

**RASHTRASANT TUKDOJI MAHARAJ NAGPUR UNIVERSITY,
NAGPUR**

BOARD OF STUDIES IN MATHEMATICS

B. Sc. Three Years (SIX SEMESTER) DEGREE COURSE

B.Sc. Part I (Semester I & II)

B. Sc. Part II and Final (Semester III, IV, V & VI)

B. Sc. Part I (Semester I)

M-1 Algebra and Trigonometry

Unit I

Rank of matrix , Normal form , Some theorems on rank(without proof) , Linear equation, Solution of non- homogeneous linear equations , Homogeneous linear equations.

Eigen values, Eigen vectors , Characteristic value problem , Cayley-Hamilton theorem (without proof) and it's use in finding Inverse of a matrix.

Unit II

Relation between the roots and coefficients of general polynomial equation in one variable , Transformation of equations , Reciprocal equations , Descartes rules of signs , Solution of cubic equations (Cardon method) , Biquadratic equations (Ferrari's method).

Unit III

De Moivre's theorem & its applications , Inverse circular and hyperbolic functions , Logarithm of a complex quantity , Expansion of trigonometrical functions , Gregory's series.

Unit IV

Definition of a group with examples and properties , Subgroups , Cosets , Lagrange's theorem , Permutation groups , Even and odd permutations.

Text Books:

Mathematics For Degree Students (B.Sc. First Year)

Dr. P. K. Mittal , S. Chand and Co. Ltd, New Delhi , 2010.

For Unit –I: Scope: Chapters 6, 7, 8 of Algebra with articles 6.2, 6.3, 6.3.1 (without proofs), Examples, Exercise, 7.1, 7.3, 7.4 (without proofs), 7.5, Examples, Exercise, 8.1, Examples, Exercise, 8.3(without proof), 8.3.1, Examples, Exercise.

For Unit-II: Scope: Chapter 9 of Algebra with articles 9.1, 9.2(without proofs) 9.3, 9.4, Example, Exercise, 9.5, Examples, Exercise, 9.6, Example, Exercise, 9.7,9.8, 9.8.1, Example, Exercise, 9.11, 9.12, Examples, Exercise, 9.13.1, Example, Exercise.

For Unit-III: Scope: Chapters 1,2,3,4,5 of Trigonometry with articles 1.1, 1.2, 2.1, 2.2, 2.3, 2.4, 2.5, 2.9, 3.1, 3.2, 3.3, 3.4, 4.1, 4.1.1, 4.12, 5.1, 5.2, 5.3

For Unit-IV: Scope: Chapters 10, 11 of Algebra with articles 10.1, 10.1.1, 10.3, 10.3.1, 10.4 (theorems 1-6) 10.7, 10.10, 10.10.1, 10.10.2, 10.12, 10.13, 11.1, 11.2, 11.3, 11.4, 11.5, 11.6.

Reference Books:

1. I. N. Herstein: Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975
2. K. B. Datta: Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd., New Delhi-2000.
3. P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul: First course in linear algebra, Willey western New Delhi, 1983.
4. P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul: Basic Abstract Algebra (2nd edition) Cambridge University Press, Indian Edition, 1997.
5. S. K. Jain, A. Gunawardena and P. B. Bhattacharya: Basic Linear Algebra with Matlab, Key College Publishing (Springer-Verlag), 2001.
6. H. S. Hall and S. R. Knight: Higher Algebra, S.Chand & Co. Ltd.,New Delhi,2008.

7. R. S. Verma & K. S. Shukla: Text Book on Trigonometry, Pothishala Pvt. Ltd. Allahbad.
8. Ayres Jr. Frank: Matrices, Schaum's Outline Series, Mcgraw Hill Book Company, Singapre, 1983.
9. Hohn Franz E: Elementary Matrix Algebra, Amerind Publishing Co. Ltd., 1964.
10. McCoyNeal H: Introduction to Modern Algebra, Allyn & Bacon inc., 1965.
11. Spiegel M. R.: Complex Variables, Scaum's Outline Series, McGraw- Hill, 1981.
12. Shanti Narayan: A Text Book of Matrices, S. Chand & Co. Ltd., New Delhi.
13. S.L.Loney:Plane Trigonometry(Part II),S. Chand & Co. Ltd.,New Delhi,
14. Chandrika Prasad:Text Book on Algebra and Theory of Equations, Pothishala Private Ltd., Allahabad.

