

Paper Code : MAT101
Credit : 4
Course content: 60 Hours

Semester -I

Paper I : Abstract Algebra

Objectives: To introduce basics in mathematics.
To introduce and develop abstract concepts.

Unit -I

Relations , Binary relations , Equivalence relations, Partial order relations , Definition of a group with examples and simple properties. Subgroups ,Cyclic groups .
(15Hours)

Unit-II

Permutation groups , Alternating groups . Cosets, Normal subgroups , Quotient group.
(10Hours)

Unit III

Homomorphism and Isomorphism ,The Fundamental theorem of homomorphism .
Rings , Subrings.
(10Hours)

Unit IV

Ideal of a ring , Polynomial ring , Characteristic of a ring , Integral domain and Fields -
their simple properties.
(10Hours)

Unit – V

Vector space, Sub-space, Linear combination of vectors, Linearly dependent and
independent vectors and their simple properties, Bases and dimension.
(15Hours)

Books Recommended:

Essential Readings:

1. K. C. Sarangi , Elements of Abstract Algebra, RBD, Jaipur.
2. Kolman , Discrete Mathematical Structure PHI,Ltd. New Delhi.
3. P.B.Bhattacharya , S.K.Jain and S.R.Nagpaul,Basic Abstract Algebra , Cambridge University Press.
4. G. C. Sharma , Modern Algebra, Shivrul Agarwal & Co. Agra.

References :

1. Deepak Chatterjee,Abstract Algebra.PHI. Ltd.New Delhi.
2. I.N.Herstein , Topics in Algebra , Wiley Eastern Ltd., New Delhi
3. Malcolm Birkoff ,Abstract Algebra , Cambridge University Press

Paper Code : MAT102
Credit : 4
Course content: 60 Hours

Semester- I

Paper II : Differential Calculus

Objectives: To improve basics in mathematics.
To improve analytical skill.

Unit I

Mean Value theorems (Lagrange's, Cauchy, Taylor's and Maclaurins with different remainders) .Expansion of $\sin x$, $\cos x$, e^x , $\log(1+x)$, $(1+x)^m$.
(12Hours)

Unit II

Derivative of an arc
Pedal equation (Cartesian and Polar Curves), Curvature .
(12Hours)

Unit III

Partial differentiation, Total derivative , Euler's theorem for homogeneous functions, Maxima and Minima of functions of two and three independent variables – necessary and sufficient conditions (without proof) , Lagrange's undetermined multipliers (without proof) and simple problems.
(12Hours)

Unit IV

Envelopes , Asymptotes. Tests for concavity and convexity and points of inflexion.
(12Hours)

Unit V

Multiple points, Classification of double points – Node, cusp.
Tracing of curves : Cartesian and Polar form.
(12Hours)

Books Recommended:

Essential Readings:

1. Shanti Narayan, Differential Calculus , S.Chand and Co., New Delhi.
2. M. Ray & G.C. Sharma, Differential Calculus, Shivlal agarwal & Co. Agra.
3. Gorakh Prasad , Text Book on Diff.Calculus , Pothishala Pvt.Ltd, Allahabad.
4. Chaurasia, Goyal , Agarwal , Jain ;Diff. Calculus, RBD , Jaipur.

References :

1. Theory and problems of Advanced Cal. - Schaum's outline series New York.
2. H.S.Dhami,Differential Calculus,New Age Int. Ltd.,New Delhi.
3. Akhtar&Ahsan, A text Book of Differential Calculus ,PHI Ltd.New Delhi.
4. G.N.Berman, A Problem book in Mathematical Analysis, Mir Publishers, Moscow.

Paper Code : MAT201
Credit : 4
Course content: 60 Hours

Semester –II

Paper I : Integral and Vector Calculus

Objectives: To introduce basics in mathematics.
To improve analytical skill.

