CHOICE BASED CREDIT SYSYTEM SCHEME AT UNDER-GRADUATE LEVEL

PROGRAMME: BACHLOR OF ARTS/SCIENCE (GENERAL): MATHEMATICS

SEMESTER	COURSE CODE	TYPES OF COURSE	TITLE OF COUSRE	CREDITS		
				THEORY	PRACTICAL 2 or 0	TUTORIAL 0 or 2
I	MM119C	DSC-1(6 CREDITS)	CALCULUS	4		2
II	MM219C	DSC-2(6 CREDITS)	DIFFRENTIAL EQUATIONS	4		2
III	MM319C	DSC-3(6 CREDITS)	REAL ANALYSIS	4		2
IV	MM419C	DSC-4(6 CREDITS)	ALGEBRA	4		2
VA or VB	MM519DA MM519DB	DSE(6 CREDITS) DSE(6 CREDITS)	PLANE AND SOLID GEOMETRY NUMERICAL ANALYSIS	4 4		2 2
V1A or V1B	MM619DA MM619DB	DSE(6 CREDITS) DSE(6 CREDITS)	LINEAR ALGEBRA THEORY OF PROBABILITY	4 4		2 2

SKILL ENHANCEMENT COURSES: 4 CREDITS

(NOTE; Students opting for the subject as a Core may or may not opt for any of the Skill Courses related to the subject

SEMESTER	COURSE CODE	TYPES OF COURSE	TITLE OF COUSRE	CREDITS		
				THEORY	PRACTICAL 2 or 0	TUTORIAL 0 or 2
III/IV	MM319S	SEC(4 CREDITS)	COMPLEX TRIGNOMETRY AND THEORY OF EQUATIONS	2		2
IV	MM419S	SEC(4 CREDITS)	DISASTER MANAGEMENT COUSRE	2		2
V	MM519S	SEC(4 CREDITS)	ADVANCED CALCULUS AND LINEAR PROGRAMMING	2		2
VI	MM619S	SEC(4 CREDITS)	MATHEMATICAL MODELING, TRANSPORTATION	2		2

			AND GAME THEORY			

Bachelor of Arts/Science

1st SEMESTER

DISCIPLINE SPECIFIC COUSRE –1 (CORE-1)

MM119C: CALCULUS CREDITS THEORY-4, TUTORIAL: 2
THEORY (4 CREDITS: 60 HOURS) MAXIMUM MARKS: 60, MINIMUM MARKS: 24

Objectives: The aim of this course is to prepare the students:

i) To know the basic concepts in Mathematics

ii) To apply the concepts/rules of differentiation and integration in the day to day problems

iii) To identify the situations where the limits fail to exist.

UNIT-1 (15 HOURS)

Limit and Continuity ($\in \text{and } \delta$ 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-2 (15 HOURS)

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-3 (15 HOURS)

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-4 (15 HOURS)

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.

Bachelor of Arts/Science

2nd SEMESTER

DISCIPLINE SPECIFIC COUSRE –2 (CORE-2)

MM219C: DIFFRENTIAL EQUATIONS CREDITS THEORY-4, TUTORIAL: 2
THEORY (4 CREDITS: 60 HOURS) 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.
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 coefficients and those reducible to such equations.

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)

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

UNIT-4 (15 HOURS)

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*.

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3rd SEMESTER

DISCIPLINE SPECIFIC COUSRE –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.
iii)

UNIT-1 (15 HOURS)

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-2 (15 HOURS)

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-3 (15 HOURS)

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-4 (15 HOURS

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.

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4th SEMESTER

DISCIPLINE SPECIFIC COUSRE –4 (CORE-4)

MM419C: ALGEBRA CREDITS THEORY-4, TUTORIAL: 2
THEORY (4 CREDITS: 60 HOURS) MAXIMUM MARKS: 60, MINIMUM MARKS: 24

Objectives: The aim of this course is to learn the concepts of algebraic structures and their applications to the salutations of algebraic equations.

UNIT-1 (15 HOURS

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-2 (15 HOURS

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-3 (15 HOURS

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

UNIT-4 (15 HOURS

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.

Bachelor of Arts/Science

VA SEMESTER

DISCIPLINE SPECIFIC COUSRE –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. 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-2 (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, enveloping cylinder of a sphere.

UNIT-3 (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.

UNIT-4 (15 HOURS)

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.

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VB SEMESTER

DISCIPLINE SPECIFIC COUSRE –5 (CORE-5

MM519DB: NUMERICAL ANALYSIS CREDITS THEORY-4, TUTORIAL: 2

THEORY (4 CREDITS: 60 HOURS) MAXIMUM MARKS: 60,

MINIMUM MARKS: 24

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 Δ^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.

