson and Laplace's equations in Cartesian, cylindrical and spherical coordinates in 2 and 3 dimensional fields using circular and spherical symmetry, Boundary conditions. Electric stress and mechanical force on charged conductor surfaces, Electrostatic energy, capacitance calculations, Energy transfer amongst connected capacitors in a system.

Electromagnetics
Magnetic field and intensity, Magnetic scalar and vector potentials, Lorentz force, Motoring and Generating principles, Faraday's Law Induced e.m.f. in conductor and coils, Ampere's Law. Magnetic polarisation, Poisson equations and solution.

12. NUMERICAL ANALYSIS & COMPUTER PROGRAMMING

Numerical Analysis : Solution of linear equations, Gaussion elimination, Matrix inversion using Gauss-Jordan, Jordan elimination.

Interpolation : Lagrange, Newton's forward, backward and divided difference formulas and errors. Least square curve fitting, Numerical integration using trapezoidal,Simpson's rule.

Programming : Basic concepts and technology of computer system and system software, Concepts of flow-chart and algorithm, recurrsion. Overflow and underflow. Program in Fortran and Pascal. Introduction to data structures.

13. ELECTRIC POWER UTILISATION :

Illumination.
Fundamentals of Light-Radiation and vision, quantities, units, standards and measurement. General classification of lamps : Incandescent, TL and HID lamps, basic principle of their operation. Laws of illumination.

Elementary Lighting Design-Definitions of design parameters. Basic luminaries classification and their distribution characteristics. Lighting calculations for indoor applications.

Lighting circuits-Starters for fluorescent lamps and ignitors of HID lamps, multiple input of lamp.

Emergency lighting and Stand by power sources-Exterior, Interior, portable on site emergency lighting-storage batteries.

Electric Welding, resistance welding and equipment for such welding.

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14. POWER SYSTEMS PROTECTION AND SWITCHGEAR

Analysis of asymmetrical faults in power system. Series unbalances in power system. Fundamental principles of protective relays, their properties and block diagrams. Single input relays, overcurrent, earth fault and over voltage relays.

Motor protection, Different types of pilot protection wire, carrier and wireless pilot.

Different forms of Switchgears and their functions. Contact wipe, contact travel and auto reclosing circuit breaker. Power system transients.

Different types of circuit breakers-their relative merits and demerits. Specific field of usage. Testing of circuit breakers.