B. Sc. Part I (Semester I)

M-2 Calculus

Unit I

Definition of the limit of the function of one variable and basic properties of limit , Continuous function of one variable and classification of discontinuities (only definitions with examples) , Differentiation , Successive differentiation , Leibnitz's theorem.

Unit II

Maclaurin and Taylor series expansions , Curvature , Asymptotes , Indeterminate forms and L'Hospital's rule.

Unit III

Partial differentiation ,Differential and Chain rules (Definitions and Theorems without Proof) , Euler's theorem on homogeneous functions and its applications , Jacobians

Unit IV

Integrations of irrational algebraic functions, Reduction formulae , Definite integrals (Examples on properties of definite integral).

Text Books:

1. Differential Calculus

Shanti Narayan & P. K. Mittal , S.Chand and Co. Ltd, 2005.

Scope : Chapters 3, 4 (articles 4.1 to 4.1.4) , 5,6,10,11,12,14 (articles 14.1 to 14.3.2), 15(articles 15.1 to 15.3.2).

2. Integral Calculus

Gorakh Prasad, Pothishala Private Ltd. 1999,

Scope : Chapters 3,4,5 (Art 3.1,3.2,3.3,3.4,3.5,3.7,4.11,4.13,4.15,4.2,4.21,5.1,5.2 (without proof), 5.3).

Reference Books:

1. Gabriel Klamballel: Mathematical Analysis, Marcel Dekkar Inc., New York, 1975
2. N. Piskunov: Differential and Integral Calculus, Peace Publishers, Moscow.
3. P. K. Jain and S. K. Kaushik: An Introduction to Real Analysis, S. Chand and Co.Ltd., New Delhi, 2002.
4. Gorakh Prasad: Differential Calculus, Pothishala Private Ltd., Allahbad.
5. Ayres F. Jr.: Calculus, Schaum's Outline Series, McGraw- Hill, 1981
6. Edward J.: Differential Calculus for Beginners, MacMillan and Co. Ltd., 1963
7. Edward J.: Integral Calculus for Beginners, AITBS Publishers and Distributors, 1994
8. Greenspan D: Introduction to Calculus, Harper and Row, 1968
9. Erwin, Kreyszig: Advanced Engineering Mathematics, John Wiley and Sons, 1999.
10. Dr. P. K. Mittal: Mathematics for Degree Students (B. Sc. First Year), S. Chand and Co. Ltd., New Delhi, 2010.
11. Murray R. Spiegel: Theory and Problems of Advanced Calculus, Schaum's Outline Series, Schaum Publishing Co; New York.

B. Sc. Part I (Semester II)

M-3 Geometry, Differential and Difference Equations

Unit I

Sphere ,Plane section of sphere ,Intersection of two spheres ,Sphere through a given circle ,Tangent line ,Tangent plane , Right circular cone , Right circular cylinder.

Unit II

First order exact differential equation, Integrating factor, First order linear differential equation and Bernoulli's differential equation, First order higher degree equations (solvable for x , y , p) , Clairaut's form.

Unit III

Higher order linear differential equation with constant coefficients , Operator method to find particular integral , Euler's equidimensional equation , To find unknown solution by using known solution , Method of variation of parameters

Unit IV

Difference equation , Formation of difference equation , Order of difference equation, Linear difference equation , Homogeneous linear equation with constant coefficients, Non-homogeneous linear equation ,Particular integrals.

Text Books:

1. Analytical Solid Geometry

Shanti Narayan, S.Chand & Co. Ltd, New Delhi, 1997.

Scope: Chapters 6,7 (Art 6.11, 6.12, 6.13, 6.2, 6.31, 6.32, 6.33, 6.4, 6.41, 6.5, 6.6, 6.7, 6.71, 7.61, 7.62, 7.81, 7.82).

