K.R. MANGALAM UNIVERSITY

THE COMPLETE WORLD OF EDUCATION

SCHOOL OF BASIC AND APPLIED SCIENCES

Master of Science- Mathematics

M.Sc. Mathematics

Programme Code: 60

2018-20

Approved in the 17th Meeting of Academic Council Held on 29 June

2018

Academic Council
Member Secretary
K.R. Mangalam University

Registrar
K.R. Mangalam University
Sohna Road, Gurugram, (Haryana)

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1.Preamble

The objective of any programme at Higher Education Institute is to prepare their students for the society at large. The K. R. Mangalam University visualizes all its programmes in the best interest of their students and in this endeavour; it offers a new vision to all its Postgraduate courses. The credit system to be implemented through this curriculum, would allow students to develop a strong footing in the fundamentals and specialize in the disciplines of his/her liking and abilities. The students pursuing this course would have to develop in depth understanding of various aspects of the subject. The conceptual understanding, development of experimental skills, designing and implementation of novel synthetic methods, developing the aptitude for academic and professional skills, research skills, acquiring basic concepts for structural elucidation with hyphenated techniques, understanding the fundamental biological processes and rationale towards computer assisted drug designing are among such important aspects.

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Approved by:
Vice-Chancellor
K.R.Mangalam University

2. Introduction

K.R. Mangalam University located on Sohna Road, Gurugram, is one of the fastest growing and most promising upcoming universities in India. It is a State Private University established in 2013 by an act of the legislature of the Haryana Government under Haryana Private Universities Act (Amendment) 8 of 2013.It is recognized by the UGC under Section 2f of the UGC Act, 1956. The primary aim of the University is to promote excellence in basic and professional education while upholding moral values.

The group of educational units in the University promote education in the areas of Engineering & Technology, Legal Studies, Basic and Applied Sciences, Management Sciences, Commerce, Journalism and Mass Communication, Hotel Management and Catering Technology, Medical and Allied Sciences, Architecture and Planning, Agriculture, Fashion Designing, Humanities and Education. All the disciplines follow a well-defined curriculum design keeping in view the guidelines of UGC/AICTE and appropriate regulatory bodies like Council of Architecture (COA), Bar Council of India (BCI), Pharmacy Council of India (PCI), National Council for Teachers Education (NCTE) etc., wherever applicable. All courses are semester and credit based.

K. R. Mangalam University is unique because of its

- An enduring legacy of providing education to high achievers who demonstrate leadership in diverse fields.
- Protective and nurturing environment for teaching, research, creativity, scholarship, social and economic justice.

Objectives

i. To impart undergraduate, post-graduate and Doctoral education in identified areas of higher education.
ii. To undertake research programmes with industrial interface.
iii. To integrate its growth with the global needs and expectations of the major stake holders through teaching, research, exchange & collaborative programmes with foreign, Indian Universities/Institutions and MNCs.
iv. To act as a nodal center for transfer of technology to the industry
v. To provide job oriented professional education to the pecia student community with particular focus on Haryana.

3. About the School

The school imparts both teaching and research through its various science disciplines viz Mathematics, Chemistry and Physics.
School of Basic and Applied Sciences imparts students disciplinary knowledge, enhances their skills and ability, motivating them to think ingeniously, helping them to act independently and take decisions accordingly in all their scientific pursuits and other endeavours. It strives to empower its students and faculty members to contribute for the development of society and Nation.
The faculty is in constant touch with various experts in the relevant fields and is willing to experiment with latest ideas in teaching and research.

The School comprises undergraduate, postgraduate and doctorate of Chemistry, Physics and Mathematics.

VISION

School of Basic and Applied Sciences intends for continuum growth as centre of advanced learning, research and innovation by disseminating analytical and scientific knowledge in the areas of basic and applied sciences by promoting interdisciplinary research and scientific acumen.

MISSION

M1: Enable students to be scientists/ academicians /entrepreneurs by accomplishing fundamental and advanced research in diverse areas of basic and applied sciences.

M2: Build strong associations with academic organizations/industries for knowledge creation, advancement, and application of scientific fervor.

M3: Create conducive environment for lifelong learning.

M4: Empower students to be socially responsible and ethically strong individuals through value-based science education.

4. Programmes offered by the School

School offers undergraduate B.Sc. (Hons) Programmes, postgraduate M.Sc. Programmes, and Doctoral Programmes. All these programmes are designed to impart scientific knowledge to the students and are aimed to provide theoretical as well as practical training in their respective fields.
School offers postgraduate M.Sc. Mathematics. This school established in 2013. This programme emphasized on hands on practice, innovative thought process and project-based learning.

