



**JECRC**<sup>TM</sup>  
**UNIVERSITY**  
BUILD YOUR WORLD

**Department of Mathematics**  
**Course Structure and Syllabi**  
**B. Sc. (Hons.) Courses**

**Session 2015-16**

# **B. Sc. (Hons.) MATHEMATICS**

## **Offered By:**

Department of Mathematics

Faculty of Science

JECRC University, Jaipur

## **Semester-wise Distribution of Courses and Credits**

### **Semester –I**

<b>Course Code</b>	<b>Title</b>	<b>Credits</b>	<b>L</b>	<b>T</b>
BMA001A	Discrete and Combinatorial Mathematics	4	3	1
BMA002A	Differential Calculus	4	3	1
BMA003A	Number Theory	4	3	1
		<b>Total</b>	<b>12</b>	

### **Semester –II**

BMA004A	Algebra	4	3	1
BMA005A	Integral Calculus	4	3	1
BMA006A	Mechanics	4	3	1
		<b>Total</b>	<b>12</b>	

### **Semester –III**

BMA007A	Real Analysis	4	3	1
BMA008A	Differential Equations	4	3	1
BMA009A	Vector Calculus	4	3	1
		<b>Total</b>	<b>12</b>	

### Semester –IV

BMA010A	Numerical Analysis	4	3	1
BMA011A	Partial Differential Equations	4	3	1
BMA012A	Probability	4	3	1

**Total 12**

### Semester –V

BMA013A	Abstract Algebra	4	3	1
BMA014A	Three Dimensional Geometry	4	3	1
BMA015A	Linear Programming	4	3	1

**Total 12**

### Semester –VI

BMA016A	Complex Analysis	4	3	1
BMA017A	Linear Algebra	4	3	1
BMA018A	Differential Geometry & Tensor Analysis	4	3	1
BMA031A	Seminar	2	2	

**Total 14**

**Grand Total 74**

## Semester –I

### **BMA001A: Discrete and Combinatorial Mathematics**

**Credits: 4**

#### **UNIT I:**

Proposition, Compound Proposition, Conjunction, Disjunction, Implication, Converse, Inverse & Contrapositive, Biconditional Statements, tautology, Contradiction & Contingency, Logical Equivalences, Quantifiers, Arguments, Boolean Algebra, Application of Boolean algebra to switching circuits( using AND, OR and NOT gates).

#### **UNIT II:**

Permutations, Combination, Pigeon-hole Principle, inclusion-exclusion principle, derangements, Fundamental theorem of arithmetic.

#### **UNIT III:**

Graphs and Planar Graphs: Graph, Multigraph, Weighted Graphs, Directed graphs. Paths and circuits.

#### **UNIT IV:**

Matrix representation of graphs. Eulerian Paths and Circuits. Planar graphs.

#### **UNIT V:**

Trees and their properties-Trees as graphs-spanning trees-Directed trees-Binary trees- Their traversals-Arithmetic and Boolean expressions as trees- height balanced trees.

#### ***Recommended Books:***

1. C.L. Liu, Elements of Discrete Mathematics, (Second Edition), McGraw Hill, International Edition, 1986.
2. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 199
3. S. Wiitala, Discrete Mathematics: A Unified Approach, McGraw-Hill Book Co.
4. N. Deo, Graph Theory with Applications to Computer Science, Prentice-Hall of India
5. B. Bollobas: Graph Theory (Chapters I - III).

6. P. J. Cameron and J.H. Van Lint: Graphs, codes and designs.
7. Edgar G. Goodaire, Michael M. Parameter, Discrete Mathematics with Graph Theory (3rd Edition), Pearson, 2005.
8. Kenneth H Rosen, Discrete Mathematics and its applications with combinatorics and graph theory by ( 7th Edition), Tata McGraw-Hill Education private Limited, 2011.