2. Ordinary and Partial Differential Equations (Theory and Applications)

Nita H. Shah, PHI, 2010,

Scope: Chapters 2, 3,4,5,7

3. **Calculus of Finite Differences and Numerical Analysis,**
H.C. Saxena, S. Chand and Co. Ltd, New Delhi, 1976,
Scope: Chapter 8

Reference Books:

1. D. A. Murray: Introducing Course on Differential Equations, Orient Longman (India), 1967
2. E.A. Coddington: An Introduction to Ordinary Differential Equations and their Applications, CBS Publisher and Distribution, New Delhi, 1985
3. H. T. H. Piaggio: Elementary Treatise on Differential Equations and Their Applications, CBS Publisher and Distribution, New Delhi, 1985
4. W. E. Boyce and P. C. Dippima: Elementary Treatise on Differential Equations and Boundry Value Problems, John Willey, 1986
5. Erwin Kreyszig: Advanced Engineering Mathematics, John Wiley and sons, 1999
6. Gorakh Prasad and H. C. Gupta: Text Book on Coordinate Geometry, Pothishala Pvt. Ltd., Allahbad.
7. R.J.T. Bell: Elementary Treatise on Coordinate Geometry of Three Dimensions, Wiley Eastern Ltd.,1994
8. P. K. Jain and Khalil Ahmad: A Text Book of Analytical Geometry of Three Dimensions, Wiley Eastern Ltd.,1994
9. N. Saran and R. S. Gupta: Analytical Geometry of Three Dimensions, Pothishala Pvt. Ltd., Allahbad.
10. Dr. P. K. Mittal: Mathematics for Degree Students (B. Sc. First Year), S. Chand and Co. Ltd., New Delhi,2010.
11. G. F. Simmions: Differential Equations with Historical Notes (Second Edition) McGraw- Hill International Edition, 1991.
12. S. L .Loney: The Elements of Coordinate Geometry, MacMilan & Co., London.

B. Sc. Part I (Semester II)

M-4 Vector Calculus and Improper Integrals

Unit I

Vector differentiation, Gradient, Divergence and Curl, Solenoidal and Irrotational vector fields, Line integral , Workdone

Unit II

Double integration and its evaluation, Area by double integration, Change of order of integration, Transformation of double integral in polar form, Evaluation of triple Integral.

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Unit III

Surface integral, Volume integral, Green's theorem in a plane, Stoke's theorem (statement only), Gauss divergence theorem (statement only)

Unit IV

Improper integrals and their convergence, Comparison tests, Beta and Gamma functions.

Text Books

1. **Vector Analysis (Second Edition)**

Murray R Spiegel, Schaum's outlines, 2009

Scope: Chapters 3,4,5,6.

2. **Theory and Problems of Advanced Calculus**

Murray R Spiegel, Schaum Publishing Company, New York, 1974.

Scope: Chapters 12,13.

3. Integral Calculus

Gorakh Prasad, Pothishala Pvt. Ltd; Allahabad, 1999,
Scope: Chapter 10.

Reference Books:

1. N. Saran and S. N. Nigam: Introduction to Vector Analysis, Pothishala Pvt. Ltd., Allahbad.
2. Erwin Kreyszig: Advanced Engineering Mathematics, John Wiley and Sons, 1999
3. N. Piskunov: Differential and Integral Calculus, Peace Publishers, Moscow.
4. Shanti Narayan: A course of Mathematical analysis, S. Chand & Co. Ltd., New Delhi
5. D. Somasundaram and B. Choudhary: A First Course in Mathematical Analysis, Narosa Publishing House, New Delhi, 1977.
6. Dr. P. K. Mittal: Mathematics for Degree Students (B. Sc. First Year), S. Chand and Co. Ltd., New Delhi, 2010.

B. Sc. Part II (Semester III)

M-5 Advanced Calculus , Sequence and Series

Unit I

Mean value theorems, Limit and Continuity of function of two variables, Taylor's theorem for function of two variables.

Unit II

Envelopes, Maxima, Minima and Saddle Points of functions of two variables, Langrange's Multiplier Method.

Unit III

Sequences and theorems on limit of sequence, Bounded and Monotonic sequences , Cauchy's sequence, Cauchy's Convergence Criterion.

Unit IV

Series of non-negative terms ,Comparision test ,Cauchy's integral test ,Ratio test , Root test , Alternating series ,Absolute and Conditional convergence.

Text Books:

1. Mathematics for Degree Students (B. Sc. Second Year)

Dr. P. K. Mittal , S. Chand & Co. Ltd, New Delhi, 2011.

Scope: Chapters 3,6,8,9,14,15,16 of Advanced Calculus.

2. Differential Calculus

Shanti Narayan & P. K. Mittal , S.Chand & Co Ltd,New Delhi, 2012.

Scope: Chapter 8.