5. M.Sc. Mathematics

The M.Sc. in Mathematics provides a broad and flexible training in variety of courses tailored to your own interests and needs, ranging from pure mathematics to mathematical modelling, computational mathematics, and applications of mathematics to many research areas.

The programme offers a substantial opportunity for independent study and research in the form of a dissertation. The dissertation is undertaken under the guidance of a supervisor and will typically involve investigating and writing in a particular area of mathematical sciences. A dissertation gives students the opportunity to develop broader transferable skills in the processes of organizing, communicating, and presenting their work, and will equip students well for further research or for a wide variety of other careers.

Eligibility Criteria: - He/ She should have passed the B.Sc. (Hons) Mathematics / B.Sc. with Mathematics as a major subject, from a recognized University or equivalent with a minimum of 50% marks in aggregate.

Course Outline: - Real Analysis/ Complex Analysis/ Functional Analysis/ Topology/ Advanced Algebra/ Measure and Integration/ Industrial & Applied Mathematics/ Numerical Analysis & Scientific Computing.

Career Options: - Opportunities exist in researchers, teachers, or even work in many branches of Engineering, Finance, Physics, Chemistry, Medicine and more.

6. Programme Duration

The minimum period required for the M.Sc. Programme offered by the University shall extend over a period of two Academic Years.
The maximum period for the completion of the M.Sc. Programme offered by the University shall be four years.

7. Class Timings

The classes will be held from Monday to Friday from 09:10 am to 04:10 pm.

8. Scheme of Studies and Syllabi

The syllabi of M.Sc. Mathematics programme offered by School of Basic and Applied Sciences with scheme of studies are given in the following pages.

BSMA 701	**LINEAR ALGEBRA**	4	-	-	4

UNIT I

Vector spaces over fields, subspaces, bases and dimension. Systems of linear equations, matrices, rank, Gaussian elimination.

UNIT II

Linear transformations, representation of linear transformations by matrices, rank-nullity theorem, duality and transpose. Determinants, Laplace expansions, cofactors, adjoint, Cramer's Rule.

UNIT III

Eigen values and Eigen vectors, characteristic polynomials, minimal polynomials, Cayley-Hamilton Theorem, triangulation, diagonalization, rational canonical form, Jordan canonical form.

UNIT IV

Inner product spaces, Gram-Schmidt orthonormalization, orthogonal projections, linear functionals and adjoints, Hermitian, self-adjoint, unitary and normal operators, Spectral Theorem for normal operators, Rayleigh quotient, Min-Max Principle.

Bilinear forms, symmetric and skew-symmetric bilinear forms, real quadratic forms, Sylvester's law of inertia, positive definiteness.

TEXT BOOK

K. Hoffman and R. Kunze; *Linear Algebra*, Pearson Education (India).

REFERENCE BOOK

1. M. Artin; *Algebra*, Prentice Hall of India.
2. S. Lang; Linear *Algebra: Undergraduate Texts in Mathematical*, Springer-Verlag, New York.
3. P. Lax; *Linear Algebra*, John Wiley & Sons, New York, Indian Ed.
4. H.E. Rose; *Linear Algebra*, Birkhauser.

BSMA703	**Real Analysis**	L	T	P	C
		4	-	-	4

UNIT I

Review of basic concepts of real numbers: Archimedean property, Completeness.
Metric spaces, compactness, connectedness, (with emphasis on R^n).

UNIT II

Definition and existence of Riemann Stieltjes integral, properties of the integral, integration and differentiation, the fundamental theorem of integral calculus, integration by parts, integration of vector-valued functions, Rectifiable curves.

UNIT III

Functions of several variables: linear transformations, Derivative in an open subset of Rn, Chain rule, Partial derivatives, directional derivatives, the contraction principle, Banach fixed point theorem. Taylor's theorem for a function of several variables, Directional derivative.

UNIT IV

Inverse function theorem, Implicit function theorem, Jacobians, extremum problems with constraints, Lagrange's multiplier method, Derivatives of higher order, mean value theorem for real functions of two variables, interchange of the order of differentiation, Differentiation of integrals.

Text Book:

Walter Rudin; *Principles of Mathematical Analysis*, McGraw-Hill.

Reference Books:

1. T. Apostol; *Mathematical Analysis*, Narosa Publishers.
2. K. Ross; *Elementary Analysis: The Theory of Calculus*, Springer Int. Edition.

