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GATE Practice Booklet

Bits & Bytes

VOLUME - II

**ELECTRICAL
ENGINEERING**

1116

EXPECTED QUESTIONS WITH SOLUTIONS

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Published at:



ACE Engineering Publications

#3rd Floor, Suryalok Complex, Rosary Convent School Road,
Gunfoundary, Basheer Bagh, Hyderabad – 500001,
Telangana, India.

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**Email :** [aceenggpublications@aceenggacademy.com](mailto:aceenggpublications@aceenggacademy.com)

**1<sup>st</sup> Edition :** 2016

**10<sup>th</sup> Edition :** 2025

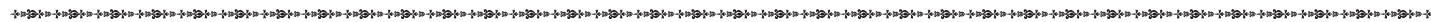
***Printed at:***

Rowshni Graphics,  
Hyderabad.

**MRP :** ₹.650/-

**ISBN :** 978-1-64597-338-6

# Foreword



Dear Students,

Solutions of all previous GATE Questions are already available. Every year about 20% of questions will have repetitive nature. However, rest of the questions are from untapped areas (never asked areas) and few from Previous Engineering Services & Civil Services Questions.



Keeping this in view, possible questions are prepared in various subjects (chapter wise) along with their hints/solutions. The student is advised to practice the questions systematically so that their chances of getting high score in GATE Exam will increase.

The student is advised to solve the problems without referring to the solutions. The student has to analyze the given question carefully, identify the concept on which the question is framed, recall the relevant equations, find out the desired answer, verify the answer with the final key such as (a), (b), (c), (d), then go through the hints to clarify his answer. This will help to face numerical answer questions better. The student is advised to have a standard text book ready for reference to strengthen the related concepts, if necessary. The student is advised not to write the solution steps in the space around the question. By doing so, he loses an opportunity of effective revision.

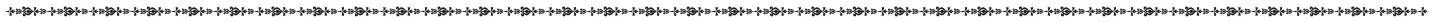
As observed in the GATE Exam, number of sets may be possible, being online exams. Hence, don't skip any subject. All are equally important.

It is believed that this book is a Valuable aid to the students appearing for competitive exams like ESE, JTO, DRDO, ISRO and Other PSU's. This book can also be used by fresh Teachers in Engineering in improving their Concepts.

With best wishes to all those who wish to go through the following pages.

**Y.V. Gopala Krishna Murthy,**  
**M Tech. MIE,**  
**Chairman & Managing Director,**  
**ACE Engineering Academy,**  
**ACE Engineering Publications,**  
**Frost Interactive Service Pvt. Ltd. (ACE ONLINE).**

# Syllabus for Electrical Engineering (EE)



## Engineering Mathematics:

**Linear Algebra:** Matrix Algebra, Systems of linear equations, Eigenvalues, Eigenvectors.

**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 integral, Surface integral, Volume integral, Stokes's theorem, Gauss's theorem, Divergence theorem, Green's theorem.

**Differential equations:** First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Method of variation of parameters, Cauchy's equation, Euler's equation, Initial and boundary value problems, Partial Differential Equations, Method of separation of variables.

**Complex variables:** Analytic functions, Cauchy's integral theorem, Cauchy's integral formula, Taylor series, Laurent series, Residue theorem, Solution integrals.

**Probability and Statistics:** Sampling theorems, Conditional probability, Mean, Median, Mode, Standard Deviation, Random variables, Discrete and Continuous distributions, Poisson distribution, Normal distribution, Binomial distribution, Correlation analysis, Regression analysis.

**Electric Circuits:** Network elements: ideal voltage and current sources, dependent sources, R, L, C, M elements; Network solution methods: KCL, KVL, Node and Mesh analysis; Network Theorems: Thevenin's, Norton's, Superposition and Maximum Power Transfer theorem; Transient response of dc and ac networks, sinusoidal steady-state analysis, resonance, two port networks, balanced three phase circuits, star-delta transformation, complex power and power factor in ac circuits.

**Electromagnetic Fields:** Coulomb's Law, Electric Field Intensity, Electric Flux Density, Gauss's Law, Divergence, Electric field and potential due to point, line, plane and spherical charge distributions, Effect of dielectric medium, Capacitance of simple configurations, Biot-Savart's law, Ampere's law, Curl, Faraday's law, Lorentz force, Inductance, Magnetomotive force, Reluctance, Magnetic circuits, Self and Mutual inductance of simple configurations.

**Signals and Systems:** Representation of continuous and discrete time signals, shifting and scaling properties, linear time invariant and causal systems, Fourier series representation of continuous and discrete time periodic signals, sampling theorem, Applications of Fourier Transform for continuous and discrete time signals, Laplace Transform and Z transform.

**Electrical Machines:** Single phase transformer: equivalent circuit, phasor diagram, open circuit and short circuit tests, regulation and efficiency; Three-phase transformers: connections, vector groups, parallel operation; Auto-transformer, Electromechanical energy conversion principles; DC machines: separately excited, series and shunt, motoring and generating mode of operation and their characteristics, speed control of dc motors; Three-phase induction machines: principle of operation, types, performance, torque-speed characteristics, no-load and blocked-rotor tests, equivalent circuit, starting and speed control; Operating principle of single-phase induction motors; Synchronous machines: cylindrical and salient pole machines, performance and characteristics, regulation and parallel operation of generators, starting of synchronous motors; Types of losses and efficiency calculations of electric machines

**Power Systems:** Basic concepts of electrical power generation, ac and dc transmission concepts, Models and performance of transmission lines and cables, Series and shunt compensation, Electric field distribution and insulators, Distribution systems, Per-unit quantities, Bus admittance matrix, Gauss-Seidel and Newton-Raphson load flow methods, Voltage and Frequency control, Power factor correction, Symmetrical components, Symmetrical and unsymmetrical fault analysis, Principles of over-current, differential, directional and distance protection; Circuit breakers, System stability concepts, Equal area criterion, Economic Load Dispatch (with and without considering transmission 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-Lag compensators; P, PI and PID controllers; State space model, Solution of state equations of LTI systems, R.M.S. value, average value calculation for any general periodic waveform.

**Electrical and Electronic Measurements:** Bridges and Potentiometers, Measurement of voltage, current, power, energy and power factor; Instrument transformers, Digital voltmeters and multimeters, Phase, Time and Frequency measurement; Oscilloscopes, Error analysis.

**Analog and Digital Electronics:** Simple diode circuits: clipping, clamping, rectifiers; Amplifiers: biasing, equivalent circuit and frequency response; oscillators and feedback amplifiers; operational amplifiers: characteristics and applications; single stage active filters, Sallen Key, Butterworth, VCOs and timers, combinatorial and sequential logic circuits, multiplexers, demultiplexers, Schmitt triggers, sample and hold circuits, A/D and D/A converters.

**Power Electronics:** Static V-I characteristics and firing/gating circuits for Thyristor, MOSFET, IGBT; DC to DC conversion: Buck, Boost and Buck-Boost Converters; Single and three-phase configuration of uncontrolled rectifiers; Voltage and Current commutated Thyristor based converters; Bidirectional ac to dc voltage source converters; Magnitude and Phase of line current harmonics for uncontrolled and thyristor based converters; Power factor and Distortion Factor of ac to dc converters; Single-phase and three-phase voltage and current source inverters, sinusoidal pulse width modulation.

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