Reference Books:

1. Earl D. Rainville: Infinite Series, Inc MacMillan Co., New York.
2. Gabriel Klambauer: Mathematical Analysis, Marcel Dekkar, Inc., New York,1975
3. I.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi,1985.
4. R.R. Goldberg: Real Analysis, Oxford & I.B.M Publishing Co., New Delhi,1970.
5. D.Somasundarran And B. Choudhary: A First Course in Mathematical Analysis, Narosa Publishing House, New Delhi,1977.
6. P.K. Jain & Kaushik: An Introduction to Real Analysis, S. Chand & Co.Ltd., New Delhi,2000.
7. Murray R. Spiegel: Theory and Problems of Advanced Calculus, Schaum Publishing Co., New York,1974.

B. Sc. Part II (Semester III)

M-6 Differential Equations & Group Homomorphism

Unit I

Bessel's and Legendre's equations, Bessel's and Legendre's functions with their properties, Recurrence relations and generating functions, Orthogonality of functions.

Unit II

Laplace transform of some elementary functions, Linearity of Laplace transform, Laplace transforms of derivatives and integrals, Shifting theorem, Differentiation and integral of transform, Convolution theorem.

Unit III

Solutions of Ordinary differential equations with constant and variable coefficients, Solutions of simultaneous ordinary and partial differential equations, Fourier transform, Sine and Cosine transforms.

Unit IV

Normal subgroup, Quotient Group, Cyclic Group, Group Homomorphism and Isomorphism, The fundamental theorem of homomorphism.

Text Books:

1. Ordinary and Partial Differential Equations (Theory and Applications)

Nita H Shah, PHI, New Delhi, 2010.

Scope: Chapter 14 (Articles 14.2, 14.5, 14.6, 14.7, 14.8), Chapter 15(articles 15.2, 15.4, 15.7, 15.9, 15.10, 15.11) and Chapters 16, 18.

2. Mathematics for Degree Students (B. Sc. First Year)

Dr. P. K. Mittal S. Chand & Co. Ltd., New Delhi,2010.

Scope: Chapters 10, 12, 13 of Algebra (Articles 10.9, 12.1, 12.2, 12.3, 12.4, 12.7, 13.1, 13.3)

Reference Books:

1. Erwin kreyzig: Advanced Engineering Mathematics , John Willey and Son's , Inc. New York,1999.
2. A.R. Forsyth: A Treatise on Differential Equations, McGraw-Hill Book Company,1972.
3. B. Courant and D. Hilbert: Methods of Mathematical Physics(Vol I and II),Willey-interscience,1953.
4. I.N. Sneddon: Fourier Transforms, Mc Graw -Hill Book Co.
5. P.B. Bhattachaya, S.K. Jain and S.R. Nagpaul: First Course in Linear Algebra ,Willey Eastern, New Delhi,1983.
6. P.B. Bhattachaya, S.K. Jain and S.R. Nagpaul: Basic Abstract Algebra,(2nd Edition) Cambridge University Press India Edition.
7. H.S. Hall and S.R. Knight: Higher Algebra,S.Chand & Co. Ltd., New Delhi, 2008.
8. Goel & Gupta: Integral Transforms, Pragati Prakashan, Meerut , 2001.
9. I. N. Herstein: Topic in Algebra, Willey Eastern Ltd., New Delhi, 1975

B. Sc. Part II (Semester IV)

M-7 Partial Differential Equations & Calculus of Variation

Unit I

Simultaneous differential equations of the first order and the first degree in three variables, Methods of solution of $dx/P = dy/Q = dz/R$, Pfaffian differential equation, Solution of Pfaffian differential equation in three variables, Partial differential equations and origins of first order partial differential equation, Formation of partial differential equations by eliminating arbitrary function and arbitrary constants.

Unit II

Lagrange's equation, Integral surface passing through given curve, Compatible system of first order equation, Charpit's method, Jacobi's method.

Unit III

Partial differential equation of second and higher order, Linear partial differential equation of second order with constant coefficients, Homogeneous and Non-homogeneous linear partial differential equations with constant coefficients, Partial differential equations reducible to equations with constant coefficients.

Unit IV

Functional, Continuity of functional, Linear functional, Extremum of a functional, Euler's differential equation and applications, Invariance of Euler's equations.

