

Department of Mathematics
Faculty of Natural Science, Jamia Millia Islamia, New Delhi-25

Course Structure of B.A./ B. Sc. (Subsidiary)

Semester – I

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	BSM-1.1	Calculus	4	4	25	75	100

Semester – II

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	BSM-2.1	Ordinary Differential Equations	4	4	25	75	100

Semester – III

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	BSM-3.1	Matrices & Vector Calculus	4	4	25	75	100

Semester – IV

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	BSM-4.1	Numerical Methods	4	4	25	75	100

Semester – V

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	BSM-5.1	Groups, Rings and Vector Spaces	4	4	25	75	100

Semester – VI

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	BSM-6.1	Partial Differential Equations	4	4	25	75	100

B. A./ B.Sc. (Subsi), Semester – I

BSM-1.1	Calculus	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Limit of a function, Algebra of limits, Continuity, Differentiability, Successive differentiation, Leibnitz Theorem, Rolle's Theorem, Mean Value Theorems, Taylor and Maclaurin's series.

Unit-II Indeterminate forms, Curvature, Cartesian, Polar and parametric formulae for radius of curvature, Partial derivatives, Euler's theorem on homogeneous functions.

Unit-III Asymptotes, Test of concavity and convexity, Points of Inflexion, Multiple points, Tracing of curves in Cartesian and polar coordinates.

Unit-IV Reduction formulae, Quadrature, Rectification, Intrinsic equation, Volumes and surfaces of solids of revolution.

Books Recommended

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
2. M.J. Strauss, G.L. Bradley and K. J. Smith, *Calculus*, 3rd Ed., Dorling Kindersley (India) P.Ltd. (Pearson Education), Delhi, 2007.
3. H. Anton, I. Bivens and S. Davis, *Calculus*, 7th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2002.
4. Gorakh Prasad, *Differential Calculus*, Pothishala Pvt Ltd, Allahabad
5. Khalil Ahmad, *Text Book of Calculus*, World Education Publishers, 2012.

B. A./ B.Sc. (Subsi), Semester – II

BSM-2.1	Ordinary Differential Equations	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks		4	4	4
End Semester Examination: 75 Marks				
Duration of Examination: 2 Hrs.				

Unit-I Order and degree of a differential equation, equations of first order and first degree, solutions of equations in which variables are separable, Homogeneous equations, Linear equations and Bernoulli equations, Exact differential equations, Integrating factors.

Unit-II Equations of the first order and higher degree, Equations solvable for p , y and x , Clairaut equation, Lagrange's equation, applications.

Unit-III Linear differential equations with constant coefficient, Complementary function and particular integral. Particular integral of the forms e^{ax} , $\sin ax$, $\cos ax$, x^m and $e^{ax}V$, Homogeneous linear equations.

Unit-IV Linear differential equations of second order, Complete solution in terms of known integral belonging to the complementary function, Normal form, Change of independent variable, Method of undetermined coefficient, Method of variation of parameters.

Books Recommended:

- C. H. Edwards and D. E. Penny, *Differential Equations and Boundary Value Problems: Computing and Modelling*, Pearson education, India 2005.
- Dennis G. Zill, *A first course in differential equations*,
- S. L. Ross: *Differential equations*, John Wiley and Sons, 2004.
- Zafar Ahsan: *Text Book of Differential Equations and their Applications*, Prentice Hall of India.
- Khalil Ahmad: *Text Book of Differential Equations*, World Education Publishers, 2012.

B. A./ B.Sc. (Subsi), Semester – III

BSM-3.1	Matrices & Vector Calculus	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Matrices and their algebra, Types of matrices, Identity, Hermitian and Skew Hermitian matrices, Singular and Non-singular matrices, Transpose of a matrix, Adjoint and inverse of a matrix, Row echelon and reduced row echelon form of a matrix, Rank of a matrix

Unit-II Consistency of the system of homogeneous and non-homogeneous linear equations- with emphasis on problems, Eigen values and Eigen vectors of a matrix, Cayley Hamilton Theorem and its application to find out inverse of a matrix.

Unit-III Definitions and basic properties of scalar and vector products, Application of scalar and vector products to geometry and mechanics, Scalar and vector products of three, four vectors and problems based on them, Reciprocal vectors.

Unit-IV Differentiation and integration of vector valued function, Gradient, curl and divergence of a vector and their properties, Properties of del operator, Problems based on line integral.

Books Recommended:

1. V Krishnamurthy, V P Mainra and J L Arora, An introduction to Linear Algebra, Affiliated East- West Press Pvt. Ltd., New Delhi.
2. Seymour Lipschutz and Marc Lars Lipson, Linear Algebra, Schaum's outlines Series, McGraw-Hill.
3. Murray R. Spiegel: Vector Analysis and an Introduction to Tensor Analysis, Schaum Outline Series, McGraw-Hill.

