

**CHOICE BASED CREDIT SYSTEM SCHEME AT UNDER-GRADUATE LEVEL PROGRAMME:
BACHLOR OF ARTS/SCIENCE (GENERAL): MATHEMATICS FOR 2018, 2019 ONWARDS**

SEMESTER	COURSE CODE	TYPES OF COURSE	TITLE OF COURSE	CREDITS		
				THEORY	PRACTICAL 2 or 0	TUTORIAL 0 or 2
I	MM119C	DSC-1(6 CREDITS)	CALCULUS AND COMPLEX TRIGNOMTERY	4		2
II	MM219C	DSC-2(6 CREDITS)	DIFFRENTIAL EQUATIONS AND THEORY OF EQUATIONS	4		2
III	MM319C	DSC-3(6 CREDITS)	REAL ANALYSIS	4	fd	2
IV	MM419C	DSC-4(6 CREDITS)	ALGEBRA	4		2
VA	MM519DA	DSE(6 CREDITS)	PLANE AND SOLID GEOMETRY	4		2
or VB	MM519DB	DSE(6 CREDITS)	NUMERICAL ANALYSIS	4		2
VIA	MM619DA	DSE(6 CREDITS)	LINEAR ALGEBRA	4		2
or VIB	MM619DB	DSE(6 CREDITS)	THEORY OF PROBABILITY	4		2

Generic Elective Courses for V & VI Semesters

SEMESTER	COURSE CODE	TYPES OF COURSE	TITLE OF COURSE	CREDITS		
				THEORY	PRACTICAL 2 or 0	TUTORIAL 0 or 2
V	MM519GA	GE(6 Credits)	Mathematics-I	4		2
VI	MM519GB	GE(6 Credits)	Mathematics-II	4		2

*** To expose the students having no background in mathematics to mathematical thinking and make them understand the basic concepts of the mathematics and their applications in day to day problems.**

Bachelor of Arts/Science

2nd SEMESTER

DISCIPLINE SPECIFIC COURSE –2 (CORE-2)

**MM219C: DIFFERENTIAL EQUATIONS AND
THEORY OF EQUATIONS
THEORY (4 CREDITS: 60 HOURS)**

CREDITS THEORY-4, TUTORIAL: 2

MAXIMUM MARKS: 60, MINIMUM MARKS: 24

Objectives: The aim of this course is:

- i) To learn the techniques of solving differential equations.
- ii) To apply these techniques in the problems of other subjects.
- iii). To study the properties of polynomial equations and their solutions upto degree 4.

At the end a student should be able to translate the real life problems into mathematical language and give the solutions.

UNIT-1 (15 HOURS)

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 and variable coefficients.

UNIT-2 (15 HOURS)

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-3 (15 HOURS)

General properties of polynomials, Synthetic division, relation between the roots and the coefficients of an equation, transformation of equations, diminishing of roots of an equation by a given number, removal of terms of an equation, formation of equations whose roots are functions of the roots of a given equation, equation of squared difference.

UNIT-4 (15 HOURS)

Symmetric functions, Newton's method for finding the sum of the powers of the roots of an equation, Cardan's solution of the cubic, nature of the root of a cubic, Descartes solution of a biquadratic, Descartes rule of signs, rational roots of an integral polynomial, location of roots of an equation (simple cases).

TUTORIALS (2 CREDITS: 30 HOURS) Maximum Marks: 30 Minimum Marks: 12

3. Tutorials based on Unit I & II - **1 credit**
4. Tutorials based on Unit III & IV – **1 credit**.

Books recommended

1. S. D. Chopra and M.L.Kochar, *Integral Calculus*, Kapoor Publications
2. M. D. Raisinghania, *Ordinary Differential Equations*.
3. Shepley L. Ross, *Differential Equations*, 3rd Ed., John Willey and Sons, 1984.
5. Schaum Series, *Differential Equations*.
6. A.Aziz, Nissar A.Rather and B.A.Zargar, *Theory of Equations*, Kapoor Publications.
7. W.S.Burnside and A.W.Panton, *The Theory of Equations*, Dublin University Press, 1954.
8. C.C.MacDuffee, *Theory of Equations*, John Wiley and Sons Inc., 1954.