Text Books:

1. Elements of Partial Differential Equations:

IAN N. Sneddon, McGraw- Hill Book Company, 1986

Scope: Chapter 1 (articles 2,3,5,6) and Chapter 2 (articles 1, 2, 4,5,9,10,13).

2. Mathematics for Degree Students (B.Sc. Second year)

Dr. P. K .Mittal , S.Chand and Co. Ltd, New Delhi, 2011.

Scope : Chapters 10, 11, 13 of Differential Equations.

Reference Books:

1. Erwin Kreyszig: Advanced Engineering Mathematics, John Willey and Son's, Inc., 1999.
2. D.A.Murray: Introductory Course on Differential Equations, Orient Longman(India), 1967.
3. A.R.Forsyth: A Treatise on Differential Equations, Macmillan and Co. Ltd, London.
4. Francis B.Hilderbrand: Advance Calculus for Applications , Prentice Hall of India Pvt.ltd , New Delhi , 1977.
5. Jane Cronin: Differential Equations, Marcel Dekkar, Inc.New Yark, 1994.
6. Richard Bronson: Theory and Problems of Differential Equations, McGraw Hill, Inc., 1973.
7. B. Courant and D. Hilbert : Methods of Mathematical Physics,(Volumes I & II), Willey Interscience, 1953.
8. I.M. Gelfand and S.V. Fomin: Calculus of Variables , Prentice Hill, Englewood Cliffs (New Jersey), 1963.
9. A.M. Arthurs: Complementary Variational Principles, Clarendon Press, Oxford, 1970.
10. V.Komkav: Variational Principles of Continuum Mechanics with Engineering Applications, (Volume I), Reidel Pup. Dordrecht, Holland, 1985.
11. J.I. Oden and J.N Reddy: Variational Methods in Theoretical Mechanics, Springer-Veriag, 1976.

12. G. F. Simmons: Differential Equations with Applications & Historical Notes (Second Editions) McGraw-Hill, 1991.
13. Frank Ayres: Theory and Problems of Differential Equations, McGraw-Hill Book Co., 1998.
14. A. S. Gupta: Calculus of Variations with Applications, Prentice Hall of India Pvt. Ltd., New Delhi, 1997.

B. Sc. Part II (Semester IV)

M-8 Mechanics

Unit I

Analytical condition of equilibrium of coplanar forces, Virtual work, Catenary.

Unit II

Velocities and Accelerations along radial and transverse directions, and along tangential and normal directions, Simple harmonic motion.

Unit III

Mechanics of a particle and a system of particles , Constraints, D'Alembert's Principle and Lagrange's equations , Velocity-dependant potential and the Dissipation function , Applications of Lagrangian.

Unit IV

Reduction to the equivalent one-body problem , Equations of motion and First integrals , Virial theorem, Central orbits.

Text Books:

1. Mathematics for Degree Students (B.sc Second Year)

Dr. P. K. Mittal , S. Chand & Co Ltd , New Delhi , 2011.

Scope: Chapters 1,2,3 of Statics and Chapters 1,2,3 of Dynamics.

2. Classical Mechanics (Second Edition)

Herbert Goldstein , Narosa Publishing House , New Delhi , 1998.

Scope : Chapter 1 and Chapter 3 (articles 3.1,3.2,3.4,3.5)

Refernce Books:

1. R. S. Verma: A Text Book on Statics, Pothishala Pvt. Ltd. Allahbad.

2. S.L. Loney: Statics , Macmillan and Company, London.

3. S.L. Loney: *An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies*, Cambridge University Press, 1956.

B. Sc. Final (Semester V)

M-9 Analysis

Unit I

Fourier series, Even & Odd functions, Dirichlet's condition, Half Range Fourier Sine and Cosine series.

Unit II

The Riemann-Stieltjes integral, Existence and Properties of the integral, The Fundamental theorem of calculus.

Unit III

Differentiability of complex function, Analytic function, Cauchy- Reimann equations, Harmonic functions, Constructions of analytic functions.

Unit IV

Elementary function, Mapping of elementary function, Mobius transformation, Cross ratio, Fixed points, Inverse points and Critical points of mappings, Conformal mapping.

Text Books:

1. Differential Equations with Applications and Historical Notes (Second Edition)

G. F. Simmons, McGraw-Hill International Editions, 1991.

Scope: Chapter 6 (articles 33,34,35,36)

2. Principles of Mathematical Analysis (Third Edition)

Walter Rudin, McGraw-Hill International Edition, 1976.