## **BMA002A: Differential Calculus**

**Credits: 4**

### **UNIT I:**

Differential Calculus: Successive differentiation and Leibnitz theorem. Limit ( $\epsilon$ - $\delta$  definition), Continuity, Discontinuity, properties of continuous functions.

### **UNIT II:**

Differentiability, Chain rule of differentiation, Mean value theorems, Taylor's and Maclaurin theorems, Asymptotes in cartesian coordinates, intersection of curve and its asymptotes, asymptotes in polar coordinates.

### **UNIT III:**

Curvature, radius of curvature for Cartesian curves, parametric curves, polar curves, Newton's method, Radius of curvature for pedal curves, Tangential polar equations, Centre of curvature, Circle of curvature, Chord of curvature, evolutes. Tests for concavity and convexity, Points of inflexion.

### **UNIT IV:**

Multiple points. Cusps and their types, nodes & conjugate points, Tracing of curves in Cartesian, parametric and polar co-ordinates.

### **UNIT V:**

***Functions of one variable*** : limit, continuity, differentiation, Change of variables ,Rolle's Theorem, Mean value theorem. Taylor's theorem. Maxima and minima.

***Functions of two real variable***: limit, continuity, partial derivatives, differentiability,

Partial differentiation,maxima and minima. Method of Lagrange multipliers, Homogeneous functions including Euler's theorem.

***Recommended Books:***

1. BANSAL , J L; AGARWAL, S M; BHARGAV, S L., Differential Calculus-2 Jaipur JAIPUR PUBLISHING HOUSE, 1988.
2. Gorakh Prasad, Differential Calculus, Pothishala Pvt. Ltd. Allahabad, 2000.
3. Gorakh Prasad, Integral Calculus, Pothishala Pvt. Ltd. Allahabad, 2000.
4. Gabriel Klambauer, Mathematical Analysis, Marcel Dekkar Inc. New York 1975.
5. Shanti Narayan, Elements of Real Analysis, S. Chand & Company, New Delhi.
6. H. S. Dhami,Differential Calculus – (New Age International)
7. Courant & John, Differential & Integral Calculus (Vols. I & II).
8. N. Piskunov ,Differential & Integral Calculus (Vol. I) – (CBS Publishers & Distributors)
9. Shanti Naryaan, Differential Calculus – (S. Chand & Co. Ltd.)
10. J. Edwards ,An elementary treatise on the Differential Calculus – (Radha Publishing House)
11. David V. Widder, Advanced Calculus – (Prentice Hall)

**BMA003A: Number Theory**

**Credits: 4**

**UNIT I:**

Divisibility theory in the integers: early number theory, the division algorithm, the greatest common divisor, the Euclidean Algorithm, Diophantine equation  $ax+by=c$ , Primes and their Distributions, The Fundamental theorem of Arithmetic, the Sieve of Eratosthenes, The Goldbach Conjecture,Primes and factorization.

**UNIT II:**

Theory of Congruences, Modular arithmetic, Carl Friendrich Gauss, Basic Properties of Congruences, Binary and Decimal Representations of Integers, Linear Congruences and the Chinese remainder theorem.

### **UNIT III:**

Fermat's Theorem: Pierre de Fermat, Fermat's little Theorem and Pseudoprimes, Wilson's Theorem, The Fermat-Kraitchik Factorization Method, Quadratic law of reciprocity, application. Arithmetical functions. Mobius inversion formula.

### **UNIT IV:**

Euler's Generalization of Fermat's Theorem, Leonhard Euler, Euler Phi function, Euler's Theorem, Some Properties of the Phi-function, The Diophantine equations  $x^2 + y^2 = z^2$ ,  $x^4 + y^4 = z^4$ . Farey sequences.

### **UNIT V:**

Primitive roots and indices :Primitive roots of unity, the Order of an Integer Modulo  $n$ , Primitive Roots for Primes, Composite Numbers Having Primitive Roots, The Theory of Indices, Numbers of special forms (perfect numbers, mersenne primes and amicable numbers, Fermat numbers).