B. A./ B.Sc. (Subsi), Semester – IV

BSM-4.1	Numerical Methods	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Absolute, relative and percentage errors, General error formula. Solution of algebraic and transcendental equations: Bisection method, False position method, Fixed-point iteration method, Newton's method and its convergence. Solution of system of non-linear equations by Iteration and Newton-Raphson method.

Unit-II Direct methods to solve the system of linear equations: Gauss elimination method, Gauss Jordan method, LU decomposition method. Indirect methods: Gauss-Jacobi and Gauss-Seidal methods. The algebraic Eigen value problems by Power method.

Unit-III Finite difference operators and finite differences, Interpolation and interpolating polynomials: Newton's forward and backward difference formulae. Central differences: Sterling's and Bessel's formula. Lagrange's interpolation formula, Divided Differences, their properties and Newton's general interpolation formula.

Unit-IV Numerical differentiation of tabular and non-tabular functions. Numerical integration using Gauss quadrature formulae: Trapezoidal rule, Simpson's rules and their error estimation. Numerical solution of ordinary differential equations by Picard's method, Taylor series, Euler's method and Runge-Kutta methods. Difference equation and their solution.

Books Recommended:

1. B. Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007
2. M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computation, New age International Publisher, India, 5th edition, 2007
3. C. F. Gerald and P. O. Wheatley, Applied Numerical Analysis, Pearson Education, India, 7th edition, 2008.
4. S.S. Sastry, Introductory Methods of Numerical Analysis (Fifth Ed.), Prentice Hall of India (Ltd.) New Delhi-110001, 2012.
5. M. Pal, Numerical Analysis for Scientists and Engineers, Narosa Publisher, 2007.
6. N. Ahmad, Fundamental Numerical Analysis with error estimation, Anamaya Publisher.

B. A./ B.Sc. (Subsi), Semester – V

BSM-5.1	Groups, Rings and Vector Spaces	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

- Unit-I** Cartesian product, Relation, Types of relations, Equivalence relation and Equivalence classes,
Definition of group and their properties, Subgroups and their characterizations, cosets, Lagrange's theorem and its consequences.
- Unit-II** Normal subgroups and their properties, Quotient groups, Group homomorphism and its Properties, Kernel of a homomorphism, Isomorphism, Permutation group, Even and odd permutations, Cycles, Alternating group.
- Unit-III** Definition and examples of rings, Properties of rings, Subrings, Ideals, Quotient rings, Ring homomorphism, Isomorphism, Kernel of a homomorphism, The homomorphism Theorems.
- Unit-IV** Definition and examples of Vector Spaces, Properties of Vector Spaces, Subspaces and their Characterizations, Linear dependence and Independence, Basis and Dimension, Linear transformation, Range and Kernel, Rank and Nullity of linear transformations.

Books Recommended:

1. N. HerrNSTein: *Topics in Algebra*, Wiley Eastern Ltd., New Delhi.
2. David C. Lay: *Linear algebra and its applications (3rd Edition)*, Pearson Education Asia, Indian Reprint.
3. Surjeet Singh & Qazi Zameeruddin: *Modern algebra*, Vikas Publishing House Pvt. Ltd., New Delhi
4. N. Jacobson: *Basic Algebra*, Volume I and II. W. H. Freeman and Co.

B. A./ B.Sc. (Subsi), Semester – VI

BSM-6.1	Partial Differential Equations	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Total differential equations, Simultaneous total differential equations, Equations of the form $dx/P = dy/Q = dz/R$, Methods of grouping and multipliers, Solution of a system of linear differential equation with constant coefficients, An equivalent triangular system.

Unit-II Formation and solution of a partial differential equations, Equations easily integrable. Linear partial differential equations of first order- Lagrange's equation, Non-linear partial differential equation of first order- Solution of some standard type of equations, Charpit's method.

Unit-III Homogeneous linear partial differential equations of second and higher orders with constant coefficients, Different cases for complimentary functions and particular integrals, Non-homogeneous partial differential equations with constant coefficients, Classification of second order linear partial differential equations, Partial differential equations reducible to equations with constant coefficients

Unit-IV Variation of a functional, Variational problems, Euler's equations and its various cases, External, Functional depending on n unknown functions, Functionals depending on higher order derivatives, Variational problems in parametric form, Isoperimetric problem.

Books Recommended:

1. Dennis G. Zill, A first course in differential equations,
2. Tyn Mint-U and Lokenath Debnath, Linear Partial Differential Equations
3. D.A. Murray: Introductory Course on Differential Equations, Orient Longman (India), 1967.
4. A.S. Gupta: Calculus of variations with applications, Prentice Hall of India, 1997.
5. I.N. Sneddon: Elements of Partial Differential Equations, McGraw Hill Book Company, 1988.
6. Zafar Ahsan: Differential Equations and their Applications, Prentice Hall of India, New Delhi (2nd Edition, 13th reprint May 2012).