GATE Syllabus

Electrical Engineering

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ELECTRICAL ENGINEERING

Subject Code: EE

Course Structure

Sections/Units	Topics
Section A	**Engineering Mathematics**
Unit 1	Linear Algebra
Unit 2	Calculus
Unit 3	Differential Equations
Unit 4	Complex Variables
Unit 5	Probability and Statistics
Unit 6	Numerical Methods
Unit 7	Transform Theory
Section B	**Electric Circuits**
Section C	**Electromagnetic Fields**
Section D	**Signals and Systems**
Section E	**Algorithms**
Section F	**Electrical Machines**
Section G	**Power Systems**
Section H	**Control Systems**
Section I	**Electrical and Electronic Measurements**
Section J	**Analog and Digital Electronics**
Section K	**Power Electronics**

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Course Syllabus

Section A: Engineering Mathematics

Unit 1: Linear Algebra

- Matrix Algebra
- Systems of linear equations
- Eigenvalues
- Eigenvectors

Unit 2: 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
- Green's theorem

Unit 3: 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

Unit 4: Complex variables

- Analytic functions
- Cauchy's integral theorem
- Cauchy's integral formula
- Taylor series
- Laurent series
- Residue theorem
- Solution integrals

Unit 5: 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

Unit 6: Numerical Methods

- Solutions of nonlinear algebraic equations
- Single and Multi-step methods for differential equations

Unit 7: Transform Theory

- Fourier Transform
- Laplace Transform
- z-Transform

Section B: Electric Circuits

- Network graph
- KCL, KVL, Node and Mesh analysis
- Transient response of dc and ac networks
- Sinusoidal steady-state analysis
- Resonance
- Passive filter, Ideal current and voltage sources
- Thevenin's theorem

- Norton’s theorem
- Superposition theorem
- Maximum power transfer theorem
- Two-port networks
- Three phase circuits
- Power and power factor in ac circuits

Section C: 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

Section D: 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
- Applications of Fourier Transform
- Laplace Transform and z-Transform

Section E: Electrical Machines

- Single phase transformer:
  - Equivalent circuit
  - Phasor diagram
  - Open circuit and short circuit tests
  - Regulation and efficiency
- Three phase transformers:
  - Connections
  - Parallel operation
- Auto-transformer
- Electromechanical energy conversion principles
- DC machines:
  - Separately excited
  - Series and shunt
  - Motoring and generating mode of operation and their characteristics
  - Starting and speed control of dc motors
- Three phase induction motors:
  - 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
  - Regulation and parallel operation of generators
  - Starting of synchronous motor
  - Characteristics
- Types of losses and efficiency calculations of electric machines

Section F: Power Systems

- Power generation concepts
- 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
- GaussSeidel 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 and distance protection
- Circuit breakers
- System stability concepts
- Equal area criterion

Section G: 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
- Routh-Hurwitz and Nyquist criteria
- Bode plots, Root loci, Stability analysis, Lag, Lead and Lead-Lag compensators
- P, PI and PID controllers
- State space model
- State transition matrix

Section H: 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

Section I: Analog and Digital Electronics

- Characteristics of diodes, BJT, MOSFET
- Simple diode circuits: clipping, clamping, rectifiers
- 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
- Demultiplexer
- Schmitt trigger
- Sample and hold circuits
- A/D and D/A converters
- 8085Microprocessor:
    - Architecture
    - Programming
    - Interfacing

Section H: Power Electronics

- Characteristics of semiconductor power devices:
    - Diode
    - Thyristor
    - Triac
    - GTO
    - MOSFET
    - IGBT
- DC to DC conversion:
    - Buck
    - Boost
    - Buck-Boost converters
- Single and three phase configuration of uncontrolled rectifiers
- Line commutated thyristor based converters
- Bidirectional ac to dc voltage source converters
- Issues of line current harmonics
- Power factor
- Distortion factor of ac to dc converters
- Single phase and three phase inverters
- Sinusoidal pulse width modulation