### ***Recommended Books:***

1. David M. Burton, Elementary Number Theory, Wm. C. Brown Publishers, Dubuque, Iowa 1989.
2. K. Ireland, and M. Rosen, A Classical Introduction to Modern Number Theory, GTM Vol. 84, Springer-Verlag, 1972.
3. G.A. Jones, and J.M. Jones, Elementary Number Theory, Springer-Verlag, 1998.
4. W. Sierpinski, Elementary Theory of Numbers, North-Holland, Ireland, 1988.
5. Niven, S.H. Zuckerman, and L.H. Montgomery, An Introduction to the Theory of Numbers, John Wiley, 1991.
6. H.B. Mann, Addition Theorems, Krieger, 1976.
7. Melvyn B. Nathanson, Additive Number Theory: Inverse Problems and the Geometry of Sumsets, Springer-Verlag, 1996.

## Semester –II

### **BMA004A: Algebra**

**Credits: 4**

#### **UNIT I:**

Matrix: Introduction, Elementary operations of matrices. Inverse of a matrix, Rank of a matrix, Symmetric, Skew symmetric, Hermitian, Skew-Hermitian and unitary matrices.

#### **UNIT II:**

Determinants: Definition and properties, application of matrices to the system of linear equations, Consistency of the system of linear equations.

#### **UNIT III:**

Algebra: Definition of a group with examples and simple properties, Subgroups, Generator of groups, Cyclic groups, Coset.

#### **UNIT IV:**

Lagrange's theorem and its consequences. Homomorphism and Isomorphism. Permutation groups and Cayley's theorem.

#### **UNIT V:**

Normal subgroups, Quotient group, Fundamental theorem of Homomorphism. Isomorphism theorems for groups. Rings.

#### ***Recommended Books:***

1. I. N. Herstein , Topics in Algebra, Wiley Eastern Ltd. New Delhi, 1975.
2. D.T. Finkbeiner, Introduction to Matrices and Linear transformations, CBS Publishers, New Delhi, 1986.
3. K.B. Datta, Matrix and Linear Algebra, PHI Pvt. Ltd. New Delhi, 2000.
4. P.B. Bhattacharya, S.K. Jain , S.R. Nagpal, First Course in Linear Algebra, Wiley Eastern Ltd. New Delhi, 1983.
5. S. Singh, Modern Algebra, Vikas Publ. House, India.
6. M. Artin: Algebra.
7. S. D. Dummit and M. R. Foote: Abstract Algebra.



## **BMA005A: Integral Calculus**

**Credits: 4**

### **UNIT I:**

Integration as the inverse process of differentiation, definite integrals and their properties, Fundamental theorem of integral calculus

### **UNIT II:**

Reduction Formulae:  $\sin^n x, \cos^n x, \tan^n x, \sin^m x \cos^n x$  where  $m, n$  are positive integers, Double integrals, Change of Variables Cartesian to Polar, change of order of integration.

### **UNIT III:**

Definition and properties of Gamma and Beta functions, Relation between Gamma and Beta functions

### **UNIT IV:**

Rectification: length of Cartesian and polar curves, Calculating surface areas and volumes using double integrals and applications.

### **UNIT V:**

Triple integrals, Calculating volumes using triple integrals and applications, Dirichlet's Integral.

### ***Recommended Books:***

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
5. Ray and Sharma, Vector algebra & Calculus, Students and Friends Co. Agra
6. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley and sons.
7. Muray R. Spiegel ,Vector Analysis, Schaum Publishing Company , New York.

8. Saran and Nigam , Introduction to Vector Analysis, Pothisala Pvt. Ltd, Allahabad
9. Shanti Narayan & P. K. Mittal, Integral Calculus – (S. Chand & Co. Ltd.)
10. H. S. Dhama, Integral Calculus – (New Age International)
11. B. C. Das & B. N. Mukherjee ,Integral Calculus – (U. N. Dhur)
12. BANSAL, J L; AGARWAL, S M; BHARGAV, S L., Integral Calculus II Jaipur JAIPUR PUBLISHING HOUSE 1991.

