Scheme for Choice Based Credit System (CBCS)

B.A/B.Sc. Mathematics

From Year 2016 and onwards

Semester	Name of the course	Course No.	Nature of course	Credits
1	Calculus	BMM-CR-16101	Core	6
2	Differential Equations	BMM-CR-16201	Core	6
3	Real Analysis	BMM-CR-16301	Core	6
	Complex Trigonometry, Logic and Sets	BMM-SEC-16301	SEC	4
4	Algebra	BMM-CR-16401	Core	6
	Theory of Equations and Vector Calculus	BMM-SEC-16401	SEC	4
5	Plane and Solid Geometry	BMM-DSE-16501	DSE	6
	Numerical Analysis	BMM-DSE-16502	DSE	6
	Advanced Calculus and Laplace Transformation	BMM-SEC-16501	SEC	4
6	Linear Algebra	BMM-DSE-16601	DSE	6
	Theory of Probability	BMM-SEC-16602	DSE	6
	Graph Theory and Boolean Algebra	BMM-SEC-16601	SEC	4

Note: The students have to opt one course from SEC in each of the semester III, IV, V & VI.

Syllabus for B.A/B.Sc., Mathematics, Semester - I

Course Name: Calculus (6 credits)
Course No: BMM-CR-16101

Unit-I

Limit and Continuity ($\in$ and δ definition), types of discontinuities, properties of continuous functions on closed intervals, differentiability of functions, Successive differentiation, Leibnitz's theorem, partial differentiation, total differentials, Euler's theorem on homogenous functions.

Unit-II

Tangents and normals (polar coordinates only), pedal equations, curvature and radius of curvature, asymptotes, singular points, tracing of curves in cartesian and polar coordinates.

Unit-III

Rolle's theorem, Mean value theorems, Taylor's theorem with Lagrange's Cauchy's forms of remainder, Taylor's series, Maclaurin's series of sin x, cos x, e^x, $\log(1+x)$, $(1+x)^m$, maxima and minima, indeterminate forms.

Unit-IV

Integration by partial fractions, integration of rational and irrational functions, definite integrals and their properties, reduction formulae for integrals of rational, trigonometric, exponential and logarithmic functions and of their combinations.

Books recommended

1. G.B. Thomas and R. L. Finney, *Calculus*, Pearson Education, 2007.
2. H. Anton, I. Birens and S. Davis, *Calculus*, John Wiley and Sons, Inc., 2002.
3. S. D. Chopra, M. L. Kochar and A.Aziz, *Differential Calculus*, Kapoor Publications.

Syllabus for B.A/B.Sc., Mathematics, Semester - II

Course Name: Differential Equations (6 credits)
Course No: BMM-CR-16201

Unit-I

Differential equations, integrating factors, Bernoulli's equation, exact differential equations, necessary and sufficient conditions for exactness, symbolic operators, homogeneous and non-homogeneous linear differential equations with constant coefficients and those reducible to such equations.

Unit-II

Miscellaneous forms of differential equations, first order higher degree equations solvable for X, Y, Z, P equations from which one variable is explicitly absent, Clairut's form, equations reducible to Clairut's form.

Unit-III

Legendre polynomials, Bessel function, recurrence relation and differential equation satisfied by each of these functions, Wronskian and its properties

Unit-IV

Formation of partial differential equations, order and degree of partial differential equations, concept of linear and non-linear partial differential equations, linear partial differential equation of first order, Lagrange's method, Geometrical interpretation of the form Pp + Qq = R, Charpit's method, classification of second order partial differential equations into elliptical, parabolic and hyperbolic through illustrations only.

Books recommended

1. I. Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill, International Edition, 1967.
2. M. D. Raisinghania, *Ordinary differential Equations.*
3. S. D. Chopra and M.L.Kochar, *Integral Calculus*, Kapoor Pub.
4. Shepley L. Ross, *Differential Equations*, 3rd Ed., John Willey and Sons, 1984.
5. Schaun Series, *Differential Equations*.

