

B. Sc.

Mathematics	
Program Out Come	Mathematical abilities and knowledge are valued for their intrinsic beauty, efficacy in developing analytical thinking skills, and application in modelling and addressing real-world situations. Students must constantly develop and practise their analytical talents in order to responsibly live within and contribute in the transformation of a rapidly changing, complicated, and interdependent society. Students who have learned to logically question assertions, recognise patterns, and distinguish the essential and irrelevant aspects of problems can think deeply and precisely, nurture the fruits of their imagination into reality, and share their ideas and insights while seeking and benefiting from the knowledge and insights of others can think deeply and precisely, nurture the products of their imagination into reality, and share their ideas and insights while seeking and benefiting from the knowledge. B.Sc (Mathematics) Programme students will be able to -Demonstrate the value of mathematics by investigating real-world situations and learning how to apply mathematical concepts and models to them. - Recognize the types of abstract mathematical problems and solve them, as well as provide geometrical interpretations of various notions. - Recognize mathematical links across diverse subjects. - Research and apply mathematical problems and answers in a range of situations in science, technology, commerce, and industry, and depict these results using symbolic, quantitative, or graphical approaches. -Appreciate the value of abstraction and generalisation, and do investigative mathematical work with independent judges. -Conduct self-evaluation and lifelong learning to continue to enrich them
Programe Specific Outcome	-Assist students in improving their soft skills and computing abilities. -Enable pupils to acquire knowledge of numerous ideas involved in single-variable functions. -Enable pupils to get understanding of various Calculus and geometry ideas.

Course Outcomes

B.Sc.(MATHEMATICS)

Semester: I,II

Semester	Paper	Title of the Paper	Hours	Credit	Marks
I	MTH-101	Mathematics-I	3	3	70 (20 Internal + 50 External)
	MTH-102	Mathematics-II	3	3	
II	MTH-201	Mathematics-III	3	3	
	MTH-202	Mathematics-IV	3	3	

B.Sc.(MATHEMATICS)

SEMESTER –I

MTH-101

MATHEMATICS-I

Unit –I

De' Moivre's theorem and its applications, Trigonometric functions for multiple arguments.

Unit-II

Euler's expressions, Evaluation of Indeterminate forms by using Euler's expressions, Hyperbolic functions for real arguments and their inverses.

Unit-III

Exponential, Circular and Hyperbolic functions for complex variables and their identities, Euler's Theorem, Relations between circular and Hyperbolic functions.

Unit-IV

Logarithm of complex quantities, Separations of Logarithmic, Inverse circular and Inverse hyperbolic functions into real and imaginary parts.

The course is covered by the following reference books:

1. S. L. Loney: Plane Trigonometry, Part I and II, Mc Millan and Co. London.
2. R. S. Verma, K. S. Shukla: Text book of Trigonometry, Pothishala Pvt. Ltd. Allahabad.
3. E. Kreyszig: Advanced Engineering Mathematics, Wiley India Pvt. Ltd.
4. N.P.Bhamore and et al: College Aadhunik Ganit shastra, Popular Prakashan, Surat

B.Sc. (MATHEMATICS)

SEMESTER –I

MTH-102

MATHEMATICS-II

Unit –I

Successive differentiation, Calculation of n^{th} derivatives of some standard functions (rational functions and powers of sine, cosine functions), Leibnitz theorem and its applications

Unit-II

Rolle's Theorems and its geometrical interpretation, Lagrange's Theorem and its geometrical interpretation, Cauchy theorem, Maclaurin and Taylor series expansions

Unit-III

Curvature and radius of curvature (except Polar form), Increasing and Decreasing functions, Asymptotes, Concavity and Convexity

Unit-IV

Reduction formulae for integration of

$\sin^n x, \cos^n x, \tan^n x, \cot^n x, \operatorname{cosec}^n x, \sin^p x \cos^q x, x^m \cos nx, x^m \sin nx$

The course is covered by the following reference books:

1. Shantinayakan: Differential Calculus, Revised Edition December-2004 , S. Chand and Co. New Delhi.
2. Shantinayakan: Integral Calculus, S. Chand and Co. New Delhi.
3. Gorakhprasad: Differential Calculus, Pothishala Pvt. Ltd. Allahabad.
5. M. R. Spiegel: Theory and Problems of Advanced Calculus, Schaum's Publishing Co., New York.
6. N. P. Bhamore and et al: College Aadhunik Ganit shastra, Popular Prakashan, Surat.

B.Sc. (MATHEMATICS)

SEMESTER –II

MTH-201

MATHEMATICS-III

Unit-I

Different types of matrices, Operations on matrices, Properties of operations of matrices, Elementary row operations,

Unit-II

Row-reduced echelon forms, Inverse of matrix by Row –Reduced Echelon form. Row rank of a matrix, Quadratic forms.

Unit-III

Trace of matrix and its properties, Solution of homogeneous system of linear equations using row – reduced echelon forms.

Unit-IV

Characteristic equation of a matrix, Method to find Characteristic equation using determinant and minors of a matrix, Eigen values and Eigen vectors of a matrix, Cayley-Hamilton theorem and its application to find an inverse of a matrix, Method of diagonalization.