Unit -I

Integration of irrational algebraic functions

$$\frac{1}{(ax+b)\sqrt{px+q}}, \frac{1}{(ax^2+bx+c)\sqrt{(px+q)}}, \frac{px+q}{\sqrt{ax^2+bx+c}}, \sqrt{(ax^2+bx+c)}, \frac{px^2+qx+r}{\sqrt{ax^2+bx+c}},$$
$$\frac{1}{(px+q)\sqrt{ax^2+bx+c}}$$
 and Transcendental functions: $\sin^n x, \cos^n x, \sin^m x \cos^n x$.

Reduction Formulae: All trigonometric ratios with power n, where n is a positive integer.

Definition and properties of Gamma and Beta functions, Relation between Gamma and Beta functions, Duplication formula and simple problems related to these functions.

Unit-II

Quadrature: Area of cartesian and polar curves, Volumes and Surfaces of solids of revolution: Volume and surface area of cartesian and polar curves. Reduction formulae (15Hours)

Unit III

Double integrals, Change of order of integration, Triple integrals and their applications
Dirichlet's Integral
(15Hours)

Unit –IV

Scalar and vector point functions, Differentiation and Integration of vector point function, directional derivatives.
(07Hours)

Unit – V

Gradient , Divergence , Curl and identities involving these operators, Gauss divergence theorem , Stokes and Greens theorems (without proof) and their applications .
(15Hours)

Books recommended:

Essential Readings:

1. Gorakh Prasad, A text book on Integral Calculus , Pothishala Pvt .Ltd , Allahabad.
2. Sharma & Jain, Integral Calculus, Galgotia Publication, Dariyaganj ,New Delhi.
3. Shanti Narayan , Integral Calculus , S.Chand and Co., New Delhi.
4. Shanti Narayan , A text book of Vector Calculus, S.Chand and Co. New Delhi

References :

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley and sons.
2. Muray R. Spiegel ,Vector Analysis, Schaum Publishing Company , New York.
3. Saran and Nigam , Introduction to Vector Analysis,Pothisala Pvt Ltd,Allahabad.

Paper Code : MAT202
Credit : 4
Course Content: 60 H0urs

Semester - II

Paper II : Analytical Geometry

Objectives: To introduce basics in mathematics.
To understand the subject as tool applicable to almost all other
Branches of Sciences Engineering and Technology.

Unit – I(2D & 3D)

Tracing of conics.

Plane: Definition, Equation of a plane (Different forms), Angle between two planes, planes through two planes, Distance of a point from a plane, Area of a triangle, Volume of Tetrahedron.

(12Hours)

Unit – II

Straight lines: Introduction, Equations of coordinate axes, Symmetrical form, Angle between a line and a plane, Perpendicular distance, Intersecting lines, Skew lines, Shortest distance and equation of line of shortest distance, Intersection of three planes. Sphere: Definition, Equation of a sphere, General equation of a sphere, Centre and radius of a sphere, Great circle, Equation of circle, Diameter form of the equation of a sphere, Tangent line and tangent plane of a sphere, Condition of tangency for a line and equation of tangent plane, Angle of intersection of two spheres, Condition of orthogonality of two spheres.

(12Hours)

Unit –III

Cone: Cone, Quadratic Cone, Equation of a cone, Enveloping cone, Condition for general equation of second degree to represent a cone, Intersection with a line, Tangent plane, Reciprocal Cone, Right Circular Cone.

Cylinder: Definition, Equation of a cylinder, Enveloping Cylinder, Equation of Enveloping Cylinder, Right Circular Cylinder, Equation of Right Circular Cylinder.

(12Hours)

Unit –IV

Central Conicoids: Conicoids, Central Conicoid, Standard equation of ellipsoid, hyperboloid of one sheet and hyperboloid of two sheets, Nature and shape of Central conicoids, Tangent line and Tangent planes. Condition of Tangency, Director sphere, Normal to a conicoid, Number of normals, Cubic curve, cone through six normals, Diametral plane, conjugate diametral plane, conjugate diameters.