### **BMA006A: Mechanics**

**Credits: 4**

Unit 1: Velocity and acceleration along radial and transverse directions, along tangential and normal directions. S.H.M., Hooke's law, motion along horizontal and vertical elastic strings.

Unit 2: Motion in resisting medium—Resistance varies as velocity and square of velocity. Work and Energy. Motion on a smooth curve in a vertical plane. Motion on the inside and outside of a smooth vertical circle.

Unit 3: Central orbits-p-r equations, Apses, Time in an orbit, Kepler's laws of planetary motion.

Unit 4: Moment of inertia of rods, Circular rings, Circular disks, Solid and Hollow spheres, Rectangular lamina, Ellipse and Triangle. Theorem of parallel axis. Product of inertia.

Unit 5: Virtual work, Lagrange's Equation of holonomic system, Hamiltonian equation.

### ***Suggested Books***

1. S.L. Loney - An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies, Kalyani Publishers, New Delhi, 2004.
2. J.L. Synge & B.A. Griffith - Principles of Mechanics, Tata McGraw-Hill, 1959.
3. Ray, M., Dynamics of Rigid Bodies, Students Friends and Co. 1998.
4. Bansal, J.L., Dynamics of a Rigid Body, Jaipur Publishing Co., 2004.

## **Semester –III**

**BMA007A :Real Analysis**

**Credits: 4**

### **UNIT I:**

Metric spaces: Introduction. Neighborhood, limit points, interior points, open and closed set, closure and interior, boundary points.

### **UNIT II:**

Subspace of a metric space, Completeness. Cantor's intersection theorem. Dense subsets. Separable metric spaces. Continuous functions. Uniform continuity,

### **UNIT III:**

Riemann Integral, Integrability of continuous and monotonic functions, Fundamental theorems of integral calculus, Mean Value theorems of integral calculus. Improper integrals and their convergence.

### **UNIT IV:**

Comparison test, Abel's and Dirichlet's test, Integrals as a function of a parameter and its applications, Sequences, Theorems on limits of sequences, Monotone convergence theorem, Cauchy's convergence criterion.

### **UNIT V:**

Infinite series, Comparison test, Ratio test, Raabe's, logarithmic, De Morgan and Bertrand's tests. Alternating series, Leibnitz's test.

### ***Recommended Books:***

1. Shanti Narayan, A Course of Mathematical Analysis. S. Chand & Co. New Delhi, 2004.
2. T. M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.
3. R.R. Goldberg, Real Analysis, Oxford & IBH Publishing Co., New Delhi, 1970.
4. S. Lang, Undergraduate Analysis, Springer-Verlag, New York, 1983.
5. P.K. Jain and S.K. Kaushik, An Introduction to Real Analysis, S. Chand & Co., New Delhi, 2000.

**UNIT I:**

Ordinary differential equations of the first order of the form  $y'=f(x,y)$ : initial and boundary conditions, Bernoulli's equation, exact differential equations, integrating factor, Orthogonal trajectories, Homogeneous differential equations-separable solutions

**UNIT II:**

Linear differential equations of second and higher order with constant coefficients, First order higher degree equations solvable for  $x$ ,  $y$ ,  $p$ . Singular solution and envelopes.

**UNIT III:**

Second order linear differential equations with variable coefficients, homogeneous linear differential equations, method of variation of parameters. Cauchy- Euler equation.

**UNIT IV:**

Series solutions of differential equations. Bessel and Legendre functions.

Bessel and Legendre equations.

**UNIT V:**

Partial differential equations of first order, Lagrange's solution. Charpit's method.