The course is covered by the following reference books:

- 1. Krishnamurthy, Mainra and Arora: An Introduction to linear Algebra, Affiliated West Press Pvt. Ltd., New Delhi.**
- 2. Erwin Kreyszig: Advanced Engineering Mathematics, Wiley India (P) Ltd., 2009.**
- 3. B.S. Vasta and Suchi Vasta: Theory of Matrices; 4th Edition -2014, New Age International (P) Ltd. Publishers, New Delhi.**
- 4. Shantinayakan: Text book of Matrices, S. Chand and Co., New Delhi.**
- 5. H. K. Dass, H. C. Saxena, M. D. Raisinghania: Simplified course in Matrices, S. Chand and Co., New Delhi.**
- 6. N.P. Bhamore and et al: College Adhunik Ganit shastra, Popular Prakashan, Surat.**

B.Sc. (MATHEMATICS)

SEMESTER –II

MTH-202

MATHEMATICS-IV

Unit-I

Curve Tracing: Equation of the form $y = f(x)$, Equation of the form $y^2 = f(x)$, Parametric equations,

Unit-II

Application of Integral calculus: Length of a curve, Intrinsic equation (except polar coordinates).

Unit-III

Bernoulli's equation, Exact differential equation, Differential equations of first order and higher degree: Solvable for x , y , p and Lagrange's equation, Clairaut's equation.

Unit-IV

Linear Differential Equations with constant coefficients: Complimentary functions, Particular Integral, General Solution, Method for finding Particular Integral specially for e^x , $\sin ax$, $\cos ax$, polynomial in terms of x , $e^{ax}V$ and xV , where V is a function of x .

The course is covered by the following reference books:

1. Shantinirayan: Differential calculus ,4th edition -2001, Shyamlal Charitable Trust, Ram nagar New Delhi, S. Chand and Company LTD.
2. Shantinirayan: Integral Calculus, Revised Edition-2009, S.Chand and Co., New Delhi.
3. Gorakhprasad: Integral Calculus, Pothishala Pvt.Ltd., Allahabad.
4. D.A.Murray: Differential Equations, Tata Mc Graw Hills.
5. Frank Ayres: Theory and problems on Differential Equations, Mc Graw Hill Book Co., New York.
6. N.P.Bhamore and et al: College Aadhunik Ganit shastra, Popular Prakashan, Surat.

B. Sc.(MATHEMATICS)
Semester:III,IV

B. Sc.	Paper	NameofthePaper	Hours	Credit	Marks
Semester III	MTH-301	Mathematics-V	3	3	70 (20Internal + 50 External)
	MTH-302	Mathematics-VI	3	3	
	MTH-303	Mathematics-VII	3	3	
	EG-3001	Mathematical Methods	2	2	
	EG-3002	Group of Symmetries-I	2	2	
Semester IV	MTH-401	Mathematics-VIII	3	3	
	MTH-402	Mathematics-IX	3	3	
	MTH-403	Mathematics-X	3	3	
	EG-4001	Mathematical Modeling	2	2	
	EG-4002	Group of Symmetries -II	2	2	

B. Sc. (MATHEMATICS)
SEMESTER- III
MTH-301
(Mathematics-V)

Unit I:

Limits and Continuity of a function of two variables, Partial Differentiation, Total Differential, Composite function, Homogeneous functions.

Unit II:

Euler's theorem for Homogeneous functions, Taylor's theorem for functions of two variables, Maclaurian's expansions in power series, Jacobian.

Unit III:

Maxima-Minima for functions of two variables: Necessary and sufficient conditions for extreme points.

Unit IV:

Vector point function, Differentiation of a Vector point function, Gradient, Divergence and Curl and their properties, Line Integral.

The course is covered by the following reference books:

1. Shantinarayan, P.K. Mittal: A course of Mathematical Analysis, S. Chand and Co., New Delhi.
2. Hari Kishan: Vector Algebra and Calculus, Atlantic Pub. & Distributors (P) Ltd., New Delhi.
3. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi.
4. S.C. Malik : Mathematical Analysis, Wiley-Eastern Ltd, New Delhi.
5. N.P. Bhamore & etel: Mathematics Paper III-IV, Popular Prakashan, Surat.

B. Sc. (MATHEMATICS)
SEMESTER-III
MTH-302
(Mathematics-VI)*

Unit I:

Error estimation: Errors and their computations, A general error formula.

Unit II:

Numerical Solution of Algebraic and Transcendental Equations: Bisection Method, Method of False position, Iteration Method, Newton-Raphson's Method.

Unit III:

Forward Differences, Backward Differences, Central Differences, Symbolic relation and separation of symbols, Differences of Polynomials.

Unit IV:

Newton's Forward and Backward Formulae, Gauss' Interpolation formulae.

The course is covered by the following reference books:

1. S.S. Sastry: Introductory methods of Numerical Analysis, Prentice-Hall of India Pvt. Ltd.; 5th Edition.
2. M.K. Jain, Iyenger, Jain: Numerical Methods for Scientific and Engineering Computations, New Age International Ltd.
3. Goel, Mittal: Numerical Analysis, Pragati Prakashan, Meerut.
4. Kaiser A. Kunz: Numerical Analysis, McGraw Hill Book Co., London.
5. James I. Buchanan, Peter R. Turner: Numerical Methods and Analysis, McGraw Hill Book Co., London.
6. P. C. Biswal: Numerical Analysis, Prentice-Hall of India, 2008.
7. H. C. Saxena: Finite Differences and Numerical Analysis, S. Chand and Co., 2005.

*Use of Scientific non-programmable calculator is allowed.

B. Sc. (MATHEMATICS)
SEMESTER-III
MTH-303
(Mathematics-VII)

Unit I:

Linear Differential Equations with variable coefficients, Homogeneous Differential Equations, Legendre's Differential Equation.