Bachelor of Arts/Science

3rd SEMESTER

DISCIPLINE SPECIFIC COURSE –3 (CORE-3)

MM319C: REAL ANALYSIS

CREDITS THEORY-4, TUTORIAL: 2

THEORY (4 CREDITS: 60 HOURS)

MAXIMUM MARKS: 60, MINIMUM MARKS: 24

Objectives: The objective of this course is:

- i) To analyse the validity of the fundamental concepts and scope.
- ii) To apply the concepts in other branches of the subject.

UNIT-1 (15 HOURS)

Finite and infinite sets, countable and uncountable sets, countability of rationals, uncountability of reals, bounded sets, suprema and infima, completeness property of \mathbb{R} , Archimedean property of \mathbb{R} , Cluster points, Nested interval Theorem, Bolzano-Weierstrass theorem.

UNIT-2 (15 HOURS)

Sequences, types of sequences (bounded, unbounded, Cauchy, convergent, divergent, oscillatory sequences), Cauchy convergence criterion of sequences and related results, limit superior and limit inferior, Cauchy's theorem on limits, monotone sequences and their convergence.

UNIT-3 (15 HOURS)

Infinite series, convergence and divergence of an infinite series, Cauchy convergence criterion for series, positive term series, geometric series, comparison tests, Root test, Ratio test, Integral test, Raabe's test, Gauss's test, alternating series, Leibnitz's test, absolute and conditional convergence.

UNIT-4 (15 HOURS)

Riemann integration, lower and upper sums, refinement of a partition, behaviour of lower and upper sums under refinement, definition and existence of the Riemann integral, necessary and sufficient condition for \mathbb{R} -integrability of a bounded function, \mathbb{R} -integrability of sum, difference, product and quotient of two functions, \mathbb{R} -integrability of continuous, monotone and discontinuous functions (having finite number of discontinuity) in an interval, Mean Value Theorem for integrals.

TUTORIALS (2 CREDITS: 30 HOURS)

Maximum Marks: 30 Minimum Marks: 12

9. Tutorials based on Unit I & II - **1 credit**

10. Tutorials based on Unit III & IV – **1 credit**.

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. S.C Malik, *Mathematical Analysis*, Narosa publications.
4. K.A.Ross, *Elementary Analysis – The Theory of Calculus Series*- Undergraduate Texts in Mathematics, Springer Verlag 2003.

Bachelor of Arts/Science

4th SEMESTER

DISCIPLINE SPECIFIC COURSE –4 (CORE-4)

MM419C: ALGEBRA
THEORY (4 CREDITS: 60 HOURS)

CREDITS THEORY-4, TUTORIAL: 2
MAXIMUM MARKS: 60, MINIMUM MARKS: 24

Objectives: The aim of this course is to learn the concepts of algebraic structures and their applications in other sciences.

UNIT-1 (15 HOURS)

Groups, Semi-groups and sub-groups, Cyclic groups and their sub-groups, cosets and Lagrange's theorem, product of sub-groups, counting principle for the number of elements in HK, normaliser and centre.

UNIT-2 (15 HOURS)

Normal subgroups and various criteria for normality of a sub-group, Quotient Groups, Group homomorphism and isomorphism, Examples.

UNIT-3 (15 HOURS)

Fundamental theorem of homomorphism, Correspondence theorem, second and third theorems of isomorphism, Permutation Group, Even and odd Permutations, Symmetric group of degree n, alternating group, simple group, Cayley's theorem.

UNIT-4 (15 HOURS)

Rings, Division rings and Fields, Sub-rings and Sub-fields, Ideals, Quotient rings, Principal ideals, Prime ideals, Maximal ideals and characterisations in terms of their associated quotient rings, Ring homomorphism and isomorphism, theorems on ring isomorphisms.

TUTORIALS (2 CREDITS: 30 HOURS) Maximum Marks: 30 Minimum Marks: 12

11. Tutorials based on Unit I & II - **1 credit**
12. Tutorials based on Unit III & IV – **1 credit**.

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. I. N. Herstein, *Topics in Algebra*.
5. S. Singh and Q. Zameer Din, *Modern Algebra*.

Bachelor of Arts/Science

V A SEMESTER

DISCIPLINE SPECIFIC COURSE –5 (CORE-5)

MM519DA: PLANE AND SOLID GEOMETRY

CREDITS THEORY-4, TUTORIAL: 2

THEORY (4 CREDITS: 60 HOURS)

MAXIMUM MARKS: 60, MINIMUM MARKS: 24

Objectives: i) To study the different sections of a cone (as conic section) and properties.
ii) To extend the concepts of 2D to 3D analogues.