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)

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V1A SEMESTER

DISCIPLINE SPECIFIC COUSRE –6(CORE-6)

MM619DA: LINEAR ALGEBRA **CREDITS THEORY-4, TUTORIAL: 2**

THEORY (4 CREDITS: 60 HOURS) **MAXIMUM MARKS: 60,**

MINIMUM MARKS: 24

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, Linear 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.

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)

Bachelor of Arts/Science

V1B SEMESTER

DISCIPLINE SPECIFIC COUSRE –6 (CORE-6)

MM619DB: THEORY OF PROBABILITY CREDITS THEORY-4, TUTORIAL: 2

THEORY (4 CREDITS: 60 HOURS) MAXIMUM MARKS: 60,

MINIMUM MARKS: 24

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 $\overline{X}$ 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.

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III/IV SEMESTER

DISCIPLINE SPECIFIC COUSRE –3/4 (SEC-3/4)

MM319S: COMPLEX TRIGNOMETRY AND THEORY OF EQUATIONS **CREDITS THEORY-2, TUTORIAL: 2**

THEORY (4 CREDITS: 30 HOURS) **MAXIMUM MARKS: 30, MINIMUM MARKS: 12**

UNIT-1 (7 ½ HOURS)

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 $\cos^n \theta$ in terms of multiples of θ.

UNIT-2 (7 ½ HOURS)

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-3 (7 ½ HOURS)

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-4 (7 ½ HOURS)

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

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.

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IV SEMESTER

DISCIPLINE SPECIFIC COUSRE –4(SEC-4)

MM419S: DISASTER MANAGEMENT CREDITS THEORY-2, TUTORIAL: 2

THEORY (4 CREDITS: 30 HOURS) MAXIMUM MARKS: 30, MINIMUM MARKS: 12

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V SEMESTER

DISCIPLINE SPECIFIC COUSRE –5(SEC-5)

MM519S: ADVANCED CALCULUS AND LINEAR PROGRAMMING **CREDITS THEORY-2, TUTORIAL: 2**

THEORY (4 CREDITS: 30 HOURS) **MAXIMUM MARKS: 30, MINIMUM MARKS: 12**

UNIT-1 (7 ½ HOURS)

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-2 (7 ½ HOURS)

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-3 (7 ½ HOURS)

Linear programming problems, Graphical approach for solving some linear programs, convex sets, supporting and separating hyperplanes, theory of simplex method, optimally and unboundness, the simplex algorithm, simplex method in tableau format, introduction to artificial variables, tow-phase method.

UNIT-4(7 ½ HOURS)

Big-M method and their comparison, duality, formulation of the dual problems, primal-dualrelationships, economic interpretation of the dual, sensitivity analysis.

Books Recommended

1.Kochar &Chopra, Advanced Calculus

2. S.C.Malik, Mathematical Analysis.

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

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VI SEMESTER

DISCIPLINE SPECIFIC COUSRE –6(SEC-6)

MM619S: MATHEMATICAL MODELING, CREDITS THEORY-2, TUTORIAL: 2

TRANSPORTATION AND GAME THEORY

THEORY (4 CREDITS: 30 HOURS) MAXIMUM MARKS: 30, MINIMUM MARKS: 12

UNIT-1 (7 ½ HOURS)

Introduction to mathematical modeling, types of modeling, classification of mathematical models, formulation, solution and interpretation of a model, linear

growth and decay models, non-linear growth and decay models, continuous population models for single species, logistic growth model.

UNIT-2 (7 ½ HOURS)

Fibonacci's rabbits, the golden ratio, compartment models, limitations of mathematical models. Applications of differential equations, Electric circuit problem, mechanics of simultaneous differential equations. Conduction of heat in solids, gravitational potential, conservation laws.

UNIT-3 (7 ½ HOURS)

Transportation problem and its mathematical formulation, northwest-corner method, least cost method and Vogel approximation method for determination of starting basic solution, algorithm for solving transportation problem, assignment problem and its mathematical formulation, Hungarian method for solving assignment problem.

UNIT-4 (7 ½ HOURS)

Game theory: formulation of two person zeros sum games, solving tow person zero sum games, games with mixed strategies, graphical solution procedure.

Books recommended

1. J.N. Kapur, Mathematical Modelling, Wiley Publishers.
2. M.A.Khanday, Introduction to Modeling and Biomathematics, Ariana Publishers, New Delhi.
3. Shepley L.Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, 1984.
4. I.Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill, International Edition.