Unit II:

Second order Differential Equations: Solution in terms of known Integral, Solution by method of removal of first order derivatives, Method of Changing Independent Variable.

Unit III:

Formation of Partial Differential Equation, Solution of Partial Differential Equations, Equations solvable by direct integral.

Unit IV:

Partial Differential Equations of first order, Nonlinear Partial Differential Equations of first order, Some special methods.

The course is covered by the following reference books:

1. D.A. Murray: An Introductory Course in Differential Equations, Orient Longmans, Bombay.
2. I.N. Sneddon: Elements of Partial Differential Equations, McGraw Hill Book Company.
3. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, New Delhi.
4. Gorakh prasad : Differential Equations, Pothishala Pvt. Ltd., Allahabad.
5. M. D. Rai Singhania: Differential Equations, S. Chand & Co., New Delhi.
6. Nita H. Shah: Ordinary and Partial Differential Equations: Theory and Applications, PHI Learning Pvt. Ltd, New Delhi.
7. N.P. Bhamore & etel.: Mathematics Paper III-IV, Popular Prakashan, Surat.

B. Sc. (MATHEMATICS)
SEMESTER-III
Elective Generic
EG-3001
(Mathematical Methods)*

Unit I:

Notationsoffinitedifferencecalculus, Operators $E, \Delta, \nabla, \delta$, Relationsbetween differentoperatorsandtheirprosperities, Relationbetween differenceand differentialoperators, Methodofconstructing differencetables, Findingthemissing terms.

Unit II:

Factorialnotation, Expressionofpolynomialsinfactorialnotationbyusing finite differences, Method ofunknowncoefficients.

Unit III:

Differenceequations: Orderanddegreeofadifferenceequation, Solutionof differenceequations, Homogeneousdifferenceequationswithconstantcoefficients.

Thecourseiscoveredbythefollowingreferencebooks:

1. S.S.Sastry: Introductorymethodsof NumericalAnalysis, Prentice-Hallof IndiaPvt. Ltd.; 4th Edition.
2. M.K.Jain, Iyenger, Jain: NumericalMethodsforScientificandEngineering Computations, New Age InternationalLtd.
3. Goel, Mittal: Numerical Analysis, PragatiPrakashan, Meerut.
4. Kaiser A. Kunz: Numerical Analysis, McGraw Hill Book Co., London.
5. JamesI. Buchanan, PeterR. Turner: NumericalMethods&Analysis, McGraw Hill BookCo., London.

*Useof Scientificnon-programmablecalculator isallowed.

B. Sc.(MATHEMATICS)
SEMESTER-III
Elective Generic
EG-3002
(Group of Symmetries-I)

Unit I:

Definition of a group

and its elementary properties, Order of a group, Order of an element of a group, Group multiplication tables, Examples of groups including finite groups and infinite groups, Abelian groups, Cyclic groups.

Unit II:

Subgroup, Condition that a subset is a subgroup, Examples of subgroups, Basic concept of symmetry, Symmetry elements and symmetry operations in a space, Identity symmetry operation.

Unit III:

Symmetry planes and reflection symmetry, Inversion centre and inversion symmetry, Rotation axes and rotation symmetry, Improper axes and improper rotation symmetry, Product of symmetry operations.

The course is covered by the following reference books:

1. F. A. Cotton: Chemical application of group theory, Wiley Inter Science, Wiley Eastern Ltd., New Delhi.
2. G. Davidson: Intro. Group Theory for Chemists, Applied Science Publisher.
3. I. N. Herstein: Topics in Algebra, Wiley Eastern Ltd., New Delhi.

B. Sc. (MATHEMATICS)
SEMESTER-IV
MTH-401
(Mathematics-VIII)

Unit I:

Beta-Gamma functions: Relation between Beta and Gamma functions, Properties, Applications of Beta-Gamma function.

Unit II:

Double and Triple Integrals: Change of order of Double integrals, Area.

Unit III:

Laplace Transforms: Laplace Transform of elementary functions, Properties of Laplace Transform, Differentiation and Integration of Laplace Transform, Laplace Transform of derivatives and integrals.

Unit IV:

Inverse of Laplace Transform: Method of Partial fractions, Properties of inverse Laplace Transform.

The course is covered by the following reference books:

1. David V. Widder : Advanced Calculus, PHI Learning Pvt. Ltd, New Delhi
2. Kreysig: Advanced Engineering Mathematics, John Wiley, New York, 1999.
3. Shantinarayan, P.K. Mittal: A course of Mathematical Analysis, S. Chand and Co., New Delhi.
4. N.P. Bhamore & et al: Mathematics Paper III-IV, Popular Prakashan, Surat.

B. Sc. (MATHEMATICS)
SEMESTER-IV
MTH-402
(Mathematics-IX)*

Unit I:

Finite difference with unequal interval, Lagrange's Interpolation Formula, Divided Differences, Newton's General Interpolation Formula.

Unit II:

Numerical Differentiation: 1st and 2nd order derivatives based on Newton's forward and backward difference interpolation formulae.

Unit III:

Numerical Integration: General Integration formula, Trapezoidal Rule, Simpson's 1/3-Rule, Simpson's 3/8-Rule.

Unit IV:

Solution of Ordinary Differential Equations by Taylor's series method, Picard's approximation method, Euler's method.