BSMA705	**Probability and Statistics**	L	T	P	C
		4	-	-	4

Unit-I

Axiomatic approach to probability, conditional probability, probability function, independence of events, Bayes' rules and its applications, discrete distribution function, properties of distribution function, discrete random variable, probability mass function (p.m.f.), continuous random variable, probability density function (p.d.f.), various measures of central tendency, dispersion, skewness and kurtosis for discrete and continuous probability distribution, continuous distribution function, properties of continuous distribution function.

Unit-II

Two-dimensional random variables, joint probability mass function, marginal probability function, conditional probability function, two-dimensional distribution function, marginal distribution functions, joint density function, marginal density function, conditional distribution function and conditional probability density function, stochastic independence.

Unit-III

Expected value of a random variable and function of a random variable, properties, properties of variance, covariance, variance of a linear combination of random variables, inequalities involving expectation, moment generating function (m.g.f.), limitations, properties, uniqueness theorem of m.g.f., characteristic function (c.f.), properties, necessary and sufficient conditions for a function to be c.f., uniqueness theorem of c.f. , Chebyshev's inequality, convergence in probability, weak law of large number, Borel-Cantelli lemma.

Unit-IV

Special discrete probability distributions: Uniform, binomial, poisson, negative binomial, geometric, hyper-geometric.

Special continuous probability distributions: Normal, rectangular, triangular, gamma, beta, exponential, standard laplace, weibul, Cauchy.

Text Books:

1. W.W. Hines, D.C. Montgomery, D.M. Goldsman, and C.M. Borror; *Probability and Statistics in Engineering*; John Wiley & Sons.
2. E.J. Dudewicz & S.N. Mishra; *Modern Mathematical Statistics*, John Wiley &. Sons.

Reference Books:

1. J.S. Milton and J.C. Arnold; *Introduction to Probability and Statistics*, McGraw-Hill.
3. H.J. Larsen; *Introduction to Probability Theory and Statistical Inference*, John Wiley &. Sons.

BSMA 707	**Integral Equations and Calculus of Variations**	4	-	-	4

UNIT - I

Linear integral equations, Some basic identities, Initial value problems reduced to Volterra integral equations, Methods of successive substitution and successive approximation to solve Volterra integral equations of second kind, Iterated kernels and Neumann series for Volterra equations. Resolvent kernel as a series in λ, Laplace transform method for a difference kernel, Solution of a Volterra integral equation of the first kind.

UNIT - II

Boundary value problems reduced to Fredholm integral equations, Methods of successive approximation and successive substitution to solve Fredholm integral equations of second kind, Iterated kernels and Neumann series for Fredholm integral equations. Resolvent kernel as a sum of series, Fredholm resolvent kernel as a ratio of two series, Fredholm equations with separable kernels, Approximation of a kernel by a separable kernel, Non homogenous Fredholm equations with degenerate kernels.

UNIT - III

Green's function, Use of method of variation of parameters to construct the Green's function for a non-homogeneous linear second order boundary value problem, Basic four properties of the Green's function, Orthogonal series representation of Green's function, Alternate procedure for construction of the Green's function by using its basic four properties. Reduction of a boundary value problem to a Fredholm integral equation with kernel as Green's function, Hilbert-Schmidt theory for symmetric kernels.

UNIT - IV

Motivating problems of calculus of variations, Shortest distance, Minimum surface of revolution, Brnchistochrone problem, Isoperimetric problem, Geodesic. Fundamental lemma of calculus of variations, Euler's equation for one dependant function and its generalization to 'n' dependant functions and to higher order derivatives, Conditional extremum under geometric constraints and under integral constraints.

TEXT BOOK:

1. M D Raisinghania; *Linear Integral Equations*, S. Chand Publication
2. A. S. Gupta; *Calculus of Variations*, Narosa Publication.

REFERENCE BOOKS:

1. A. J. Jerri; *Introduction to Integral Equations with Applications*, Wiley-Interscience Pub.
2. Shanti Swarup; *Linear Integral Equations*, Krishna Prakashan Media.
3. J. M. Gelfand and S.V. Fomin; *Calculus of Variations*, Prentice Hall, New Jersy, 1963.
4. Weinstock; *Calculus of Variations*, McGraw Hall.
5. Abdul-Majid wazwaz; *A first course in Integral Equations*,World Scientific Pub.

6. P. David and S. G. David Stirling; *Integral Equations*, Cambridge University Press.

BSMA 709	**MATHEMATICAL MODELLING**	L	T	P	C
		4	-	-	4

UNIT I

Mathematical Modelling: Need, Techniques, Classifications, Characteristic and Limitations of Mathematical Models.