**Recommended Books:**

1. Gorakh Prasad, Integral Calculus, Pothishala Private Ltd. Allahabad.
2. S. Balachandra Rao & H.R. Anuradha, Differential Equations with Applications and Programmes, University Press, Hyderabad, 1996.
3. R.S. Senger, Ordinary Differential Equations with Integration, Prayal Publ. 2000.
4. D.A. Murray, Introductory Course in Differential Equations, Orient Longman (India), 1967.
5. E.A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall of India, 1961.

6. B.Rai, D.P.Choudhary, Ordinary Differential Equations, Narosa Publ. 2004.
7. J.L. Bansal & H.S. Dhani : Differential Equations Vol. I & II, Jaipur House, Jaipur.
8. S. Balachandra Rao & H.R. Anuradha, Differential Equations with Applications and Programmes, University Press, Hyderabad, 1996.

### **BMA009A : Vector Calculus**

**Credits : 4**

#### **UNIT I:**

Operations with vectors. Scalar and vector product of three vectors. Product of four vectors. Reciprocal vectors.

#### **UNIT II:**

Scalar-valued functions over the plane and the space. Vector function of a scalar variable: Curves and Paths.: Scalar and vector fields.

#### **UNIT III:**

Vector differentiation. Directional derivatives, the tangent plane, total differential, gradient, divergence, curl and Laplacian operator.

#### **UNIT IV:**

Line integrals, surface and volume integrals. Line integrals of linear differential forms, integration of total differentials, conservative fields.

**UNIT V:** Green's, Stokes and Gauss theorems and their applications.

### **Recommended Books:**

1. Susan J. Colley, Vector Calculus (4th Edition) (Featured Titles for Vector Calculus) Pearson; 4 edition (October 8, 2011) (Oct 8, 2011).
2. Susan J. Colley, Vector Calculus (3rd Edition) Pearson; 3 edition (March 26, 2005) (Mar 26, 2005)
3. J N Sharma, Vector Calculus, Krishna Prakashan Media.
4. A. R. .Vasishta & J. N. Sharma, Vector Calculus, Krishna Prakashan Mandir, 1991.

5. Shanti Narayan, Textbook of Vector Calculus, S. Chand 2003.

### **Semester –IV**

#### **BMA010A:Numerical Analysis**

**Credits: 4**

##### **UNIT I:**

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

##### **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.

##### **UNIT III:**

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

##### **UNIT IV:**

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.

##### **UNIT V:**

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

#### ***Recommended Books:***

1. M.K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International, 1999.
2. C.F. Gerald, P.O. Wheatley, Applied Numerical Analysis, Addison-Wesley, 1998.
3. S. D. Conte, C de Boor, Elementary Numerical Analysis, McGraw-Hill, 1980.
4. C.E. Froberg, Introduction to Numerical Analysis, (Second Edition), Addison-Wesley,1979.
5. Melvin J. Maron, Numerical Analysis A Practical Approach, Macmillan

Publishing Co. Inc. New York, 1982.

6. Gupta and Malik, Calculus of Finite Differences and Numerical Analysis, , Krishna Prakashan Mandir
7. Gourdin, Boumahrat, Applied Numerical Methods, Prentice Hall of India
8. Melvin J. Maron, Numerical Analysis a Practical Approach, Machmillon Publishing Company, New York
9. H.C. Saxena, Finite Differences & Numerical Analysis, S.Chand & Co. New Delhi
10. Bansal J.L., Bhargava S.L., Numerical Analysis, Jaipur *Publishing* House, 2004.

### **BMA011A: Partial Differential Equations**

**Credits: 4**

#### **UNIT I:**

Formation of partial differential equations. Types of solutions. PDEs of the first order. Lagrange's solution, Non-linear PDE of first order: Charpit's method.

#### **UNIT II:**

Classification of linear partial differential equation of second order, Canonical forms, Cauchy's problem of first and second order partial differential equation.

#### **UNIT III:**

Linear homogeneous boundary value problem, Eigen values and eigen functions, Sturm-Liouville boundary value problems

#### **UNIT IV:**

Non-homogeneous boundary value problems, Non-homogeneous Sturm-Liouville boundary value problems (method of eigen function expansion).