Plane section of conicoids: Nature of a plane section of a central conicoid, Central section, Axes and Area of central plane section of a central conicoid, Circular sections of the conicoid, Circular sections of central conicoid, Circular sections of ellipsoid, Umbilics, Umbilics of ellipsoid.
(12Hours)

Unit –V

Generating Lines: Introduction, Developable and Skew Surfaces, Condition for a straight line to be generator, Characteristics of generator of hyperboloid of one sheet.

Reduction of second degree equation in three variables: Introduction, Points of intersection of a straight line and a conicoid, Tangent plane, Normal line and condition of tangency, Plane section with a given centre, Diametral plane, Principal planes, Principal directions and Discriminating cubic, Nature of roots of discriminating cubic, Conditions for zero roots of the discriminating cubic.
(12Hours)

Books Recommended:

Essential Readings:

1. N.Saran and R.S.Gupta , Analytical Geometry of three dimensions , Pothisala Pvt.Ltd , Allahabad.
2. Gorakh Prasad and H.C.Gupta ,Text book on Coordinate Geometry , Pothisala Pvt. Ltd., Allahabad
3. P.K.Jain and Khalil Ahmad , A text book of Analytical Geometry of Two dimensions , Wiley Eastern Ltd.
4. Sharma & Jain, Co-ordinate Geometry, Galgotia Publication, Dariyaganj , New Delhi.
5. P.K.Jain and Khalil Ahmad , A text book of Analytical Geometry of Three Dimensions , Wiley Eastern Ltd.

References:

1. The Elements of Coordinate Geometry , S.L.Loney, Macmillan and Co., London
2. R.J.T.Bell, Elementary Treatise on Coordinate Geometry of Three Dimensions , Macmillan India Ltd

Paper Code : MAT301
Credit :4
Course content: 60 Hours

Semester – III

Paper I – Real Analysis

Objectives: To introduce basics in mathematics.
To improve analytical skill.

Unit – I

Order completeness of Real numbers, open and closed sets, limit point of sets, Bolzano Weirstrass theorem ,concept of compactness, Heine Borel theorem. Connected sets.
(10Hours)

Unit – II

Real Sequences , Limit and convergence of a sequence, Monotonic sequences, Cauchy's sequences, Sub sequences and Cauchy's General principle of convergence, Infinite series and their convergences – Comparison test, Cauchy's nth root test, D'Alembert, Raabe's ,Cauchy's Test, Logarithmic test.
(15Hours)

Unit – III

Alternating Series – Leibnitz Test , Absolute and conditional convergence, Properties of continuous function and derivable functions.
(10Hours)

Unit - IV :

Reimann Integration , Lower and upper Reimann integrals, Properties of Reimann integration , Mean value theorem of Integral calculus , Fundamental theorem of integral calculus.
(10Hours)

Unit – V

Uniform convergence , Sequence and series of function – pointwise and uniform convergence , Weirstrass M- Test, Abel's and Driehlet's Test for uniform convergence of series of functions . Continuity of the sum functions of the limit fuctions.
(15Hours)

Books Recommended:

Essential readings:

1. Shanti Narayan, A course of Mathematical Analysis ,S.Chand and Co. New Delhi.
2. T.M.Apostol , Mathematical Analysis , Norosa Publishing House, New Delhi.
3. K.C.Sarangi , Real Analysis and Metric spaces, Ramesh Book Depot, Jaipur.

References :

1. Jain and Kaushik, An introduction to Real Analysis , S.Chand and Co., New Delhi
2. Undergraduate Analysis , S.Lang , Springer-Verlag , Mathematical Analysis ,
3. Real Analysis , R.R.Goldberg, Oxford and IBH publishing Company, New Delhi.

Paper code : MAT302
Credit : 4
Course content: 60 Hours

Semester - III

Paper II: Differential Equations

Objectives: To improve analytical skill.
To understand the subject as tool applicable in other branches of Sciences, Engineering and Technology.

Unit – I

Degree and order of a differential equation .Equations of first order and first degree – Variable separable method , Homogeneous and equations reducible to homogeneous form , Linear and equations reducible to linear form.