Mathematical Modelling through Ordinary Differential Equation of First Order and systems of Ordinary Differential Equation of First Order: Linear Growth and Decay Models, Non-Linear Growth and Decay Models, Compartment Models.

UNIT II

Mathematical Modelling through Ordinary Differential Equation of Second Order: Planetary Motion, Circular Motion and Motion of Satellites; Linear differential equations: Rectilinear Motion, Electrical Circuits, Stabilization Model.

UNIT III

Mathematical Modelling through Difference Equations: Basic Theory of Linear Difference equations with constant coefficient, Models used in Economics and Finance, Population Dynamics and Genetics, Probability Theory.

UNIT IV

Mathematical Modelling through Partial Differential Equations: Mass-Balance Equations, Momentum Balance Equations, Variational Principles, Probability Generating Function, Model for Traffic Flow on a Highway.

TEXTBOOK:

J. N. Kapur; *Mathematical Modelling*, New Age International Publishers.

REFERENCE BOOKS:

1. Reinhard Illner; *Mathematical Modelling*, A Case Studies Approach, Indian Editions of AMS (American Mathematical Society).
2. Rutherford Aris; *Mathematical Modelling Techniques*, Dover Publications Inc.
3. Frank R. Giordano , William P. Fox , Steven B. Horton; *A First Course in Mathematical Modeling*, Brooks Pub Co.
4. Edward A. Bender; *An Introduction to Mathematical Modeling*, John Wiley & Sons.
5. Mark M. Meerschaert; *Mathematical Modeling*, Academic Press Inc.
6. J. Caldwell and Y. M. Ram; *Mathematical Modelling*; Concepts and Case Studies, Springer.

BSMA 702	**Abstract Algebra-I**	4	-	-	4

UNIT - I

Groups : Zassenhaus lemma, Normal and subnormal series, Composition series, Jordan-Holder theorem, Solvable series, Derived series, Solvable groups, Solvability of Sn – the symmetric group of degree $n \geq 2$.

UNIT - II

Nilpotent group: Central series, Nilpotent groups and their properties, Equivalent conditions for a finite group to be nilpotent, Upper and lower central series, Sylow-p sub groups, Sylow theorems with simple applications. Description of group of order p2 and pq, where p and q are distinct primes (In general survey of groups upto order 15).

UNIT - III

Field theory, Extension of fields, algebraic and transcendental extensions. Splitting fields, Separable and inseparable extensions, Algebraically closed fields, Perfect fields.

UNIT - IV

Finite fields, Automorphism of extensions, Fixed fields, Galois extensions, Normal extensions and their properties, Fundamental theorem of Galois theory, Insolvability of the general polynomial of degree $n \geq 5$ by radicals.

TEXT BOOK:

1. I. N. Herstein; *Topics in Algebra*, Wiley Eastern Ltd., New Delhi.
2. David S. Dummit, Richard M. Foote; *Abstract Algebra*, John Wiley.

REFERENCE BOOKS:

1. P. B. Bhattacharya, S.K. Jain and S.R. Nagpaul; *Basic Abstract Algebra*, Cambridge University Press, Indian Edition.
2. P. M. Cohn, *Algebra*, Vols. I, II & III, John Wiley & Sons.
3. S. Lang, *Algebra*, 3rd edition, Addison-Wesley.
4. I.S. Luther and I. B. S. Passi, *Algebra*, Vol. I-Groups, Vol. II-Rings, Narosa Publishing House.
5. Vivek Sahai and Vikas Bist, *Algebra*, Narosa Publishing House.

BSMA704	**Topology**	L	T	P	C
		4	-	-	4

UNIT-I

Definition and examples of topological spaces. Closed sets. Closure. Dense sets. neighborhoods, interior, exterior, and boundary. Accumulation points and derived sets. Bases and sub-bases. Subspaces and relative topology. Alternative methods of defining a topology in terms of Kuratowski closure operator and neighborhood systems.

UNIT-II

Continuous functions and homeomorphism. First and second countable space. Lindelöf spaces. Separable spaces.

The separation axioms T_0, T_1, T_2, $T_{3½}$, T_4; their characterizations and basic properties. Urysohn's lemma. Tietze extension theorem.

UNIT-III

Compactness. Basic properties of compactness. Compactness and finite intersection property. Sequential, countable, and B-W compactness. Local compactness. One-point compactification.

Connected spaces and their basic properties. Connectedness of the real line. Components. Locally connected spaces.

UNIT-IV

Tychonoff product topology in terms of standard sub-base and its characterizations. Product topology and separation axioms, connected-ness, and compactness (incl. the Tychonoff's theorem), product spaces.