#### **UNIT V:**

Solution of heat and wave equations in one and two dimensions by method of separation of variables. Second order PDE with variable coefficients. Monge's method.

### ***Recommended Books:***

1. Ian N. Sneddon, Elements of Partial Differential Equations, McGraw-Hill Book Company, 1988.
2. S.B. Rao and H.R. Anuradha, Differential Equations, University Press, 1996.
3. W.T.H. Piaggio, Elementary Treatise on Differential Equations and their applications, CBS Publishers N.Delhi,1985..
4. J.L. Bansal & H.S. Dhama : Differential Equations Vol. I & II, Jaipur Publishing House, Jaipur.
5. Phoolan Prasad , Renuka Ravindran, Partial Differential Equations (English) 1st Edition, New Age International Publishers Ltd., 1985.

### **BMA012A:Probability**

**Credits 4**

#### **UNIT I:**

Notion of probability: Random experiment, sample space, axiom of probability, elementary properties of probability, equally likely outcome problems.

#### **UNIT II:**

Random Variables: Concept, cumulative distribution function, discrete and continuous random variables, expectations, mean, variance, moment generating function. Discrete random variables: Bernoulli random variable, Binomial random variable, geometric random variable, Poisson random variable.

#### **UNIT III:**

Continuous random variables: Uniform random variable, exponential random variable, Gamma random variable, normal random variable. Conditional probability and conditional expectations, Baye's theorem.

#### **UNIT IV:**

Independence, computing expectation by conditioning; some applications - a list model, a random graph, Polya's urn model. Bivariate random variables: Joint distribution, joint and conditional distributions, correlation coefficient.

#### **UNIT V:**



Functions of random variables: Sum of random variables, the law of large numbers and central limit theorem, the approximation of distributions. Uncertainty, information and entropy, conditional entropy, solution of certain logical problems by calculating information.

***Recommended Books:***

1. S.M. Ross, Introduction to Probability Models (Sixth edition) Academic Press, 1997.
2. I. Blake, An Introduction to Applied Probability, John Wiley & Sons, 1979.
3. J. Pitman, Probability, Narosa, 1993.
4. A.M. Yagolam and I.M. Yagolam, Probability and Information, Hindustan Publishing Corporation, Delhi, 1983.
5. Jagat Narain Kapur, H.C. Saxena, Mathematical Statistics, S. Chand, 1960.

**Semester –V**

**BMA013A:Abstract Algebra**

**Credits: 4**

**UNIT I:**

Automorphism and inner automorphism, Automorphism groups and their computations.

**UNIT II:**

Normalizer and centre, Finite groups, Commutator subgroups.

**UNIT III:**

Rings, Integral Domains and Fields.

**UNIT IV:**

Ideal and quotient Rings. Ring Homomorphism and basic isomorphism theorems. Prime and maximal ideals.

## UNIT V:

Fields of quotients of an integral domain. Principal ideal domains. Polynomial Rings, Division algorithm. Euclidean Rings.

### *Recommended Books:*

1. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal, Basic Abstract Algebra (2nd Edition)Cambridge University Press, Indian Edition, 1977.
2. I. N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
3. Sharma, Gokhroo, sainsi, Elements of Abstract Algebra, Jaipur Publishing House, S.M.S. Highway, Jaipur.
4. N. P. Chaudhuri, Abstract Algebra –(Tata Mc.Graw Hill).
5. A. R. Vasishtha, A. K. Vasishtha, Modern Algebra (Abstract Algebra), Krishna Prakashan Media (p) Ltd. 2011.

## **BMA014A:Three Dimensional Geometry**

**Credits: 4**

### UNIT I:

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

### UNIT II:

**Straight lines:** Introduction, Equations of coordinate axes, Symmetrical form & Non 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.

