# ENGINEERING MATHEMATICS – I

**CODE: 10 MAT 11** **IA Marks: 25**
**Hrs/Week: 04** **Exam Hrs: 03**
**Total Hrs: 52** **Exam Marks:100**

## PART-A

### Unit-I: DIFFERENTIAL CALCULUS - 1

Determination of $n^{th}$ derivative of standard functions-illustrative examples*. Leibnitz's theorem (without proof) and problems.

Rolle's Theorem – Geometrical interpretation. Lagrange's and Cauchy's mean value theorems. Taylor's and Maclaurin's series expansions (without proof). **[6 hours]**

### Unit-II: DIFFERENTIAL CALCULUS - 2

Indeterminate forms – L'Hospital's rule (without proof), Polar curves: Angle between polar curves, Pedal equation for polar curves. Derivative of arc length – concept and formulae without proof. Radius of curvature - Cartesian, parametric, polar and pedal forms. **[7 hours]**

### Unit-III: DIFFERENTIAL CALCULUS - 3

Partial differentiation: Partial derivatives, total derivative and chain rule, Jacobians-direct evaluation.

Taylor's expansion of a function of two variables-illustrative examples*. Maxima and Minima for function of two variables

**[6 hours]**

### Unit-IV: VECTOR CALCULUS

Derivative of a vector function of one variable. Velocity and acceleration – concept with illustrative examples*. Scalar and vector point functions – Gradient, Divergence, Curl, Laplacian, Solenoidal and Irrotational vectors.

Vector Identities: div $(\phi \vec{A})$ , Curl $(\phi \vec{A})$, Curl (grad $\phi$), div (Curl $\vec{A}$), div ( $\vec{A} \times \vec{B}$ ) and Curl (Curl $\vec{A}$).

Orthogonal Curvilinear Coordinates – Definition, unit vectors, scale factors, orthogonality of Cylindrical and Spherical Systems. Expression for Gradient, Divergence, Curl, Laplacian in an orthogonal system and also in Cartesian, Cylindrical and Spherical System as particular cases – No problems **[7 hours]**

## PART-B

### UNIT – V: INTEGRAL CALCULUS

Differentiation under the integral sign – simple problems with constant limits. Reduction formulae for the integrals of $\sin^n x$, $\cos^n x$, $\sin^m x \cos^n x$ and evaluation of these integrals with standard limits - Problems.

Tracing of curves in Cartesian, Parametric and polar forms – illustrative examples*. Applications – Area, Perimeter, surface area and volume. Computation of these in respect of the curves – (i) Astroid: $x^{2/3}+y^{2/3}=a^{2/3}$ (ii) Cycloid: $x=a(\theta-\sin\theta), y=a(1-\cos\theta)$ and (iii) Cardioid: $r=a(1+\cos\theta)$

**[6 hours]**

### UNIT – VI: DIFFERENTIAL EQUATIONS

Solution of first order and first degree equations: Recapitulation of the method of separation of variables with illustrative examples*. Homogeneous, Exact, Linear equations and reducible to these forms, orthogonal trajectories. **[7 hours]**

### UNIT – VII: LINEAR ALGEBRA-1

Recapitulation of Matrix theory. Elementary transformations, Reduction of the given matrix to echelon and normal forms, Rank of a matrix, consistency of a system of linear equations and solution. Solution of a system of linear homogeneous equations (trivial and non-trivial solutions). Solution of a system of non-homogeneous equations by Gauss elimination and Gauss –Jordan methods. **[6 hours]**

### UNIT – VIII: LINEAR ALGEBRA-2

Linear transformations, orthogonal transformations, Eigen values and eigen vectors of a square matrix, Similarity of matrices, Reduction to diagonal form, Quadratic forms, Reduction of quadratic form into canonical form, Nature of quadratic forms **[7 hours]**

**Note: * In the case of illustrative examples, questions are not to be set.**

### Text Books:


1. B.S. Grewal, Higher Engineering Mathematics, Latest edition, Khanna Publishers
2. Erwin Kreyszig, Advanced Engineering Mathematics, Latest edition, Wiley Publications.