(10Hours)

Unit – II

Exact differential equations and equation which can be made exact. First order higher degree equations – solvable for x , y , p . Clairaut's form.and singular solutions with extraneous loci.

(10Hours)

Unit – III

Linear differential equation with constant coefficients, complimentary function and particular integral. Homogeneous linear differential equations with variable coefficient. Simultaneous differential equations . Exact linear differential equations of n th order .

(15Hours)

Unit – IV

Linear differential equations of second order- Linear independence of solutions . Solution by transformation of the equations by changing the dependent and independent variable. Factorization of operators. Method of variation of parameters, Method of undetermined coefficients.

(15Hours)

Unit – V

Partial differential equations of the first order. Lagrange's linear equation, Charpit's general method of solution , homogeneous linear partial differential equations with constant coefficients. Equations reducible to equations with constant coefficients.

(10Hours)

Books Recommended:

Essential Readings:

1. D.A.Murray, Introductory course on Differential Equations, Orient Longman
2. I. N. Sneddon, Elements of Partial Differential Equations , TMH
3. Zafar Ahsan, Differential Equations & their applications, PHI ,New Delhi.

References :

1. A.R.Forsyth , A Treatise on Differential Equations , Macmillan and Co. Ltd, London
2. Frank Ayres, Theory and Problems of Differential Equations, TMH.

Paper Code : MAT401
Credit :4
Course content: 60 Hours

Semester – IV

Paper – I Mechanics

(Unit – I and II Statics)

(Unit – III,IV and V Dynamics)

Objective: To enable the learner to apply the principle of Mechanics in daily life

Unit – I

Parallel forces, Moments and couples.

(12Hours)

Unit – II

Friction , common catenary.

(12Hours)

Unit – III

Rectilinear Motion – radial and transverse components of velocity and acceleration, tangential and normal components of velocity and acceleration . S.H.M. – Hooke’s Law, Horizontal and vertical elastic strings.

(12Hours)

Unit – IV

Rectilinear motion in a resisting medium. Central forces, Kepler’s law of planetary motion.

(12Hours)

Unit – V

Work, Energy, Constrained motion in two dimensions: Motion of a particle on the inside of a smooth vertical circle.

(12Hours)

Books recommended:

Essential Readings:

1. Dynamics , Ramsey A.S. , CBS Publishers and distributors
2. Dynamics , Bali , Laxmi Publications, Meerut
3. Dynamics , M.Ray, S. Chand & Co.
4. Statics ,Dynamics,Gokhroo&Gokhroo,Navkar Prakashan Ajmer.s
5. Statics , M.Ray, S. Chand & Co.

References :

1. Dynamics of a Particle , Loney, Macmillan India Ltd.
2. Dynamics of a Particle , Ray , Students Friends and Co., Agra
3. Dynamics of a Particle , Vasishtha A.R.; Gupta, Krishna Prakashan Mandir
4. Statics ,Bali, Laxmi Publication
5. Statics, Jain& Bhatt, Ramesh Book Depot
6. Statics , Ramsey , CBS Publishers and Distributors

Paper Code : MAT402
Credit : 4
Course Content: 60 Hours

Semester- IV

Paper II:Discrete Mathematics

Objectives:To introduce and develop abstract concepts.
To understand the subject as tool applicable in computer science.

Unit – I

Russel’s Paradox, Principle of inclusions and exclusions , Poset , Hasse diagram , pigeon hole principle ,
Languages , Phrasestructure, Grammar - types of grammars and languages .
(12Hours)

Unit -II

Graphs- basic terminology , multigraphs, weighted graphs , paths and circuits, shortest path , Eulerian and Hamilton paths and circuits, travelling salesman problem ,planar graphs. Graph colouring and chromatic number.
(12Hours)

Unit III

Trees, rooted trees, Paths Lengths in Rooted Trees , Binary Search Trees Spanning Trees , Minimum Spanning Trees .Finite state machines, equivalent machines(Deterministic and non-deterministic).
(12Hours)

