B. Sc. (Subsidiary)
Syllabus for Semester System

First Semester

Code	Course	Periods/ Week	Credits
BSM-101	Calculus	4	4
BSM-102	Geometry of Two and Three Dimensions	4	4

Second Semester

Code	Course	Periods/ Week	Credits
BSM-201	Differential Equations	4	4
BSM-202	Theory of Equations and Complex Trigonometry	4	4

Third Semester

Code	Course	Periods/ Week	Credits
BSM-301	Matrices , Determinants and Vector Calculus	4	4
BSM-302	Numerical Analysis	4	4

Fourth Semester

Code	Course	Periods/ Week	Credits
BSM-401	Operations Research	4	4
BSM-402	Groups, Rings and Vector Spaces	4	4

BSM-101: Calculus

Unit I

Limits, Continuity, Differentiability, Successive differentiation, Leibnitz Theorem, Rolle's Theorem, Mean value theorems, Taylor's and Mclauren's series.

Unit II

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

Unit III

Asymptotes, Tracing of curves in Cartesian and polar coordinates.

Unit IV

Reduction formulae, Rectification, Intrinsic equation, Volumes and surfaces of solids of revolution.

Books Recommended:

- Gorakh Prasad, *Differential Calculus*, Pothishalas Pvt Ltd, Allahabad.
- Gorakh Prasad, *Integral Calculus*, Pothishalas Pvt Ltd, Allahabad.
- Shanti Narayan, *Differential Calculus*, S. Chand & Co.
- Shanti Narayan, *Integral Calculus*, S. Chand & Co.
- Khalil Ahmad, *Text Book of Calculus*, World Education Publishers, 2012.

BSM-102: Geometry of Two and Three dimensions

Unit I

Conic sections, General equation of second degree, Pair of lines, Parabola, Tangent, normal. Euation of parabola in standard and parametric form,Tangent, normal, pole and polar and their properties.

Unit II

Equations of ellipse and hyperbola in standard and parametric forms, Tangent, normal, pole, polar and their properties, Conjugate diameters,Asymptotes, conjugate hyperbola and rectangular hyperbola.

Unit III

Polar equation of a conic, Polar equation of Tangent, normal, polar and asymptote. Tracing of parabola, ellipse and hyperbola.

Unit IV

Equation of sphere,Tangent plane. Ntersection of two spheres, Equation of cone, Intersection of cone with a plane and a line. Right circular cone.

Books Recommended:

- Ram Ballabh: *Text book of Coordinate Geometry*. Prakashan Kendra, 1965
- S. L. Loney: *The elements of coordinate geometry*, Michigan Historical Reprint Series
- P.K. Jain and Khalil Ahmad: *Text book of Analytical Geometry*, New Age International (P) Ltd. Publishers.

BSM-201: Differential Equations

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.

Unit II

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

Unit III

Linear differential equations with constant coefficient, Complementary function and particular integral. Particular integral of the forms e^{ax}, *sinax, cosax,* $x^m$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 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.

BSM-202: Theory of Equations and Complex Trigonometry

Unit I

Properties of algebraic equations with rational and integral coefficients. Nature and location of roots of polynomial equations. Transformation of equations. Removal of terms.

Unit II

Solutions of cubic equations by Cardan's method. Solution of biquadratic equations by radicals. Ferrari's and Descarte's methods.

Unit III

De Moivre's theorem and its application in separation of real and imaginary parts and determination of roots of complex numbers. Expansion of $\sin n\,\theta$, $\cos n\,\theta$ in terms of powers of $sin\theta$ and $cos\theta$, and vice versa.

Unit IV

Seperation of real and imaginary parts of trigonometric and inverse trigonometric functions. Hyperbolic and inverse hyperbolic functions. Summation of series including C+iS method.

Books Recommended:

- Ushri Dutta, A.S.Muktibodh and S.D. Mohagaonkar: *Algebra and Trigonometry*, PHI India

BSM-301: Matrices, Determinants and Vector Calculus

Unit I

Determinants and their properties. Solution of determinants using properties. Multiplication of determinants. Matrices and their algebra. Types of matrices. Identity, Hermitian and Skew Hermitian matrices. Transpose of a matrix. Adjoint and inverse of a matrix. Rank of a matrix.