The course is covered by the following reference books:

1. S. S. Sastry: Introductory methods of Numerical Analysis, Prentice-Hall of India Pvt. Ltd.; 4th Edition.
2. M. K. Jain, Iyenger, Jain: Numerical Methods for Scientific and Engineering Computations, New Age International Ltd.
3. Goel, Mittal: Numerical Analysis, Pragati Prakashan, Meerut.
4. Kaiser A. Kunz: Numerical Analysis, McGraw Hill Book Co., London.
5. James I. Buchanan, Peter R. Turner: Numerical Methods and Analysis, McGraw Hill Book Co., London.

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B. Sc.(MATHEMATICS)
SEMESTER-IV
MTH-403
(Mathematics-X)

Unit I:

Sets and elements, Operations on sets, Functions, Real-valued functions.

Unit II:

Countable & Uncountable sets, Greatest lower bound and least upper bound.

Unit III:

Sequences of real numbers, Sub-sequences, limit of a sequence, Convergent sequences, Divergent sequences.

Unit IV:

Divisors, Greatest common divisor, Least Common multiple, Prime numbers, Fundamental theorem of Arithmetic, Congruence relation, Equivalence classes.

The course is covered by the following reference books:

1. R. R. Goldberg : Methods of Real Analysis, Oxford & TBH Pub. Co.
2. I. N. Herstein : Topics in Algebra, Wiley Eastern Ltd., New Delhi, 2006.
3. I. H. Sheth : Abstract Algebra, Nirav Prakashan, Ahmedabad.
4. T. M. Apostol : Mathematical Analysis, Narosa Publishing House, New Delhi.
5. S. C. Malik : Mathematical Analysis, Wiley-Eastern Ltd, New Delhi.
6. Shantinayakan : Modern Algebra, S. Chand and Co., New Delhi.

SYLLABUS FOR B. Sc. (MATHEMATICS)
SEMESTER-IV
Elective Generic
EG-4001
(Mathematical Modeling)*

Unit I:

Mathematical modelling through ordinary differential equation of first order, Linear growth models; Linear decay models, Models for growth of Science and scientists.

Unit II:

Non-linear growth and decay models, Model of Logistic law of population, Spread of technological innovation, Spread of infectious diseases.

Unit III:

Mathematical models of geometrical problems through ordinary differential equation of first order, Simple geometrical problems, Orthogonal trajectories.

The course is covered by the following reference books:

1. J.N. Kapoor: Mathematical Modelling, New Age International Publishers, New Delhi.
2. Kreysig: Advanced Engineering Mathematics, John Wiley, New York, 1999.
3. J. K. Sharma: OR Theory & Applications, Mac Millan India Ltd., 1998.
4. G. Hadley: Linear Programming, Narosa Publishing House, New Delhi, 1995.
5. G. Paria: Linear Programming, Transportation, Assignment, Game, Books & Allied Pvt. Ltd. Calcutta.

*Use of Scientific non-programmable calculator is allowed.

B. Sc.(MATHEMATICS)
SEMESTER-IV
Elective Generic
EG-4002
(Group of Symmetries-II)

Unit I:

Formation of groups of symmetries (in space) of the following Plane figures (regarded as rigid objects):

1. An isosceles triangle (cyclic group C_2 of order 2)
2. An equilateral triangle (the group S_3 of order 6)
3. A rectangle (the group V_4)
4. A square (the group D_4)

Unit II:

Formation of groups of symmetries of the following Chemical Molecules (Configuration of atoms).

1. H_2O (the group V_4)
2. H_2O_2
3. Trans- N_2-F_2 (the group V_4)
4. NH_3 , PCl_3 , $CHCl_3$ (the group S_3)

Unit III:

Concept of isomorphism of groups, Isomorphism of multiplicative group with the group C_2 of the symmetries of an isosceles triangle, Isomorphism of multiplicative group with the group V_4 of the symmetries of a rectangle, Isomorphism of group V_4 of the symmetries of a rectangle with the group of symmetries of H_2O , Isomorphism of group S_3 of the symmetries of an equilateral triangle with the group of symmetries of NH_3 , PCl_3 , $CHCl_3$.

The course is covered by the following reference books:

1. F. A. Cotton: Chemical application of group theory, Wiley Inter Science Wiley Eastern Ltd., New Delhi.
2. G. Davidson: Intro. Group Theory for Chemists, Applied Science Publisher.
3. I. N. Herstein: Topics in Algebra, Wiley Eastern Ltd., New Delhi, 2006.

B.Sc. (MATHEMATICS)
Semester: V, VI

Semester	Paper	Name of the Paper	Hours	Credit	Marks
V	MTH-501	Group Theory	3	3	Total marks 70 (50 External +20 Internal)
	MTH-502	Linear Algebra – I	3	3	
	MTH-503	Real Analysis – I	3	3	
	MTH-504	Real Analysis – II	3	3	
	MTH-505	Graph Theory	3	3	
	MTH-506	Number Theory – I	3	3	
	E.G.	5001-Operations Research – I	2	2	
5002-Computer Oriented Numerical Methods – I					
5003-Fourier Series					
VI	MTH-601	Ring Theory	3	3	Total marks 70 (50 External +20 Internal)
	MTH-602	Linear Algebra – II	3	3	
	MTH-603	Real Analysis – III	3	3	
	MTH-604	Real Analysis – IV	3	3	
	MTH-605	Discrete Mathematics	3	3	
	MTH-606	Number Theory – II	3	3	
	E.G.	6001-Operations Research – II	2	2	
6002-Computer Oriented Numerical Methods – II					
6003-Fourier Transform and its Applications					

B.Sc. (MATHEMATICS)
SEMESTER –V
MTH – 501
(Group Theory)

Unit 1:

Definition of a Group, Examples of Group, elementary properties of a Group, Finite Groups. Subgroups, Cyclic Groups, Order of an element.