Unit –IV

Recurrence relations . Method of generating functions.
Lattices: duality, distributive and complemented lattices .
(12Hours)

Unit – V

Boolean function and expression , propositional calculus , switching circuits and logic gates.
(10Hours)

Books Recommended:

Essential Readings:

1. Elements of Discrete Mathematics , C.L.Liu, MacGraw Hill Intl, Edition
2. Discrete Mathematical Structures , Kolman , Prentice Hall, New Delhi
3. Schaum’s Outlines Discrete Mathematics , Lipschutz, Seymour, TMH, NewDelhi.
4. Graph Theory by N.S. Dev
5. Advanced Discrete Mathematics, Sharma & Jain, Laxmi Prakashan, Delhi.

References :

1. Discrete Mathematics,Johnsonbaugh, Richard, Addison-Wesley Publishing Company(5th Edition).
2. Discrete Mathematics : Elementary and Beyond , Lovasz,L. Pelikan ,J. Springer, New York
3. Discrete Mathematics with Graph Theory , Goodaire , Edgar G , Prentice Hall of India.
4. Discrete Mathematical Structure, R. Manohar.

Paper Code : MAT501

Credit : 4

Course Content: 60 Hours

Semester – V

Paper I: Numerical Analysis

Objectives: To understand the subject as tool applicable in other branches of Sciences, Engineering and Technology.

Unit – I

Differences ,Relation between differences and derivatives,difference of polynomials, Factorial notation,Newton's forward and backward interpolation formula (including proof) .

(12Hours)

Unit – II

Divided differences:Newton's and Lagrange's divided differences formulae.Central differences: Gauss's,Stirling's and Bessel's interpolation formulae.Numerical differentiation.

(12Hours)

Unit – III

Numerical integration – Quadrature formula-trapezoidal rule , Simpson's 1/3 rd and 3/8 th formulae,Gaussian Integration , Newton cotes formula.

(12Hours)

Unit – IV

Inverse Interpolation,Numerical solution of algebraic and transcendental equations-Bisection method , Regula-falsi method, Method of iteration and Newton Raphson's Method.Newton's iterative formula for obtaining square and inverse square root

(12Hours)

Unit – V

Solution of system of linear equations : Gauss elimination method , Jacobi and Gauss Seidal method . Solutitons of ordinary differential equations with initial boundary conditions: Picard's method, Euler's and modified Euler's method, Runge's Kutta Method.

(12Hours)

Books Recommended:

Essential Readings:

1. Calculus of Finite Differences and Numerical Analysis, Gupta and Malik, Krishna Prakashan Mandir
2. Numerical Methods Problems and Solutions , M.K.Jain, Iyengar,New Age International Ltd.
3. Numerical Analysis, Sharma & Sharma, Ratan Prakashan Mandir, Agra.

References:

1. Applied Numerical Analysis , Gerald, Addison Wesley Publishing Company
- 2 Applied Numerical Methods, Gourdin; Boumahrat, Prentice Hall of India
4. Numerical Methods Problems and Solutions , M.K.Jain, Iyengar,New Age International Ltd
4. Numerical Analysis a Practical Approach , Melvin J.Maron, Machmillon Publishing Company, New York

Paper Code : MAT502
Credit : 4
Course Content: 60 Hours

Semester – V

Paper : II Operations Research

Objectives: To improve analytical skill.
To understand the subject as tool applicable in Business Management and Industries.

Unit – I

Introduction ,historical background ,objective of OR, scope of OR. Introduction : general L.P.P. Formulation of the problem- Graphical method for the solution of the L.P.P. (10Hours)

Unit – II

Simplex Method – Big M method- Two phase Method and special cases. Duality in L.P.P. (15Hours)

Unit – III

Transportation problem : Optimality test. Degeneracy in transportation problem. Unbalanced transportation problems. Assignment problems. (10Hours)

Unit- IV

Theory of Games- Introduction –Description and characteristics of game theory –Two person zero sum game- solution of mixed strategy problems – principle of dominance .Solution of mix game by Linear programming method .Simulation –advantages and disadvantages. (12Hours)

