GATE Syllabus

Part I – ENGINEERING SCIENCE (XE)

Section–XE-A Engineering Mathematics

tutorialspoint
SIMPLY EASY LEARNING

Part I – ENGINEERING SCIENCE (XE)

Course Structure

Section-Code	Topics
Section – XE-A	**Engineering Mathematics** (***Compulsory for all XE candidates***)
Unit 1	Linear Algebra
Unit 2	Calculus
Unit 3	Vector Calculus
Unit 4	Complex Variables
Unit 5	Ordinary Differential Equations
Unit 6	Partial Differential Equations
Unit 7	Probability and Statistics
Unit 8	Numerical Methods
Section XE-B	**Fluid Mechanics**
Section XE-C	**Materials Science**
Section XE-D	**Solid Mechanics**
Section XE-E	**Thermodynamics**
Section XE-F	**Polymer Science & Engineering**
Section XE-G	**Food Technology**
Section XE-H	**Atmospheric & Ocean Science**

Course Syllabus

SECTION – XE-A: ENGINEERING MATHEMATICS

Unit 1: Linear Algebra

- Algebra of matrices
- Inverse and rank of a matrix
- System of linear equations
- Symmetric, skew-symmetric and orthogonal matrices
- Determinants
- Eigenvalues and eigenvectors
- Diagonalisation of matrices
- Cayley-Hamilton Theorem

Unit 2: Calculus

Chapter 1: Functions of single variable

- Limit, continuity and differentiability
- Mean value theorems
- Indeterminate forms and L'Hospital's rule
- Maxima and minima
- Taylor's theorem
- Fundamental theorem and mean value-theorems of integral calculus
- Evaluation of definite and improper integrals
- Applications of definite integrals to evaluate areas and volumes

Chapter 2: Functions of two variables

- Limit, continuity and partial derivatives
- Directional derivative
- Total derivative
- Tangent plane and normal line
- Maxima, minima and saddle points
- Method of Lagrange multipliers
- Double and triple integrals, and their applications

Chapter 3: Sequence and Series

- Convergence of sequence and series
- Tests for convergence
- Power series
- Taylor's series
- Fourier Series
- Half range sine and cosine series

Unit 3: Vector Calculus

➢ Gradient, divergence and curl
➢ Line and surface integrals
➢ Green's theorem, Stokes theorem and Gauss divergence theorem (without proofs)

Unit 4: Complex Variables

➢ Analytic functions
➢ Cauchy-Riemann equations
➢ Line integral, Cauchy's integral theorem and integral formula (without proof)
➢ Taylor's series and Laurent series
➢ Residue theorem (without proof) and its applications

Unit 5: Ordinary Differential Equations

➢ First order equations (linear and nonlinear)
➢ Higher order linear differential equations with constant coefficients
➢ Second order linear differential equations with variable coefficients
➢ Method of variation of parameters
➢ Cauchy-Euler equation
➢ Power series solutions
➢ Legendre polynomials, Bessel functions of the first kind and their properties

Unit 6: Partial Differential Equations

➢ Classification of second order linear partial differential equations
➢ Method of separation of variables
➢ Laplace equation
➢ Solutions of one dimensional heat and wave equations

Unit 7: Probability and Statistics

➢ Axioms of probability
➢ Conditional probability
➢ Bayes' Theorem
➢ Discrete and continuous random variables:
   • Binomial
   • Poisson
   • Normal distributions
➢ Correlation and linear regression

Unit 9: Numerical Methods

➢ Solution of systems of linear equations using LU decomposition
➢ Gauss elimination and Gauss-Seidel methods
➢ Lagrange and Newton's interpolations

- Solution of polynomial and transcendental equations by Newton-Raphson method
- Numerical integration by trapezoidal rule
- Simpson's rule and Gaussian quadrature rule
- Numerical solutions of first order differential equations by Euler's method and 4th order Runge-Kutta method