UNIT-1 (15 HOURS)

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.

UNIT-2 (15 HOURS)

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-3 (15 HOURS)

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.

UNIT-4 (15 HOURS)

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.

TUTORIALS (2 CREDITS: 30 HOURS)

Maximum Marks: 30 Minimum Marks: 12

13. Tutorials based on Unit I & II - **1 credit**

14. Tutorials based on Ruled Surfaces, Unit III & IV – **1 credit**.

Text Books Recommended

1. P. Balasubrahmanyam, 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.

Bachelor of Arts/Science

V B SEMESTER

DISCIPLINE SPECIFIC COURSE –5 (CORE-5)

MM519DB: NUMERICAL ANALYSIS

CREDITS THEORY-4, TUTORIAL: 2

THEORY (4 CREDITS: 60 HOURS)

MAXIMUM MARKS: 60, MINIMUM MARKS: 24

Objectives: To learn the techniques and approximations to solve numerical problems arising in physical and engineering sciences.

UNIT-1 (15 HOURS)

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 D^2 - process).

UNIT-2 (15 HOURS)

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-3 (15 HOURS)

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-4 (15 HOURS)

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

TUTORIALS (2 CREDITS: 30 HOURS) Maximum Marks: 30 Minimum Marks: 12

15. Tutorials based on Unit I & II - **1 credit**

16. Tutorials based on Unit III & IV – **1 credit**.

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)

Bachelor of Arts/Science

V1 A SEMESTER

DISCIPLINE SPECIFIC COURSE –6(CORE-6)

MM619DA: LINEAR ALGEBRA

CREDITS THEORY-4, TUTORIAL: 2

THEORY (4 CREDITS: 60 HOURS)

MAXIMUM MARKS: 60, MINIMUM MARKS: 24

Objectives: To find the solutions of systems of equations and their consistency arising from various branches of science and social science.

UNIT-1 (15 HOURS)

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-2 (15 HOURS)

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, inner product of two vectors, orthogonal and unitary matrices, determination of orthogonal matrices.

UNIT-3 (15 HOURS)

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

UNIT-4 (15 HOURS)

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.

TUTORIALS (2 CREDITS: 30 HOURS)

Maximum Marks: 30 Minimum Marks: 12

17. Tutorials based on Unit I & II - **1 credit**

18. Tutorials based on Unit III & IV – **1 credit**.

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 Linear Algebra, Springer.
4. Shanti Narayan, A Text Book of Matrices.
5. Gilbert Strang, Linear Algebra and its Applications, Thomson (2007)

Bachelor of Arts/Science
V1 B SEMESTER
DISCIPLINE SPECIFIC COURSE –6 (CORE-6)

MM619DB: THEORY OF PROBABILITY

CREDITS THEORY-4, TUTORIAL: 2

THEORY (4 CREDITS: 60 HOURS)

MAXIMUM MARKS: 60, MINIMUM MARKS: 24

Objectives: To introduce the students to study the situations involving uncertainty that arising day to day life and applications in other subjects.

UNIT-1 (15 HOURS)

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-2 (15 HOURS)

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-3 (15 HOURS)

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

UNIT-4 (15 HOURS)

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 \bar{X} and $\frac{nS^2}{\sigma^2}$. Limiting distributions, different modes of convergence, central limit theorem.

TUTORIALS (2 CREDITS: 30 HOURS)

Maximum Marks: 30 Minimum Marks: 12

19. Tutorials based on Unit I & II - **1 credit**

20. Tutorials based on Unit III & IV – **1 credit**.

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.

Bachelor of Arts/Science

V SEMESTER

Generic Elective Course –6(GE-6)

BMM519G: Mathematics-I

CREDITS THEORY-4, TUTORIAL: 2

THEORY (6 CREDITS: 60 HOURS)

MAXIMUM MARKS: 60, MINIMUM MARKS: 24

Objectives: To understand the notions of limit, continuity, differentiation and integration of a function and techniques of solving differential equations.

UNIT-1 (15 HOURS)

Cartesian Product of Sets, Relations, Types of relations, Functions, Types of functions, Composition of functions, Inverse of a function, Limit of a function, Left hand and right hand limits, Properties and evaluation of limits, Continuity of a function, Tests of continuity, Types of discontinuities.