Scope: Chapter 6 (articles 6.1-6.13 and 6.20-6.22.)

3. Functions of a Complex Variable

Goyal & Gupta, Pragati Prakashan, 2010.

Scope: Chapters 3 and 5.

Reference Books:

1. I. M. Apostol: Mathematical Analysis, Narosa Publishing house, New Delhi, 1985
2. R. R. Goldberg: Real Analysis, Oxford & IBH Publishing Co., New Delhi, 1970
3. S. Lang: Undergraduate Analysis, Springer-Verlag, New York, 1983
4. D. Somasundaram and B. Chaudhary: A First Course in Mathematical Analysis , S. Chand Co. New Delhi, 2000
5. P. K. Jain and S. K. Kaushik: An Introduction to Real Analysis, S. Chand & Co., New Delhi. 2000.
6. R. V. Churchill and J. W. Brown: Complex Variables and Applications (5th Edition), McGraw Hill, New York, 1990
7. Monk J. Ablowitz and A. S. Fokas: Complex Variables (Introduction and Applications), Cambridge University Press, South Asian Edition, 1998.
8. Shanti Narayan: A Course of Mathematical Analysis, S. Chand & Co. Ltd., New Delhi.
9. Shanti Narayan: Theory of Complex Variables, S. Chand & Co. Ltd., New Delhi.

B. Sc. Final (Semester V)

M-10 Metric Space, Complex integration & Algebra

Unit I

Countable and uncountable sets, Definition and examples of metric space, Neighbourhood, Limit points, Interior points, Open and closed sets, closure and interior.

Unit II

Completeness, Compactness, Connectedness

Unit III

Ring, Integral domain, Ideals, Fields, Quotient ring, Ring-Homomorphism.

Unit IV

Complex integration: Cauchy's integral theorem and formula, Singularity, Residue theorem, Evaluation of integrals.

Text Books:

1. **Principles of Mathematical Analysis (Third Edition)**

Walter Rudin, McGraw Hill International Editions, 1976.

Scope: Chapter 2

2. **Functions of a Complex Variable**

Goyal & Gupta, Pragati Prakashan, 2010.

Scope: Chapters 7, 8, 9.

3. **Topics in Algebra (Second Edition)**

I.N.Herstein , Wiley Eastern Ltd. , New Delhi , 1975.

Scope: Chapter 3 (articles 3.1-3.4).

Reference Books:

1. R. V. Churchill and J. W. Brown: Complex Variables and Applications (5th Edition), McGraw Hill, New York, 1990
2. Mark J. Ablowitz and A. S. Fokas: Complex Variables (Introduction and Applications), Cambridge University Press, South Asian Edition, 1998
3. G. F. Simmons: Introduction to Topology and Modern Analysis, McGraw Hill Book Company,
4. E. C. Titchmarsh: Theory of Functions.
5. N. Jacobian: Basic Algebra (Volume I & II), W. H. Freeman, 1980 (Also Published by Hindustan Company)
6. K. B. Datta: Matrix and Linear Algebra, Prentice Hall of India Pvt., New Delhi, 2000.
7. K. Hoffman and R. Kunze: Linear Algebra (2nd Edition), Prentice-Hill Englewood Cliffs (New Jersey) 1971.
8. Shanti Narayan: Theory of Complex Variables, S. Chand & Co. Ltd., New Delhi.
9. P. K. Jain and K. Ahmad: Metric Spaces, Narosa Publishing House, New Delhi, 1968.

B. Sc. Final (Semester VI)

M-11 Abstract Algebra

Unit I

Group Automorphisms, Inner Automorphisms, Cayley's theorem, Conjugacy relation, Normalizer.

Unit II

Definition and examples of Vector Spaces, Subspaces, Sum and direct sum of subspaces, Linear span, Linear Dependence and independence, Basis, Dimensions.

Unit III

Algebra of linear transformation, Range, Rank, Kernel, Nullity of a linear map, Inverse of linear transformation, Composition of linear maps.

Unit IV

Matrix associated with a linear map, Linear map associated with a matrix, Rank and nullity of a matrix, Inner product space, Gram-Schmidt orthogonalisation process, Orthogonal and unitary matrices.