### UNIT III:

**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.

#### **UNIT IV:**

**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.

#### **UNIT V:**

**Cylinder:** Definition, Equation of a cylinder, Enveloping cylinder, Equation of enveloping cylinder, Right circular cylinder, Equation of right circular cylinder.

**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.

#### ***Recommended Books:***

1. N.Saran and R.S.Gupta , Analytical Geometry of Three Dimensions , PothisalaPvt.Ltd , Allahabad, 2001.
2. Gorakh Prasad and H.C.Gupta ,Text book on Coordinate Geometry , Pothisala Pvt. Ltd., Allahabad, 2004.
3. Sharma & Jain, Co-ordinate Geometry, Galgotia Publication, Dariyaganj , New Delhi, 1998.
4. P.K.Jain and Khalil Ahmad , A text book of Analytical Geometry of Three Dimensions , Wiley Eastern Ltd, 2008.
5. S.L.Loney, The Elements of Coordinate Geometry , Macmillan and Co., London, 2001.
6. R.J.T.Bell, Elementary Treatise on Coordinate Geometry of Three Dimensions, Macmillan India Ltd, 1998.

7. Bansal J.L., Bhargva S.L., Agarwal S.M., 3-D Coordinate Geometry II, Jaipur Publishing House 2004.

**BMA015A:Linear programming Problem and Operation Research Credits: 4**

**UNIT I:**

Linear Programming problem, formulation, concave and convex sets, Graphical method.

**UNIT II:**

Simplex and Revised Simplex algorithm.

**UNIT III:**

Duality theory, Dual simplex method .

**UNIT IV:**

Transportation, Assignment and Traveling Salesman problems.

**UNIT V:**

Portfolio Theory, Principle of Optimality and its applications.

***Recommended Books:***

1. G. Hadley, Linear Programming, Narosa Publishing House, 1995.
2. S.I. Gass, Linear Programming: Methods and Applications (4th edition) McGraw-Hill, New York, 1975.
3. Kanti Swaroop, P.K. Gupta and Man Mohan, Operations Research, Sultan Chand & Sons, New Delhi, 1998.
4. Hamdy A. Taha, Operations Research, Prentice-Hall of India, 1997.
5. Sharma S. D., Operations Research : Theory, Methods & Applications, KEDAR NATH RAM NATH-MEERUT, 2011.

**Semester –VI**

**BMA016A:Complex Analysis**

**Credits: 4**

**UNIT I:**

**Complex Numbers:**Stereographic projection.Functions of a complex variable, mappings, limits,theorems of limits without proof, continuity, derivatives,

differentiation formula, Cauchy-Riemann equations, sufficient conditions, Cauchy-Riemann equations in Polar form, analytic functions, and harmonic functions.

#### **UNIT II:**

Linear functions, the function  $1/Z$ , linear fractional transformations, the functions  $w = z^n$ ,  $w = \exp(Z)$ , special linear fractional transformations.

#### **UNIT III:**

Definite integrals, contours, line integrals, Cauchy-Goursat theorem (without proof), Cauchy integral formula, derivatives of analytic functions, maximum moduli of functions.

#### **UNIT IV:**

Convergence of sequences and series (theorems without proofs), Taylor's series, Laurent's series, zero's of analytic functions.

#### **UNIT V:**

Residues, the residue theorem, the principle part of a function, poles, evaluation of improper real integrals, improper integrals. integrals involving trigonometric functions, definite integrals of trigonometric functions.

#### ***Recommended Books:***

1. Shanti Narayan, Theory of Functions of a Complex Variable, S. Chand & Co. New Delhi.
2. R.V. Churchill & J.W. Brown, Complex Variables and Applications, 5th Edition, McGraw-Hill, New York, 1990.
3. Mark J., Ablowitz & A.S. Fokas, Complex Variables: Introduction and Applications, Cambridge University Press. South Asian Edition, 1998.
4. Murray R. Spiegel, Theory and Problems of Complex Variables-, Schaum outline series, 2004.