### Reference Book:


1. B.V. Ramana, Higher Engineering Mathematics, Latest edition, Tata Mc. Graw Hill Publications.

## ENGINEERING MATHEMATICS – II

**CODE: 10 MAT 21** **IA Marks: 25**
**Hrs/Week: 04** **Exam Hrs: 03**
**Total Hrs: 52** **Exam Marks:100**

## PART-A

### Unit-I: DIFFERENTIAL EQUATIONS - 1

Equations of first order and higher degree (p-y-x equations), Equations solvable for p,y,x. General and singular solutions, Clairauit's equation. Applications of differential equations of first order–illustrative examples*. **[6 hours]**

### Unit-II: DIFFERENTIAL EQUATIONS – 2

Linear differential equations: Solution of second and higher order equations with constant coefficients by inverse differential operator method. Simultaneous differential equations of first order. **[7 hours]**

### Unit-III: DIFFERENTIAL EQUATIONS – 3

Method of variation of parameters, Solutions of Cauchy's and Legendre's linear equations, Series solution of equations of second order, Frobenius method – simple problems. **[6 hours]**

### Unit-IV: PARTIAL DIFFERENTIAL EQUATIONS (PDE)

Formation of Partial differential equations (PDE) by elimination of arbitrary constants/ functions. Solution of non-homogeneous PDE by direct integration. Solution homogeneous PDE involving derivative with respect to one independent variable only. Solution of Lagrange's linear PDE. Solution of PDE by the Method of separation of variables (first and second order equations) **[7 hours]**

## PART-B

### Unit-V: INTEGRAL CALCULUS

Multiple Integrals **–** Evaluation of Double integrals and triple integrals. Evaluation of double integrals over a given region, by change of order of integration, by change of variables. Applications to area and volume – illustrative examples*.

Beta and Gamma Functions - Properties and problems **[6 hours]**

### Unit-VI: VECTOR INTEGRATION

Line integrals – definition and problems, Surface and volume integrals-definition. Green's theorem in a plane, Stoke's and Gauss divergence theorem (statements only). **[6 hours]**

### Unit-VII: LAPLACE TRANSFORMS-1

Definition, transforms of elementary functions, properties, Periodic function, Unit step function and unit impulse function. **[7 hours]**

### Unit-VIII: LAPLACE TRANSFORMS-2

Inverse Laplace Transforms, Convolution theorem, solution of linear differential equations using Laplace transforms. Applications – illustrative examples*. **[7 hours]**

**Note: * In the case of illustrative examples, questions are not to be set.**

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1. B.S. Grewal, Higher Engineering Mathematics, Latest edition, Khanna Publishers
2. Erwin Kreyszig, Advanced Engineering Mathematics, Latest edition, Wiley Publications.


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## ENGINEERING MATHEMATICS – III

**CODE: 10 MAT 31** **IA Marks: 25**
**Hrs/Week: 04** **Exam Hrs: 03**
**Total Hrs: 52** **Exam Marks:100**

## PART-A

### Unit-I: FOURIER SERIES

Convergence and divergence of infinite series of positive terms, definition and illustrative examples*
Periodic functions, Dirichlet's conditions, Fourier series of periodic functions of period $2\pi$ and arbitrary period, half range Fourier series. Practical harmonic analysis. **[7 hours]**

### Unit-II: FOURIER TRANSFORMS

Infinite Fourier transform, Fourier Sine and Cosine transforms, properties, Inverse transforms **[6 hours]**

### Unit-III: APPLICATIONS OF PDE

Various possible solutions of one dimensional wave and heat equations, two dimensional Laplace's equation by the method of separation of variables, Solution of all these equations with specified boundary conditions. D'Alembert's solution of one dimensional wave equation.
**[6 hours]**

### Unit-IV: CURVE FITTING AND OPTIMIZATION

Curve fitting by the method of least squares- Fitting of curves of the form $y = ax+b,\ y=a x^2 + b x+c,\ y = a e^{bx},\ y = ax^b$