Unit 2:

Cosets, Congruence Relation in Group Lagrange's theorem, Euler's theorem, Fermat's theorem, Counting principle.

Unit 3:

Normal subgroups & Quotient groups, Homomorphism, Isomorphism, Isomorphic groups, Fundamental theorem of homomorphism, Automorphisms, Cayley's theorem.

Unit 4:

Permutation Groups, Orbit & Cycles, Even permutation, Odd permutation, Alternating Group.

The course is covered by the following reference books:

1. I. N. Herstein : Topics in Algebra, Wiley Eastern Ltd. New Delhi, 1983.
2. I. H. Sheth : Abstract Algebra, Nirav Prakashan, Ahmedabad.
3. N. S. Gopal Krishnan : University Algebra, Wiley Eastern Ltd.
4. P. R. Bhattacharya, S. K. Jain and S. R. Nagpaul : Basic Abstract Algebra, Cambridge University Press, Indian Edition, 1997.
5. Shantinayakan : Modern Algebra, S. Chand & Co.
6. Serge Lang : Algebra, Addition Wesley, 1993.
7. Surjeet & Kazi Zameeruddin : Modern Algebra, Vikas Publishing House.

B.Sc. (MATHEMATICS)
SEMESTER – V
MTH – 502
(Linear Algebra – I)

Unit 1:

Definition and examples of Vector space, Subspace, Necessary and sufficient condition for a subspace, Illustrations.

Unit 2:

Span of a set, union and intersection of subspaces, Sum and Direct sum of subspaces.

Unit 3:

Linearly dependent and independent vectors, Verification of Linear dependence or independence.

Unit 4:

Dimension and Basis of a vector space, Extension of a linearly independent set to a basis, Dimension of sum.

The course is covered by the following reference books:

1. V. Krishnamurthy, V. P. Mainra & J. L. Arora : An Introduction to Linear Algebra, Affiliated East-West Press Pvt. Ltd., New Delhi.
2. I. H. Sheth : Linear Algebra, Nirav Prakashan.
3. S. Kumaresan : Linear Algebra, Prentice Hall of India, 2000.
4. Serge Lang : Linear Algebra, Addition-Wesley Pub. Co. (Student Ed.).
5. Balakrishnan : Linear Algebra, Tata-McGraw Hill Ed.

B.Sc. (MATHEMATICS)
SEMESTER – V
MTH – 503
(Real Analysis – I)

Unit 1:

Bounded sequences, Monotone sequences, Operations on convergent sequences.

Unit 2:

Operations on divergent sequences, Concepts of limit superior and inferior, Cauchy sequence.

Unit 3:

Convergence and divergence of series of real numbers, Series with non-negative terms, Alternating series, Conditional and absolute convergence.

Unit 4:

Tests for absolute convergence, Series whose terms form a non-increasing sequence.

The course is covered by the following reference books:

1. R. R. Goldberg : Methods of Real Analysis, Oxford & TBH Pub. Co.
2. T. M. Apostol : Mathematical Analysis, Narosa Publishing House, New Delhi.
3. S. C. Malik : Real Analysis, Wiley-Eastern Pub. Co., New Delhi.
4. Walter Rudin : Principles of Mathematical Analysis, McGraw Hill book Company.

B.Sc. (MATHEMATICS)
SEMESTER – V
MTH – 504
(Real Analysis – II)

Unit 1:

Revision of Limit and Continuity of a function on the real line, Definition & examples of Metric spaces.

Unit 2:

Limit, Convergence and Cauchy sequence in metric space, Equivalent metrics.

Unit3:

Open ball in $\mathbb{R}^1$, Open ball in metric space, Functions continuous on metric spaces.

Unit 4: Open sets, More about open sets.

The course is covered by the following reference books:

1. R. R. Goldberg : Method of Real Analysis, Oxford & IBH Pub. Co. Ltd. New Delhi.
2. T. M. Apostol : Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.
3. S. Lang : Undergraduate Analysis, Springer-Verlag, New York, 1983.
4. D. Som Sundaram & B. Chaudhari : A first course in Mathematical Analysis, Narosa Publishing House, New Delhi, 1997.
5. P. K. Jain & S. K. Kaushik : An Introduction to Real Analysis, S. Chand & Co. New Delhi, 2000.
6. E. T. Copson : Metric Spaces, Cambridge University Press, 1968.
7. P. K. Jain & K. Ahmed : Metric Spaces, Narosa Pub. House, New Delhi, 1996.

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B.Sc. (MATHEMATICS)
SEMESTER – V
MTH – 505
(Graph Theory)

Unit 1:

Graphs, Various type of graphs, Incidence and Degree, Isolated and pendent vertices, Subgraphs, Isomorphism between two graphs.

Unit 2:

Operations on graphs, Walks, Paths, Circuits, Connected graphs, Disconnected graphs, Components of graphs.

Unit 3:

Euler graphs, Arbitrary traceable graph, Hamiltonian Graphs, Applications of graphs: Königsberg Bridge Problem, Seating Arrangement Problem, Utility Problem.

Unit 4:

Trees, Properties of trees, Pendent vertices in a tree, Distance between two vertices, Centre, Radius and Diameter of a Tree, Rooted & Binary trees.

The course is covered by the following reference books:

1. Narsingh Deo : Graph Theory with applications to Engineering & Computer Science, Prentice Hall of India Pvt. Ltd.,2000.
2. R. J. Wilson : Introduction to Graph Theory, Academic Press, New York, 1972.
3. E. Harary : Graph Theory, Addison Wesley Pub. Co.,1969.
4. C. Berge : The Theory of Graphs and its Applications, John Wiley & Sons, 1962.

