TEERTHANKER MAHAVEER UNIVERSITY

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Delhi Road, Moradabad (U.P.)

SYLLABUS FOR RESEARCH APTITUDE TEST IN ELECTRICAL NGINEERING

The syllabus for Research Aptitude Test (RAT) in Electrical Engineering is divided in two parts viz. Part A and Part B as described below:

PART – A

Part A of the RAT shall be designed to assess the research skills/aptitude of the candidate consisting of questions from the following areas:

1. **Research Methodology:** meaning, characteristics, and ethical issues in research; types of research; research methods.

2. **Logical Reasoning:** arguments, deductive and inductive research; logical and Venn diagram; inferences; analogies.

3. **Data Interpretation:** interpretation of data; mapping and analysis of data, tools for data analysis; quantitative and qualitative research.

4. **General Awareness about Basic Science:** basic science up to the level of SSC.

5. **Mathematical Reasoning:** number series, letter series, codes; relationships, classification.

PART – B

Part-B of RAT is designed to assess the subject specific knowledge of the candidate covering the syllabus given as below:

Electric Circuits: circuits elements, network graph, Kirchhoff's laws, mesh and nodal analysis, network theorems and applications, natural response and forced response, transient response and steady state response for arbitrary inputs, resonance, basic filter concepts; ideal current and voltage sources properties of networks in terms of poles and zeros, transfer function, resonant circuits, three phase circuits, two-port networks, elements of two-element network synthesis, three phase circuits.

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.

Electrical Machines: magnetic circuits, analysis and design of power transformers - equivalent circuit, Phasor diagram, tests, regulation and efficiency; three phase transformers -connections, parallel operation; auto-transformer; 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; fractional KW motors, servo and stepper motors.

Power Systems: basic power generation concepts- types of power stations, hydro, thermal and nuclear stations. pumped storage plants economics and operating factors; transmission line models and performance; voltage control. load flow studies. optimal power system operation, load frequency control, 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, stability of sampled data system, elements of non-linear control analysis, control system components, electromechanical, hydraulic, pneumatic components.

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; potentiometric recorders; error analysis, transducers and their applications to the measurement of non-electrical quantities like temperature, pressure, flow-rate displacement, acceleration and noise level etc, data acquisition systems, A/D and D/A converters.

Analog and Digital Electronics: characteristics of diodes, BJT, FET, Zener, tunnel, Schottky, photo diodes and their applications, rectifier circuits; 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, pulse width modulation, sinusoidal modulation with uniform sampling, switched mode power supplies.

EM Theory: electric and magnetic fields, electric field and potential due to point, line, plane and spherical charge distributions, Gauss's Law, Amperes Law and Biot-Savart's laws, fields in dielectrics, conductors and magnetic materials, Maxwell's equations, time varying fields, Plane-Wave propagating in dielectric and conducting media, transmission lines.