Text Books:

1. Topics in Algebra

I. N. Herstein, Wiley Eastern Ltd., New Delhi, 1975.

Scope: Chapter 2 (Art. 2.8, 2.9, 2.11)

2. An Introduction to Linear Algebra

V. Krishnamurthy, V. P. Mainra and J. L. Arora

Affiliated East-West Pres Pvt. Ltd., 1976.

Scope: Chapters 3, 4, 5, 7

Reference Books:

1. I. S. Luther and I. B.S. Passi: Algebra [Volume-I Groups, Volume II-Rings], Narosa Publishing House, New Delhi , (Vol. I-1996 , Vol. II-1999).
2. Vivek Sahani and Vikas Bist: Algebra, Narosa Publishing House, New Delhi, 1997
3. S. Kumaresan: Linear Algebra (A Geometrical Approach), Prentice Hall of India, 2000
4. S. K. Jain, A. Gunawardena and P. B. Bhattacharya: Basic Linear Algebra with MATLAB, Key College Publishing (Springer-Verlag) 2001.
5. K. Hoffman and R. Kunze: Linear Algebra (2nd Edition), Prentice-Hall, Englewood Cliffs (New Jersey), 1971.
6. K. B. Datta: Matrix and Linear Algebra, Prentice Hall of India Pvt., New Delhi, 2000
7. Shanti Narayan: A Text Book of Modern Abstract Algebra, S. Chand & Co.Ltd., New Delhi.
8. N. Jacobson: Basic Algebra (Volumes I & II), W. H. Freeman, 1980 (Also Published by Hindustan Publishing Company).
9. D. S. Malik, J. N. Mordeson and M. K. Sen: Fundamentals of Abstract Algebra, McGraw- Hill International Edition,1997.
- 10.P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul: Basic Abstract Algebra (2nd Edition), Cambridge University Press, India Edition, 1997.

B. Sc. Final (Semester VI)

M-12 Discrete Mathematics and Elementary Number Theory (Optional Paper)

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Unit I

Binary Relations, Equivalence Relation, Partitions, Partial Order Relation, Lattices, Duality, Distributive and Complemented Lattices, Boolean Algebra, Graph, Multigraph, Weighted Graphs, Isomorphisms of Graphs, Node

Unit II

Divisibility, Division Algorithm, G.C.D., Euclidean Algorithm L.C.M., Primes, Properties of Congruences, Theorems of Fermat, Euler & Wilson, Congruence of degree 1, Chinese Remainder Theorem, The Function $\phi(n)$.

Unit III

Quadratic Residues and Reciprocity, The Jacobi's symbol, Greatest integer function, Arithmetic functions, Moebius inversion formula.

Unit IV

The Diophantine equations, $ax + by = c$, Positive solutions, Other linear equations, The equations $x^2 + y^2 = z^2$ & $x^4 + y^4 = z^4$, Farrey sequences.

Text Books:

1. Discrete Mathematical Structures with Applications to Computer Science

J. P. Tremblay and R. Manohar, Tata McGraw-Hill Edition, 1997.

Scope: Chapters 2, 4, 5 (Art. 2.3.1, 2.3.2, 2.3.4, 2.3.5, 2.3.8, 2.3.9, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.1.5, 4.2.1, 5.1.1, 5.1.2, 5.1.4)

2. An Introduction to the theory of Numbers (Third Edition)

I. Niven and H. S. Zuckerman, John Wiley,.

Scope: Chapters 1,2, 3, 4, 5, 6

Reference Books:

1. C. L. Liu: Elements of Discrete Mathematics (Second Edition), McGraw Hill International Edition, Computer Sciences Series, 1986.
2. David M. Burton: Elementary Number Theory, Win. C. Brown Publishers, Dubuque, Iowa, 1989.
3. K. Ireland and M. Rosen: A Classical Introduction to Modern Number Theory, GTM Volume 84, Springer-Verlag 1972
4. G. A. Jones and I. M. Jones: Elementary Number Theory, Springer, 1998
5. W. Sierpinski: Elementary Theory of Number, North-Holland, 1988, Ireland.
6. K. Rosen and M. Rosen: A Classical Introduction to Modern Number Theory, GTM Volume 94, Springer-Verlag, 1972.