B.Sc. (MATHEMATICS)
SEMESTER – V
MTH – 506
(Number Theory – I)

Unit 1:

Divisibility of integers, the Division Algorithm, Greatest Common Divisor of two integers, the Euclidean algorithm, Relation between Greatest Common Divisor and Least Common Multiple of two integers.

Unit 2:

Computation of the solutions of Linear Diophantine Equations in two variables, Primes and Composite numbers, Fundamental Theorem of Arithmetic, Pythagorean theorem for the irrationality of $\sqrt{p}$, for any prime p .

Unit 3:

Sieve of Eratosthenes, Infinitude of primes, Upper Bound for the primes, Theory of Congruences.

Unit 4:

Basic Properties of Congruence, Divisibility tests of 9 and 11.

The course is covered by the following reference books:

1. David M. Burton : Elementary Number Theory, Tata McGraw-Hill Pub. Co. Ltd., New Delhi, 6th Ed., 2006.
2. S. G. Telang : Number Theory, The Tata McGraw Hill Co. Ltd., New Delhi.
3. I. Niven, S. Zuckerman & L. Montgomery: An Introduction to Theory of Numbers, John Wiley, 1991.
4. George Andrews : Number Theory, The Hindustan Pub. Corporation, New Delhi.

B.Sc. (MATHEMATICS)
SEMESTER – V
Elective Generic – 5001
(Operations Research – I)

Unit 1:

Graphical solution of Linear Programming Problem (LPP). Definition of the Dual Problem, General rules for converting any Primal Problem into its dual, The symmetric Dual Problems.

Unit 2:

Basic concept of Basic, Non-basic, Degenerate, Non-degenerate and Basic feasible solutions of LPP, Slack & Surplus variables, LPP in the standard matrix form, Slack & Surplus variables, Solution of LPP using Simplex method.

Unit 3:

Solution of LPP using Two Phase Simplex method and Big-M method.

The course is covered by the following reference books:

1. J. K. Sharma : Operations Research: Theory & Applications, McMillan India Ltd., 1998.
2. Kanti Swaroop, P. K. Gupta & Man Mohan : Operations Research, S. Chand & Sons, New Delhi, 1998.
3. G. Hadley : Linear Programming, Narosa Publishing House, New Delhi, 1995.
4. S. D. Sharma : Operations Research, Kedarnath Ramnath & Co.
5. P. M. Karak : Linear Programming, New Central Book Agency Pvt. Ltd. Calcutta.
6. K. V. Mittal & L. Mohan : Optimization methods in O.R. and System Analysis, New Age International Publications.
7. Goel & Mittal : O.R., Pragati Prakashan, Meerut.

B.Sc. (MATHEMATICS)
SEMESTER – V
Elective Generic – 5002
(Computer Oriented Numerical Methods–I)

Unit 1:

Flow charts and symbols, More flow charting examples.

FORTRAN language, character used in FORTRAN, FORTRAN constants, FORTRAN variable names, Type declaration for integer and real, Arithmetic expression (real and integer expressions), Hierarchy of operations in expressions, Examples of Arithmetic expression.

Unit 2:

Arithmetic statement, Mode of Arithmetic expression, Special function, Examples of use of functions, Program preparation preliminaries.

Unit 3:

Input-Output statement, STOP and END statement, FORTRAN coding form, Simple FORTRAN program, FORTRAN programming examples.

The course is covered by the following reference books:

1. V. Rajaraman : Computer Programming in FORTRAN 77, PHI.
2. V. Rajaraman : Computer Oriented Numerical Methods, PHI.
3. Dhaliwal, Agarwal and Gupta : Programming with FORTRAN 77, Wiley Eastern Ltd.
4. R. S. Salaria : Computer Oriented Numerical Methods, Khanna Book Pub. Co. Ltd.
5. R. Sirkar : FORTRAN based Algorithms, New Central Book Agency, Calcutta.
6. V. Krishnamurthy : FORTRAN based Algorithms, East-West Press, New Delhi.

B.Sc. (MATHEMATICS)
SEMESTER – V
Elective Generic – 5003
(Fourier Series)

Unit 1:

Definition of Fourier series, Euler's formulae, Evaluation of definite integrals, Conditions for a Fourier expansion.

Unit 2:

Functions having points of discontinuity, Change in intervals, Even and Odd functions, Expansion of Even or Odd Periodic functions.

Unit 3:

Half range series, Typical wave forms, Parseval's formula, Root mean square value, Complex form of Fourier series.

The course is covered by the following reference books:

1. B. S. Grewal : Higher Engineering Mathematics, Khanna Prakashan, New Delhi.
2. S. K. Jain : Fourier series and Fourier Transforms, Swarup and Sons Pub., New Delhi.
3. R. R. Goldberg : Method of Real Analysis, Oxford & IBH Pub. Co. Ltd. New Delhi.
4. R. V. Churchill : Fourier series and Boundary value problems, McGraw Hill ISE.
5. Vashishtha and Gupta : Integral Transforms, Krishna Publications, Meerut.

B.Sc. (MATHEMATICS)

SEMESTER – VI

MTH – 601

(Ring Theory)

Unit 1:

Definition of a Ring, Examples of Ring, Integral Domain, Field, Boolean Ring.

Unit 2:

Ring Homomorphism and Isomorphism, Ideals & Quotient rings, Maximal Ideal, Principal Ideal.