### **BMA017A: Linear Algebra**

**Credits: 4**

#### **UNIT I:**

Vector spaces, subspaces and linear spans, linear dependence and independence.

## **UNIT II:**

Finitedimensional vector spaces. Linear transformations and their matrix representations.

## **UNIT IV:**

Algebra of linear transformations, the rank and nullity theorem. Change of basis.

## **UNIT IV:**

Dual spaces, bi dualspace and natural isomorphism. Eigen values and eigen vectors of LT. Diagonalization, Cayley-Hamilton theorem.

## **UNIT V:**

Inner product spaces, Cauchy-Schwarz inequality, orthogonal vectors. Orthonormal basis, Bessel's inequality, Gram-Schmidt orthogonalization process.

### ***Recommended Books:***

1. K. Hoffman and R. Kunze, Linear Algebra, 2nd edition, Prentice-Hall of India, New Delhi, 1971.
2. K.B. Dutta, Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd, New Delhi, 2000.
3. David C. Lay, Linear Algebra and Its Applications, 4th Edition (Jan 20, 2011).
4. Georgi E. Shilov, Linear Algebra (Dover Books on Mathematics) (Jun 1, 1977).
5. Rajul Dutt, A. R. Vasishtha, J.N. Sharma, A. K. Vasishtha, Linear Algebra, Krishna Prakashan Media (p) Ltd., 2011.

## **BMA018A: Differential Geometry and Tensor Analysis**

**Credits : 4**

### **UNIT I:**

Curves in Space: Definition of unit tangent vector, tangent line, Normal line and Normal plane. Contact of a curve and a surface. Equation of osculating plane. Fundamental unit vectors, equations of fundamental planes. Curvature, Torsion and skew curvature vectors. Serret-Frenet formulae and their applications.

### **UNIT II:**

Definition and properties of the osculating circle and osculating spheres. Bertrand curves and their properties. Involute and evolute of space curves. Envelope of family

of surfaces. Ruled surfaces: Definition and properties of developable and skew surfaces.

### **UNIT III:**

Parametric representation of a surface. First and Second fundamental forms and magnitudes of various surfaces. Orthogonal trajectories. Definition and Differential equation of lines of curvature (Excluding theorems). Definition and equation of curvature and torsion of asymptotic lines. Beltrami- Enneper Theorem.

### **UNIT IV:**

Notations and definitions of contravariant and covariant tensors of first and second order. Mixed tensors, higher order tensors. Contraction and Quotient law for tensors. Symmetric and skew symmetric tensors. Metric [Fundamental] tensor, conjugate metric tensors. Definitions and properties of first and second kind of Christoffel's symbols.

### **UNIT V:**

Laws of transformation of Christoffel's symbols. Covariant derivatives of contravariant and covariant tensors of first and second orders. Laws of covariant differentiation. Ricci's Theorem. Definition and properties of Riemann-Christoffel's tensor. Definition and properties of covariant curvature tensor. Contraction of Riemann-Christoffel Tensor.

### ***Recommended Books:***

1. Bansal, J.L. and Sharma, P.R.: Differential Geometry: Jaipur Publishing House (2004).
2. Thorpe, J.A.: Introduction to Differential Geometry, Springer-Verlag.
3. Slemberg, S.: Lectures on Differential Geometry, P.H.I. 1964.
4. Docarmo, M.: Differential Geometry of Curves and surfaces, P.H.I. 1976.
5. Bansal, J.L.: Tensor Analysis, Jaipur Publishing House, 2004.
6. Gupta, P.P. and Malik, G.S.: Three Dimensional Differential Geometry, Pragati Prakashan, Meerut.
7. Barry Spain, Tensor Calculus, Radha Publ. House Calcutta, 1988.

8. R.S. Mishra, A Course in Tensors with Applications to Riemannian Geometry. Pothishala Pvt. Ltd, Allahabad.
9. R.J.T. Bell, Elementary Treatise on Co-ordinate geometry of three dimensions, Macmillan India Ltd., 1994.