Syllabus for B.A/B.Sc., Mathematics, Semester - III

Course Name: Real Analysis (6 credits)
Course No: BMM-CR-16301

Unit-I

Finite and infinite sets, examples of countable and uncountable sets, real line, bounded sets, suprema and infima, completeness property of R, Archimedean property of R, intervals, concept of cluster points and statement of Bolzano-Weierstrass theorem.

Unit-II

Real sequence, bounded sequence, Cauchy convergence criterion of sequences, Cauchy's theorem on limits, order preservation and seqeeze theorem, monotone sequences and their convergence (monotone convergence theorem without proof).

Unit-III

Infinite series, Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, alternating series, Leibnitz's test, definition and examples of absolute, conditional and uniform convergence.

Unit-IV

Sequences and series of functions, point wise and uniform convergence, Mn-test, M-test, statements of the results about uniform convergence and integrability and differentiability of functions, power series and radius of convergence.

Books recommended

1. T.M.Apostol, *Calculus* (Vol I), John Wiley and Sons (Asia) P. Ltd., 2002.
2. R.G.Bartle and D.R. Sherbert, *Introduction to Real Analysis*, John Wiley and Sons (Asia) P. Ltd., 2000.
3. E. Fischer, *Intermediate Real Analysis,* Springer Verlag, 1983.
4. K.A.Ross, *Elementary Analysis – The Theory of Calculus Series*- Undergraduate Texts in Mathematics, Springer Verlag 2003.

Syllabus for B.A/B.Sc., Mathematics, Semester - III

Course Name: Complex Trigonometry, Logic and Sets (4 credits)

Course No: BMM-SEC-16301

Unit-I

Review of complex number system, triangle inequality, equation of a circle and ellipse in complex form, De Moivere's theorem and its applications, expansion of sin nθ, cos nθ etc. in terms of powers of sin θ, cos θ and expansion of $\sin^n \theta$ and $\text{sos}^n \theta$ in terms of multiples of θ.

Unit-II

Functions of a complex variable, exponential, circular, hyperbolic, inverse hyperbolic and logarithmic functions of a complex variable and their properties, summation of trigonometric series, difference method, C + iS method, C-R equations, definition of analytic functions.

Unit-III

Introduction, propositons, truth table, negation, conjuction and disjunction. Implications biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators, propositional equivalence, logical equivalences, predicates and quantifiers, introduction, Quantifiers, Binding variables and negations.

Unit-IV

Sets, subsets, set operations, the laws of set theory and Venn diagrams, examples of finite and infinite sets, finite sets and counting principle, empty set, properties of empty set, standard set operations, classes of sets, power set of a set. Difference and symmetric difference of two sets, set identities, generalized union and intersections. Relation: product set, composition of relations, types of relations, partitions, equivalence relations with example of congruence modulo relation.

Text Books Recommended

1. S.D. Chopra and M.L. Kochar and A.Aziz-ul-Auzeem, Differential Calculus (Thoroughly revised and enlarged new edition- 2004).

2. A.Aziz and N.A.Rather, Complex Trigonometry, KBS.

3. R.P.Grimaldi, Discrete Mathematics and Combinatorial Mathematics, Pearson Education, 1998.

4. P.R.Halmos, Native Set Theory, Springer, 1974.

5. E.Kamke, Theory of Sets, Dover Publishers, 1950.

Syllabus for B.A/B.Sc., Mathematics, Semester - IV

Course Name: Algebra (6 credits)

Course No: BMM-CR-16401

Unit-I

Definition and examples of groups, examples of abelian and non-abelian groups, the group Z_n of integers under additional modulo n and group U(n) of units under multiplication modulo n. Cyclic groups from number systems, complex roots of unity, circle group, the general linear group GL_n (N, r), groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle and (iv) a square, the permutation group Sym (n), groups of quaternions.