Optimization: Linear programming, mathematical formulation of linear programming problem (LPP), Graphical method and simplex method.
**[7 hours]**

## PART-B

### Unit-V: NUMERICAL METHODS - 1

Numerical Solution of algebraic and transcendental equations: Regula-falsi method, Newton - Raphson method. Iterative methods of solution of a system of equations: Gauss-seidel and Relaxation methods. Largest eigen value and the corresponding eigen vector by Rayleigh's power method. **[6 hours]**

### Unit-VI: NUMERICAL METHODS – 2

Finite differences: Forward and backward differences, Newton's forward and backward interpolation formulae. Divided differences - Newton's divided difference formula, Lagrange's interpolation formula and inverse interpolation formula.

Numerical integration: Simpson's one-third, three-eighth and Weddle's rules (All formulae/rules without proof) **[7 hours]**

### Unit-VII: NUMERICAL METHODS – 3

Numerical solutions of PDE – finite difference approximation to derivatives, Numerical solution of two dimensional Laplace's equation, one dimensional heat and wave equations **[7 hours]**

### Unit-VIII: DIFFERENCE EQUATIONS AND Z-TRANSFORMS

Difference equations: Basic definition; Z-transforms – definition, standard Z-transforms, damping rule, shifting rule, initial value and final value theorems. Inverse Z-transform. Application of Z-transforms to solve difference equations. **[6 hours]**

**Note: * In the case of illustrative examples, questions are not to be set.**

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## ENGINEERING MATHEMATICS – IV

**CODE: 10 MAT 41** **IA Marks: 25**
**Hrs/Week: 04** **Exam Hrs: 03**
**Total Hrs: 52** **Exam Marks:100**

## PART-A

### Unit-I: NUMERICAL METHODS - 1

Numerical solution of ordinary differential equations of first order and first degree; Picard's method, Taylor's series method, modified Euler's method, Runge-kutta method of fourth-order. Milne's and Adams - Bashforth predictor and corrector methods (No derivations of formulae). **[6 hours]**

### Unit-II: NUMERICAL METHODS – 2

Numerical solution of simultaneous first order ordinary differential equations: Picard's method, Runge-Kutta method of fourth-order.
Numerical solution of second order ordinary differential equations: Picard's method, Runge-Kutta method and Milne's method. **[6 hours]**

### Unit-III: Complex variables – 1

Function of a complex variable, Analytic functions-Cauchy-Riemann equations in cartesian and polar forms. Properties of analytic functions.
Application to flow problems- complex potential, velocity potential, equipotential lines, stream functions, stream lines. **[7 hours]**

### Unit-IV: Complex variables – 2

Conformal Transformations: Bilinear Transformations. Discussion of Transformations: $w = z^2$, $w = e^z$, $w = z + (a^2 / z)$
Complex line integrals-Cauchy's theorem and Cauchy's integral formula **[7 hours]**

## PART-B

### Unit-V: SPECIAL FUNCTIONS

Solution of Laplace equation in cylindrical and spherical systems leading Bessel's and Legendre's differential equations, Series solution of Bessel's differential equation leading to Bessel function of first kind, Series solution of Legendre's differential equation leading to Legendre polynomials, Rodrigue's formula. **[7 hours]**

### Unit-VI: PROBABILITY THEORY - 1

Probability of an event, empherical and axiomatic definition, probability associated with set theory, addition law, conditional probability, multiplication law, Baye's theorem. **[6 hours]**

### Unit-VII: PROBABILITY THEORY- 2

Random variables (discrete and continuous), probability density function, cumulative density function.

Probability distributions – Binomial and Poisson distributions; Exponential and normal distributions. **[7 hours]**

### Unit-VIII: SAMPLING THEORY

Sampling, Sampling distributions, standard error, test of hypothesis for means, confidence limits for means, student's t-distribution. Chi -Square distribution as a test of goodness of fit **[6 hours]**

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