Unit II

Row echelon and reduced row echelon form of a matrix. Augmented matrix. Solution of system of linear equations by matrix method. Consistency of the system of homogeneous and non-homogeneous linear equations- with emphasis on problems. Cayley Hamilton Theorem and its application to find inverse of a matrix.

Unit III

Application of scalar and vector products of two vectors to geometry and mechanics. Scalar and vector products of three and four vectors and problems based on them.

Unit IV

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

Books Recommended:

- Ushri Dutta, A.S.Muktibodh and S.D. Mohagaonkar: *Algebra and Trigonometry*, PHI India
- Weatherbarn, C.E. : *Vector Analysis*, Vol II and II.
- Chandrika Prasad: *A text book on algebra & theory of equations*.

BSM-302: Numerical Analysis

Unit1.
Solution of algebraic and transcendental equations: Bisection method, False position method, Fixed-point iteration method, Newton's method and its convergence, Chebyshev method. Solution of system of non-linear equations by Iteration and Newton-Raphson method.

Unit 2.
Finite difference operators and finite differences; Interpolation and its formulae: Newton's forward and backward difference, Lagrange's interpolation formula and Newton's divided difference interpolation formula, Solution of homogeneous and non-homogeneous difference equations.

Unit 3.
Direct methods to solve system of linear equations: Gauss elimination method, Gauss-Jordan method, LU decomposition; Indirect methods: Gauss-Jacobi and Gauss-Seidal methods. The algebraic eigen value problems by Power method.

Unit 4.
Numerical differentiation and Numerical integration by Newton cotes formulae, Trapezoidal rule, Simpson's rule, Romberg formula and their error estimation. Numerical solution of ordinary differential equations by Euler's method, Picard's method, Taylor series and Runge-Kutta methods.

Books Recommended:

- 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
- N. Ahmad, *Fundamental Numerical Analysis with error estimation*.
- M. Pal : *Numerical Analysis for scientific and engineering Computation*, Narosa, India

BSM-401: Operations Research

Unit I:
Operations Research (OR) and its Scope, Modeling in OR, Scientific Method in Operations Research, Linear Programming (LP) Problems and it's Applications, Formulation of LP Problem, Solution of LP Problems - Graphical Method, Simplex Method.

Unit- II:
Transportation Problem, Initial basic feasible solution, optimal solution of transportation problem, unbalance transportation problem, Assignment problem, Hungarian Method for solving assignment problem, unbalance assignment problem.

Unit III:
Sequencing theory, *m* machines and *n* jobs problem, Graphical method for sequence problem, Elementary inventory models, Replacement models.

Unit IV:
Game Theory, saddle point, two-persons-zero-sum game, game with saddle point, game with mixed strategies, dominance rule, graphical method for $2\times n$ and $m\times 2$ games, Inter - relation between the theory of games and linear programming.

Books Recommended:

- J. K. Sharma, *Operations Research – Theory and Application*, Macmillian Pub.
- J. K. Sharma, *Operations Research – Problems and Solutions*, Macmillian Pub.
- G. Hadly, *Linear Programming*, Narosa Publishing House
- A. H. Taha, *Operations Research – An Introduction*. Prentice Hall
- Hillier and Lieberman, *Introduction to Operations Research*, McGraw Hill.

BSM-402: Groups, Rings and Vector Spaces

Unit I

Cartesian product, relation, Types of relations, Equivalence relation and equivalence classes. Definition of group and their properties, Subgroups and their characterization, Order of an element of a group, Lagrange's theorem.

Unit II

Normal subgroups and their properties. Quotient group. Group homomorphism and its properties. Kernel of a homomorphism, isomorphism. Even and odd permutations. cycles. Alternating group. Permutation group (Basic results only).

Unit III

Rings and their properties, subrings, ideal. Quotient ring. Ring homomorphism. Kernel of a homomorphism and its properties. Quotient ring. Some elementary results based on the above.

Unit IV

Definition and examples of vector spaces. Properties of vector spaces. Subspaces and their characterization. Problems based on them. Linear dependence and independence. Basis. Dimension. Linear transformation and problems based on rank and nullity of a linear transformation.

Books Recommended:

- I. N. Herrnstein: *Topics in Algebra*
- Surjeet Singh & Qazi Zameeruddin: *Modern algebra*, Vikas Publishing House Pvt. Ltd.,