Unit-II

Subgroups, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group. Cosets, index of subgroup, Lagrange's theorem, order of an element.

Unit-III

Normal subgroups: their definition, examples, and characterizations, Quotient groups.

Unit-IV

Definition and examples of rings, examples of commutative and non-commutative rings: rings from number systems, Z_n the ring of integers modulo n, ring of real quanternions, rings of matrices, polynomial rings, and rings of continuous functions, subrings and ideals, integral domain and fields, examples of fields: Z_p Q, R and C. Field of rational functions.

Books recommended

1. John B. Fraleigh, *A First Course in Abstract Algebra*, 7th Ed., Pearson 2002.
2. M.Artin, *Abstract Algebra*, 2nd Ed., Pearson 2011.
3. Joseph A Gallian, *Contemporary Abstract Algebra*, 4th Ed., Narosa 1999.
4. George E Andrew, *Number Theory*, Hindustan Publishing Corporation, 1984.

Syllabus for B.A/B.Sc., Mathematics, Semester - IV

Course Name: Theory of Equations and Vector Calculus (4 credits)

Course No: BMM-SEC-16401

Unit-I

General properties of polynomials, graphical representation of polynomials, maximum and minimum values of polynomials, general properties of equation, Descarte's rule of signs positive and negative rule, relation between the roots and the coefficients of equations.

Unit-II

Symmetric functions, applications symmetric function of the roots, transformation of equations, solutions of reciprocal and binomial equations, algebraic solutions of the cubic biquadratic, properties of the derived functions

Unit-III

Parametric representation of curves and surfaces; limit, continuity and differentiability of vector functions, derivative of sum, dot product and cross product of two vectors, gradient of a scalar field and directional derivative, geometrical representation.

Unit-IV

Divergence of vector field, curl of vector field, physical interpretation of divergence and curl, line integrals and Green's Theorem, surface area and surface integrals, Divergence Theorem of Gauss, Stoke's Theorem.

Books recommended

1. W.S.Burnside and A.W.Panton, The tHeory of Equations, Dublin University Press, 1954.
2. C.C.MacDuffee, Theory of Equations, John Wiley and Sons Inc., 1954.
3. G.B.Thomas and R.L. Finney, calculus, 9th Ed., Pearson Education, Delhi, 2005.
4. H.Anton, I.Bivens and S.Davis, Calculus, John Wiley and Sons (Asia) P.Ltd.
5. P.C.Matheew's, Vector Calculus, Springer Verlag London Limited, 1998.

Syllabus for B.A/B.Sc., Mathematics, Semester - V

Course Name: Plane and Solid Geometry (6 credits)

Course No: BMM-DSE-16501

Unit-I

Parabola, tangents and normals, pole and polar, parametric equations of a parabola, ellipse, tangents and normals, pole and polar, parametric equations of ellipse, diameters, conjugate diameters and their properties. Hyperbola, tangents and normals, equation of hyperbola referred to asymptotes as axes, rectangular and conjugate diameters and their properties, tracing of conics (Cartesian co-ordinates only), general second degree equation in x and y, conditions under which a general second degree equation represents a conic and determination of equation of the corresponding conic.

Unit-II

Sphere, radical plane, coaxial system, cone, vertex, guiding curve, generator, equation of cone with vertex as origin or a given vertex and guiding curve, condition that the general equation of the second degree should represent a cone, necessary and sufficient conditions for a cone to have three mutually perpendicular generators, cylinder, equation of the cylinder whose generators intersect a given conic and are parallel to given line, enveloping cylinder of a sphere.

Unit-III

Types of conicoids, central conicoids, tangent and tangent planes, director sphere, normals to a surface, polar and polar planes, enveloping and enveloping cylinder, the paraboloids, conjugate diameters and conjugate planes, plane sections of a conicoid, circular sections of conicoids, umbilics.