Unit 3:

Euclidean rings, Divisibility in commutative ring, GCD of two elements in a ring, Units and Associates in rings.

Unit 4:

Prime element in a Euclidean Ring, Unique factorization theorem in a Euclidean ring.

The course is covered by the following reference books:

1. I. N. Herstein : Topics in Algebra, Wiley Eastern Ltd. New Delhi, 1983.
2. I. H. Sheth : Abstract Algebra, Nirav Prakashan, Ahmedabad.
3. N. S. Gopal Krishnan : University Algebra, Wiley Eastern Ltd.
4. P. R. Bhattacharya, S. K. Jain and S. R. Nagpaul : Basic Abstract Algebra, Cambridge University Press, Indian Edition, 1997.
5. Shantinarayan : Modern Algebra, S. Chand & Co.
6. Serge Lang : Algebra, ed. Addition Wesley, 1993.
7. Surjeet & Kazi Zameeruddin : Modern Algebra, Vikas Publishing House.

B.Sc. (MATHEMATICS)
SEMESTER – VI
MTH – 602
(Linear Algebra – II)

Unit 1:

Definition and examples of Linear transformation, Range and kernel of a linear transformation.

Unit 2:

Rank-Nullity Theorem, Inverse of a linear transformation, Consequences of Rank-Nullity Theorem, Composition of linear transformations.

Unit 3:

Matrix associated with Linear transformations, Linear transformation associated with a matrix, Application of Rank-Nullity Theorem for matrix.

Unit 4:

Inner product spaces, Norm of a vector, Cauchy-Schwarz's inequality, Triangular inequality, Orthogonal vectors, Vector Projection, Gram-Schmidt Orthogonalization Process, Orthonormal Set.

The course is covered by the following reference books:

1. V. Krishnamurthy, V. P. Mainra & J. L. Arora : An Introduction to Linear Algebra, Affiliated East-West Press Pvt. Ltd., New Delhi.
2. I. H. Sheth : Linear Algebra, Nirav Prakashan.
3. S. Kumaresan : Linear Algebra, Prentice Hall of India, 2000.
4. Serge Lang : Linear Algebra, Addition-Wesley Pub. Co. (Student Ed.).
5. Balakrishnan : Linear Algebra, Tata-McGraw Hill Ed.

B.Sc. (MATHEMATICS)

SEMESTER – VI

MTH – 603

(Real Analysis – III)

Unit 1:

Summability of sequences, Addition and subtraction of $(C, 1)$ summable sequences, $(C, 2)$ summable sequences, $(C, 1)$ Summability of series.

Unit 2:

Sequences of functions, Pointwise convergence of Sequences of functions, Uniform convergence of Sequences of functions.

Unit 3:

Sets of measure zero, Definition of the Riemann Integral, Algebraic properties of Riemann Integral.

Unit 4:

Non-Algebraic properties of Riemann Integral Fundamental theorems of Integral Calculus, Mean-value Theorems of Integral Calculus.

The course is covered by the following reference books:

1. R. R. Goldberg : Method of Real Analysis, Oxford & IBH Pub. Co. Ltd., New Delhi.
2. T. M. Apostol : Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.
3. S. Lang : Undergraduate Analysis, Springer-Verlag, New York, 1983.
4. Louis Leithold : Calculus with analytic Geometry, Harper and Collins Pub. Co.
5. J. B. Thomas and Finney : Calculus with analytic Geometry.
6. E. T. Copson : Metric Spaces, Cambridge University Press, 1968.
7. P. K. Jain & K. Ahmed : Metric Spaces, Narosa Pub. House, New Delhi, 1996.

B.Sc. (MATHEMATICS)
SEMESTER – VI
MTH – 604
(Real Analysis – IV)

Unit 1:

Limit points, Closure of a set, Closed sets, Homeomorphism of metric spaces, Dense set.

Unit 2:

Connected sets, Bounded sets, Totally bounded sets.

Unit 3:

Complete metric spaces, Contraction mapping, Picard's fixed-point theorem.

Unit 4:

Compact metric spaces, Open covering, Heine-Borel property, Finite Intersection property.

The course is covered by the following reference books:

1. R. R. Goldberg : Method of Real Analysis, Oxford & IBH Pub. Co. Ltd., New Delhi.
2. T. M. Apostol : Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.
3. S. Lang : Undergraduate Analysis, Springer-Verlag, New York, 1983.
4. S. C. Malik : Real Analysis, Wiley-Eastern Pub. Co., New Delhi.
5. Walter Rudin : Principles of Mathematical Analysis, McGraw Hill book Company.
6. Copson : Metric Spaces, Cambridge University Press, 1968.
7. P. K. Jain & K. Ahmed : Metric Spaces, Narosa Pub. House, New Delhi, 1996.

B.Sc. (MATHEMATICS)
SEMESTER – VI
MTH – 605
(Discrete Mathematics)

Unit 1:

Binary relations, Properties of binary relations, Equivalence relation, Partial ordered relation, Partially ordered sets, Upper bounds, Lower bounds, GLB & LUB of sets, Totally ordered sets, Well ordered sets, Hasse Diagram, Lattices and its properties.

Unit 2:

Lattices as Algebraic Systems, Lattice Homomorphism, Different types of lattices.

Unit 3:

Boolean Algebra as an algebraic system, Boolean expressions (forms), Sum of Products Canonical form and Product of Sums Canonical forms of Boolean expressions.