Unit – V

Queuing theory: Simple models.Inventory control : Introduction , EOQ models , Quantity Discounts, Stock Levels , Buffer stocks , ABC analysis. (13Hours)

Books Recommended:

Essential Readings:

1. Problems in O.R. Kanti Swaroop, Gupta P.K. and Manmohan , Sultan Chand and sons ,
2. Operations Research , H.A.Taha , Macmillan Publishing Company , New York.
3. Operations Research , Sharma & Jain, Students friends & Co.
4. Operations research, S.D. Sharma, Kedarnath & Ramnath Co., Meerut

References :

1. Linear Programming , Gauss S.I., McGraw Hills Book Company.
2. Problems in O.R. Gupta P.K. and Hira D.S., S.Chand and Co.
3. Operations Research, Hilter & Liberman.
4. Mathematical Programming, Manmohan Gupta.

Paper Code : MAT601
Credit : 4
Course content: 60 Hours

Semester : VI

Paper – I Complex Analysis

Objectives: To improve basics in mathematics.
To improve analytical skill.

Unit – I

Complex Plane, connected and compact sets, curves and regions in complex plane. Statement of Jordan curve theorem. Extended complex plane. Complex valued functions, Analytic functions, C-R equation, Harmonic equations. Construction of an analytic functions.

(15Hours)

Unit – II

Complex Integration, Complex line Integrals, Cauchy's Integral theorem, Indefinite integrals, fundamental theorem of Integral Calculus for complex functions, Cauchy's Integral Formula, Analyticity of the derivative of an analytic function.

(10Hours)

Unit – III

Lioville's theorem, Poisson's Integral formula, Morera's theorem. Maximum modulus principle. Taylor's and Laurent's Series.

(10Hours)

Unit- IV

Singularities. Meromorphic functions and Entire functions. Riemann's theorem, Casorati- Weirstrass theorem. Rouchy's theorem. Fundamental theorem of algebra. Cauchy's Residue theorem. Evaluation of definite integrals by Contour integration.

(15Hours)

Unit – V

Conformal mapping (Introduction). Bilinear transformation and their simple properties. Power series- Hadamard theorem and its applications.

(10Hours)

Books Recommended:

Essential Readings

1. Complex Analysis, Purohit and Goyal, Jaipur Publishing House
2. Complex Variables: Theory and Applications, H.S. Kasana, Prentice Hall, Delhi

References :

1. Theory and Problems of Complex Variables, R. Murray Spiegel, Schaum Outline Series
2. Introduction to Complex Analysis, S. Ponnuswamy, Narosa Publishers.

Paper Code : MAT602
Credit :2
Max. Marks:50

Semester : VI
Paper : II (Dissertation)

Students are required to familiarize themselves with popular software like MATLAB, LINDO, MATHEMATICA, MAPLE for numerical/statistical computation and optimization .The department will decide the topic of dissertation at the beginning of the session. Few topics are given below for reference. (Application problems are to be taken).

1. Plotting of functions
2. Matrix Operations.
3. Data Analysis and curve fitting
4. Numerical differentiation
5. Numerical integration
6. Differential equations.
7. 2-D and 3-D graphics
8. L.P.P.

References :

MATLAB- High performance numeric computation and visualization software.
MATHEMATICA- Stephen Wolfram , Cambridge.
Optimization modeling with LINDO : Linus Schrage.
Books on Modeling

Paper Code : MAT603

Credit : 2

Max. Marks:50

SYLLABUS FOR MATHEMATICS PRACTICAL

Group A

Numerical Integration-Simpson's $1/3^{\text{rd}}$ & $3/8^{\text{th}}$ rule, Solution of system of linear equations- Gauss elimination method, Jacobi and Gauss Seidel method.

Solution of ordinary differential equations-Euler's and modified Euler's method, Runge Kutta method.

Group B

Solution of ordinary differential and partial differential equations-Euler's and modified Euler's method, Runge Kutta method.

Note: Students are required to solve the problems computationally.