Unit-IV

Generating lines- ruled surfaces, real ruled surfaces, generating lines for hyperbolic paraboloid of one sheet, perpendicular generators, generating lines for hyperbolic paraboloid, conicoids through three given lines, hyperboloid whose two generators are coordinate axes, properties of a generating line

Text Books Recommended

1. P. Balasubrahamanyam, K.G. Subramanian and G.R.Venkataraman, Coordinate Geometry of two and three Dimensions.
2. S.Pirzada and T.A.Chishti, Analytical Solid Geometry, Universities Press, Orient Blackswan, 2007.
3. Shanti Narayan, Analytical Solid Geometry.

Syllabus for B.A/B.Sc., Mathematics, Semester - V

Course Name: Numerical Analysis (6 credits)

Course No. BMM- DSE-16502

Unit-I

Preliminaries of Computing; Basic concepts: round-off errors; Errors in Numerical calculations; Absolute, relative and percentage errors, General error formula; Error in a series approximation; Taylor and Maclaurin's series approximations; Convergence of a numerical solution; The Bisection method; fixed-point iteration; the iteration method; Acceleration of convergence (Aitken's Δ^2 - process).

Unit II

Newton- Raphson method; Computing roots of algebraic and transcendental equations. Interpolation and Polynomial Approximation; Finite differences: Forward, Backward and Central differences; Symbolic relations and separation of symbols; Lagrange's Interpolation formula.

Unit-III

Numerical differentiation; Errors in numerical differentiation; Newton's forward difference method; The cubic spline method; Numerical Integration; General quadrature formula; Trapezoidal rule; Simpson 1/3 and 3/8 methods.

Unit-IV

Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods; Numerical factorizations; Eigenvalue problems; IVP problems for ODE; Euler's, Taylor's and Runge-Kutta methods; Picard's iterative method; Approximation theory; Least square approximation.

Suggested Books

1. S.C. Chapra, and P.C. Raymond, Numerical Methods for Engineers, Tata McGraw Hill, New Delhi (2000)
2. R.L. Burden, and J. Douglas Faires, Numerical Analysis, P.W.S. Kent Publishing Company, Boston (1989), Fourth edition.
3. S.S. Sastry, Introductory methods of Numerical analysis, Prentice- Hall of India, New Delhi (1998).
4. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical methods for scientific and Engineering computation, Wiley Eastern (1993)

Syllabus for B.A/B.Sc., Mathematics, Semester - V

Course Name: Advanced Calculus and Laplace Transformation (4 Credits)

Course No: BMM-SEC-16501

Unit I

Limit, Continuity and differentiability of functions of two or more variables, Total and second derivatives, Sufficient conditions for validity of reversal in the order of derivation, Young's theorem,Schwarz's theorem.

Unit II

Change of variables, Extreme values of functions of two or more variables, Restricted maxima and minima , Lagrange's method of multipliers. Jacobians, curvilinear integrals, Beta and Gamma functions and relation between them.

Unit III

Multiple integrals, Integral over plane areas in xy-plane, Double integrals,evaluation , change of order of integration for two variables, Double integrals in polar co-ordinates, Integrals over regions in xyz-space, Triple integrals,evaluation in Cartesian , spherical and cylindrical co-ordinates.

Unit IV

Laplace transform-definition, Laplace transform of some elementary functions, piecewise continuity, functions of exponential order, sufficient conditions for existence of Laplace transform, linearity property, first and second translation (shifting property), Laplace transform of derivatives, Laplace transform of integrals, periodic functions, initial and final value theorems.

Books Recommended

1.Kochar &Chopra, Advanced Calculus

2. S.C.Malik, Mathematical Analysis.

3. Murrey R. Spiegel, Laplace Transforms, Schaum's outline series.

Syllabus for B.A/B.Sc., Mathematics, Semester - VI

Course Name: Linear Algebra (6 credits)

Course No: BMM-DSE-16601

Unit-I

Types and properties of matrices, Inverse of a square matrix, matrix polynomials, characteristic equation, Cayley-Hamilton Theorem , Eigen values and eigen vectors of matrices and their determination, rank of a matrix, invariance of rank matrix under elementary transformations. Reduction of matrix to normal form, elementary matrices.