Unit 4:

Representation and Minimization of Boolean functions by Karnaugh Map method and Quine- McCluskey Algorithm, AND, OR & NOT gates, Reduction of switching circuit diagram.

The course is covered by the following reference books:

1. J. P. Tremblay & R. Manohar : Discrete mathematical Structures with Applications to Computer Science., McGraw Hill Book Co., 1999.
2. B. Kolman, R. C. Busby & S. Ross : Discrete Mathematical Structures, Prentice Hall of India Pvt. Ltd., 3rd ed., 2001.
3. Elements of Discrete Mathematics, C. L. Liu, D. P. Mohapatra, Tata McGraw Hill, 2008.
4. Discrete Mathematics with Applications, Thomas Koshy, Academic Press, 2004.

B.Sc. (MATHEMATICS)
SEMESTER – VI
MTH – 606
(Number Theory – II)

Unit 1:

Computation of the solutions of linear congruence, Chinese Remainder Theorem.

Unit 2:

Fermat's little theorem, Pseudo-primes, Wilson's theorem.

Unit 3:

The number of positive divisors and sum of all positive divisors of an integer, Basic properties and Multiplicative nature of these functions, The Möbius Inversion formula, Greatest integer function.

Unit 4:

Introduction of Euler's Phi-function, Multiplicative nature, Euler's Theorem.

The course is covered by the following reference books:

1. David M. Burton : Elementary Number Theory, Tata McGraw-Hill Pub. Co. Ltd., New Delhi, 6th Ed., 2006.
2. S. G. Telang : Number Theory, The Tata McGraw Hill Co. Ltd., New Delhi.
3. I. Niven, S. Zuckerman & L. Montgomery: An Introduction to Theory of Numbers, John Wiley, 1991.
4. George Andrews : Number Theory, The Hindustan Pub. Corporation, New Delhi.

B.Sc. (MATHEMATICS)
SEMESTER – VI
Elective Generic – 6001
(Operations Research – II)

Unit 1:

Transportation problem, methods for finding initial basic feasible solution, Solution of Transportation problem by MODI method, Unbalanced Transportation problem.

Unit 2:

Assignment problems, The Hungarian method, Balanced & Unbalanced Assignment problems.

Unit 3:

Competitive Games, Two-person zero-sum game, Maximin and Minimax principle, Saddle points and the value of the game (based on pure strategies), Mixed strategies, Solution of Games with Saddle point, Game without saddle points, Dominance rule, Solution of $m \times 2$ and $2 \times n$ Games using graphical method.

The course is covered by the following reference books:

1. J. K. Sharma : Operations Research: Theory & Applications, McMillan India Ltd., 1998.
2. Kanti Swaroop, P. K. Gupta & Man Mohan : Operations Research, S. Chand & Sons, New Delhi, 1998.
3. G. Hadley : Linear Programming, Narosa Publishing House, New Delhi, 1995.
4. S. D. Sharma: Operations Research, Kedarnath Ramnath & Co.
5. P. M. Karak : Linear Programming, New Central Book Agency Pvt. Ltd. Calcutta.
6. K. V. Mittal & L. Mohan : Optimization methods in O.R. and System Analysis, New Age International Publications.
7. Goel & Mittal : O.R., Pragati Prakashan, Meerut.

B.Sc. (MATHEMATICS)
SEMESTER – VI
Elective Generic – 6002
(Computer Oriented Numerical Methods – II)

Unit 1:

Control statements, Relational operators, Logical IF statement, Arithmetic IF statement, Block IF statement. Statement labels, GOTO statement, Examples of use of Logical IF statement.

Unit2:

Nested logical IF statement, Computed GO TO statement, DO statement, Examples of DO statement, Rules to be followed in utilizing DO loops, Subscripted variables, Subscripted Expression, Dimension statement, DO type notation for input/output statement, FORMAT specification.

Unit3:

FORMAT specification for a numerical data, Iterative methods, Numerical integrations and differentiations, Numerical solution of ordinary differential equations.

The course is covered by the following reference books:

1. V. Rajaraman : Computer Programming in FORTRAN 77, PHI.
2. V. Rajaraman : Computer Oriented Numerical Methods, PHI.
3. Dhaliwal, Agarwal and Gupta : Programming with FORTRAN 77, Wiley Eastern Ltd.
4. R. S. Salaria : Computer Oriented Numerical Methods, Khanna Book Pub. Co. Ltd.
5. R. Sirkar : FORTRAN based Algorithms, New Central Book Agency, Calcutta.
6. V. Krishnamurthy : FORTRAN based Algorithms, East-West Press, New Delhi.

B.Sc. (MATHEMATICS)
SEMESTER – VI
Elective Generic – 6003
(Fourier Transform and Its Applications)

Unit 1:

Integral transforms, Fourier Transforms, Properties of Fourier Transform and its application.

Unit 2:

Convolution, Convolution theorem for Fourier transforms, Parseval's Identity for Fourier transform.

Unit 3:

Relation between Fourier and Laplace Transforms, Fourier transforms of the derivatives of a function, Fourier transform and its applications.

The course is covered by the following reference books:

1. B. S. Grewal : Higher Engineering Mathematics, Khanna Prakashan, New Delhi.
2. S. K. Jain : Fourier series and Fourier Transforms, Swarup and Sons Pub., New Delhi.
3. R. R. Goldberg : Method of Real Analysis, Oxford & IBH Pub. Co. Ltd. New Delhi.
4. R. V. Churchill : Fourier series and Boundary value problems, McGraw Hill ISE.
5. Vashishtha and Gupta : Integral Transforms, Krishna Publications, Meerut.