B. Sc. Final (Semester VI)

M-12 Differential Geometry (Optional Paper)

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Unit I

Parametric representation and definition of curve in space , Special Curves and their representation, length of arc, Tangent at a given point to a curve, Oscillating plane, Normal Plane , Principal normal and binormal , Rectifying plane , Fundamental planes, Curvature of curve, Torsion of curve, Serret-Frenet Formulae, Helices, Locus of the centre of curvature, Oscillating sphere (Sphere of Curvature), Locus of centre of spherical curvature.

Unit II

Involute & Evolute , The curvature and torsion of the evolute, Bertrand curves, Fundamental theorem for space curves, Envelopes and characteristics relating to one parameter family of surfaces and planes, Developable surfaces, Ruled surfaces.

Unit III

Curves on a surface, Parametric Curves, Two fundamental forms, Positive definiteness, Fundamental magnitudes for some important surfaces, Direction coefficients, Orthogonal trajectories of given curves , The formulas of Gauss , Meusnier's theorem , Lines of curvature as parametric curves , Euler's theorem on normal curvature, Rodrigues' formula, Third fundamental form.

Unit IV

Definition and the differential equations of Geodesic, Canonical equations for Geodesics, Geodesics on a surface of revolution, Normal property of Geodesics, Torsion of Geodesic, Curvature of Geodesic, Bonnet's Theorem, Geodesic parallels, Geodesic polar coordinates, Theorems on geodesic parallels, Geodesic ellipse and hyperbolas, Gauss-Bonnet Theorem, Gaussian Curvature.

Text Books:

1. **Differential Geometry (Third Revised Edition)**

H. D. Singh & P. K. Singh, Ram Prasad and Sons, Agra-3, 1995.

Scope: Chapter 2 (Art. 2.1 to 2.24) and Chapter 7 (Art. 7.1 to 7.24)

2. **Differential Geometry (Fifth Edition)**

Bansilal & Sanjay Arora, Atma Ram & Sons.

Scope: Chapters 2, 3 (Art. 2.60 to 2.90, 3.20, 3.40, 3.50 to 3.63, 3.70 to 3.81) and Chapters 4, 5 (Art. 4.00 to 4.31, 4.33, 4.40, 4.41, 4.73, 4.74, 5.20, 5.21, 5.30, 5.35)

Reference Books:

1. I. M. Singer and J. A. Thorpe, Lecture Notes on Elementary Topology and Geometry. Springer-verlag, 1967
2. B. O. Nell. Elementary Differential Geometry, Academic Press, 1966.
3. S. Sternberg, Lectures on Differential Geometry, Prentice-Hall. 1976.
4. M. Docarmo : Differential Geometry of Curves and Surfaces, Prentice Hall, 1976.

B. Sc. Final (Semester VI)

M-12 Special Theory of Relativity (Optional Paper)

Unit I

Newtonian Relativity , Galilean Transformations , The theory of Ether, Michelson – Morley experiment , Lorentz transformation equations , Geometrical interpretation of Lorentz transformations , Group properties of Lorentz transformations.

Unit II

Event and Particle , Simultaneity, Relativistic formulae for composition of velocities (Transformation of particle velocities), Relativistic addition law for velocities ,Relativistic formulae for composition of accelerations of a particle, Transformation of Lorentz contraction factor , length contraction , time dilation.

Unit III

Tensors , Riemannian metric, metric tensor or fundamental tensor, Minkowski space , Space and Timelike intervals , Light cone or null cone , world points and world lines , Events occurring at the same point and the same time , four vector , four tensors .

Unit IV

Equivalence of mass and energy i. e. $E= mc^2$, Transformation formula for mass , Transformation formula for momentum and energy ,Energy momentum four vector, four-velocity , four- acceleration ,Relativistic equations of motions, The energy momentum tensor T^{ij} , Maxwell's equations of electromagnetic theory in vacuo , Propagation of electric and magnetic field strengths , four potential , Transformations of electromagnetic four potential vector.

Text Books:**1. The Theory of Relativity**

C. Moller, Oxford Clarendon Press , 1952.

2. Theory of Relativity

Goyal and Gupta, Krishna Prakashan, Meerut , Delhi.

Reference Books:

1. Murray R.. Spiegel, Theory and Problems on Vector Analysis SIJ Metrics and Introduction to Tensor Theory, Schaum's outline Series, Mcgraw -Hill Book Company.

2. Sriranjana Banerji and Asip Banerjee, The Theory of Relativity. PHI, New Delhi 2010.