Unit-II

Linear dependence and linear independence of row(column) vectors, conditions for columns of a matrix to be linearly dependent, matrix A has rank r iff it has r linearly independent columns, analogous results for rows. Linear homogeneous and non-homogeneous equations, Linear product of two vectors, orthogonal and unitary matrices, determination of orthogonal matrices.

Unit-III

Vector spaces, examples, subspaces, algebra of subspaces, quotient spaces, linear dependence, independence and linear span of vectors, basis and dimensions of vector spaces.

Unit-IV

Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations, dual space and dual basis, homomorphism and isomorphism, isomorphism theorems.

Text Books Recommended:

1 A. Aziz, N. A. Rather and B. A. Zargar, A Text Book of Matrices, KBD.
2 Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, PHI.
3 S. Lang, Introduction to Lineaer Algebra, Springer.
4 Shanti Narayan, A Text Book of Matrices.
5 Gilbert Strang, Linear Algebra and its Applications, Thomson (2007)

Syllabus for B.A/B.Sc., Mathematics, Semester - VI

Course Name: Theory of Probability (6 credits)

Course No: BMM-DSE-16602

UNIT-I

The probability set functions, its properties, probability density function, the distribution function and its properties, mathematical expectations, some special mathematical expectations, inequalities of Markov, Chebyshev and Jensen.

Unit -II

Conditional probability, independent events, Baye's theorem, distribution of two and more random variables, marginal and conditional distributions, conditional means and variances, correlation coefficient, stochastic independence and its various criteria.

Unit –III

Some Special Distributions, Bernoulli, Binomial, trinomial, multinomial, negative binomial, Poisson, gamma, chi-square, beta, Cauchy, exponential, geometric, normal and bivariate normal distributions.

Unit –IV

Distribution of functions of random variables, distribution function method, change of variables method, moment generating function method, t and F distributions, distribution of order statistics, distribution of $\overline{X}$ and $\frac{nS^2}{\sigma^2}$. Limiting distributions, different modes of convergence, central limit theorem.

Recommended Books:

1. Hogg and Craig, An Introduction to Mathematical Statistics.

2. Mood and Grayball, An Introduction to Mathematical Statistics.

References

3. C. R. Rao, Linear Statistical Inference and its Applications.

4. V. K. Rohatgi, An Introduction to Probability and Statistics.

Syllabus for B.A/B.Sc., Mathematics, Semester - VI

Course Name: Graph Theory and Boolean Algebra (4 credits)

Course No: BMM-SEC-16601

Unit-I

Introduction to graphs, paths and cycles, operations on graphs, bipartite graphs and Konig's Theorem, Euler graphs and Euler's Theorem, Konigsberg bridge problem, Hamiltonian graphs, degree sequences.

Unit-II

Tress and their properties, centers in tress, binary and spanning trees, cut vertex and cut edge in graphs, incidence and adjacency matrix in graphs, directed graphs.

Unit-III

Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, maximal and minimal elements, lattices ordered sets, complete lattices, lattices as algebraic structures, sublattices, products and homomorphisms.

Unit-IV

Definition, examples and properties of modular and distributive lattices, lattices, Boolean Algebras, Boolean polynomials, minimal forms of Boolean polynomials, Quinn-McCluskey method, Karnaugh diagrams, switching circuits and applications of switching circuits.

Books recommended:

1. S.Pirzada, *An Introduction to Graph Theory*, Universities Press, Orient Blackswan, 2012.
2. Narsingh Deo, *Graph Theory with Applications to Engineering and Computer Science*, Prentice Hall.
3. B.A.Davey and H.A.Priestley, *Introduction to lattices and Order*, Cambridge University Press, Cambridge, 1990.
4. Rudolf Lidl and Gunter Pilz, *Applied Abstract Algebra*, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.