UNIT-2 (15 HOURS)

Differentiation of a function, Rules of differentiation, Differentiation of x^n , $(ax+b)^n$, trigonometric and inverse trigonometric functions, exponential, logarithmic, hyperbolic and inverse hyperbolic functions, Successive differentiation, Leibnitz's Theorem, Partial Differentiation, Total differentiations, Euler's Theorem.

UNIT-3 (15 HOURS)

Integration as inverse process of differentiation, Indefinite and definite integrals, Integration by substitution, by parts and by partial fractions methods, Integrals of the types $\sqrt{a^2-x^2}$, $\sqrt{a^2+x^2}$ and $\sqrt{x^2-a^2}$, trigonometric and inverse trigonometric functions, exponential, logarithmic, hyperbolic and inverse hyperbolic functions, Reduction Formulae.

UNIT-4 (15 HOURS)

Differential equations, Order and degree of a differential equation, Differential equations of the first order and their solutions by Variables Separable Method, Solutions of homogeneous and non-homogeneous differential equations of first order, Solution of the linear differential Equation $dy/dx + Py = Q$, Equations reducible to linear form, Change of variables method, Bernoulli's differential equation.

TUTORIALS (2 CREDITS: 30 HOURS) Maximum Marks: 30 Minimum Marks: 12

21. Tutorials based on Unit I & II - **1 credit**

22. Tutorials based on Unit III & IV – **1 credit.**

Books Recommended

1. S.D. Chopra, M.L.Kochar and A.Aziz, Differential Calculus, Kapoor Publications.
2. S.D. Chopra and M.L.Kochar, Integral Calculus, Kapoor Publications.

Bachelor of Arts/Science

VI SEMESTER

Generic Elective Course –6(GE-6)

BMM619G: Mathematics-II
THEORY (6 CREDITS: 60 HOURS)

CREDITS THEORY-4, TUTORIAL: 2
MAXIMUM MARKS: 60, MINIMUM MARKS: 24

Objectives: i). To study/extend the complex analogues of plane trigonometry.
ii). To learn techniques for solving equations of degree upto four.
iii). To use matrix methods for solving equations.
iv). To study different sections of a cone.

UNIT-1 (15 HOURS)

Review of complex number system, triangle inequality, geometrical representations of sum, difference, product and quotient of the complex numbers, equation of a circle, Cross-ratio, De Moivre's theorem and its applications, expansion of $\sin n\theta$, $\cos n\theta$ etc. in terms of powers of $\sin \theta$, $\cos \theta$ and expansion of $\sin^n \theta$ and $\cos^n \theta$ in terms of multiples of $\cos \theta$ and $\sin \theta$, $n \in \mathbb{N}$. 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 and $C + iS$ methods.

UNIT-2 (15 HOURS)

General properties of polynomials, Remainder and Factor Theorem, relation between the roots and the coefficients of a polynomial equations, transformation of equation, symmetric function and their applications, solutions of the cubic and biquadratic equations, Descartes's rule of signs, upper bounds for positive and negative root of an equation.

UNIT-3 (15 HOURS)

Types of matrices, inverse of a square matrix, matrix polynomials, matrix and characteristics polynomial, eigen values and eigen vectors of matrix and their determination, rank of a matrix, invariance of rank through elementary transformation, reduction of matrix to normal form, elementary matrices, linear dependence and linear independence of row (column) vectors, conditions for columns of a matrix to be linearly dependent, A matrix has rank r iff it has r linearly independent columns, analogous results for rows, linear homogenous and non-homogenous equations, orthogonal and unitary matrices.

UNIT-4 (15 HOURS)

Pair of equations, joint equation of two straight lines, equations of angle bisectors, condition for general equation of 2nd degree to represent two straight lines, circle equation of tangent and normal to the circle, chord of contact, orthogonality of circles, parabola equation of parabola, tangent and normal, parametric equations,

ellipse, tangent and normal, pole and polar, Parametric equations of an ellipse, conjugate diameters and their properties, Hyperbola, equation of tangent and normal, equation of asymptotes axes, rectangular hyperbola, conjugate diameters and their properties.

TUTORIALS (2 CREDITS: 30 HOURS) Maximum Marks: 30 Minimum Marks: 12

23. Tutorials based on Unit I & II - **1 credit**

24. Tutorials based on Unit III & IV – **1 credit.**

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. A..Aziz and N.A.Rather, Complex Trigonometry, KBS.
4. A. Aziz, Nissar A. Rather and B. A. Zargar, Elementary Matrix Algebra, KBD.
5. Coordinate Geometry, KBD.