Nets and filters, their convergence, and interrelation. Hausdorffness and compactness in terms of net/filter convergence.

TEXT BOOK:

George F. Simmons, *Introduction to Topology and Modern Analysis*, McGraw-Hill.

REFERENCE BOOKS:

1. J. L. Kelley, *General Topology*, Van Nostrand,
2. K. D. Joshi, *Introduction to General Topology*, Wiley Eastern.
3. James R. Munkres, *Topology*, 2nd Edition, Pearson International.
4. J. Dugundji, *Topology*, Prentice-Hall of India, 1966.
5. N. Bourbaki, *General Topology*, Part I, Addison-Wesley.
6. S. Willard, *General Topology*, Addison-Wesley.

BSMA706	**Complex Analysis**	L	T	P	C
		4	-	-	4

UNIT I

Function of a complex variable, continuity, differentiability. Analytic functions and their properties, Cauchy-Riemann equations in Cartesian and polar coordinates. Power series, Radius of convergence, Differentiability of sum function of a power series.

UNIT II

Path in a region, smooth path, p.w. smooth path, contour, simply connected region, multiply connected region, bounded variation, total variation, complex integration, Cauchy-Goursat theorem, Cauchy theorem for simply and multiply connected domains.

Cauchy integral formula. Extension of Cauchy integral formula for multiple connected domain. Higher order derivative of Cauchy integral formula. Gauss mean value theorem Morera's theorem. Cauchy's inequality. Zeros of an analytic function, entire function, radius of convergence of an entire function, Liouville's theorem, Fundamental theorem of algebra, Taylor's theorem.

UNIT III

Maximum modulus principle, Minimum modulus principle. Schwarz Lemma. Singularity, their classification, pole of a function and its order. Laurent series, Cassorati – Weiertrass theorem Meromorphic functions, Poles and zeros of Meromorphic functions. The argument principle, Rouche's theorem, inverse function theorem

UNIT IV

Residue : Residue at a singularity, residue at a simple pole, residue at infinity. Cauchy residue theorem and its use to calculate certain integrals.

Bilinear transformation, their properties and classification, cross ratio, preservance of cross ratio under bilinear transformation, preservance of circle and straight line under bilinear transformation, fixed point bilinear transformation, normal form of a bilinear transformation. Definition and examples of conformal mapping, critical points.

TEXT BOOK:

Shanti Narayan; *Theory of Functions of a complex variable*, S. Chand & Co.

REFERENCE BOOK:

1. J. B. Conway, *Functions of One Complex Variable*, 2nd ed., Narosa, New Delhi.
2. T.W. Gamelin, *Complex Analysis*, Springer International Edition.
3. R. Remmert, *Theory of Complex Functions*, Springer Verlag.
4. A.R. Shastri, *An Introduction to Complex Analysis*, Macmilan India, New Delhi.

BSMA 708	**Advanced Ordinary Differential Equations**	4	-	-	4

Unit-I

Review of solution methods for first order as well as second order equations, Power Series methods with properties of Bessel functions and Legendre polynomials.

Existence and Uniqueness of Initial Value Problems: Picard's and Peano's Theorems, Gronwall's inequality, continuation of solutions and maximal interval of existence, continuous dependence.

Unit-II

Higher Order Linear Equations and linear Systems: fundamental solutions, Wronskian, variation of constants, matrix exponential solution, behaviour of solutions.

Unit-III

Two Dimensional Autonomous Systems and Phase Space Analysis: critical points, proper and improper nodes, spiral points and saddle points.
Asymptotic Behavior: stability (linearized stability and Lyapunov methods).

Unit-IV

Boundary Value Problems for Second Order Equations: Green's function, Sturm comparision theorems and oscillations, eigenvalue problems.

TEXT BOOKS:

1. M. Hirsch, S. Smale and R. Deveney; *Differential Equations, Dynamical Systems and Introduction to Chaos,* Academic Press.
2. L. Perko; *Differential Equations and Dynamical Systems, Texts in Applied Mathematics*, Vol. 7, 2nd ed., Springer Verlag, New York.

REFERENCE BOOKS:

1. M. Rama Mohana Rao; *Ordinary Differential Equations: Theory and Applications*, Affiliated East-West Press Pvt. Ltd., New Delhi.
2. D. A. Sanchez; *Ordinary Differential Equations and Stability Theory: An Introduction*, Dover Publ. Inc., New York, 1968.

BSMA 710	**Numerical Analysis**	L	T	P	C
		4	-	-	4

UNIT I

Solution of Algebraic and Transcendental Equations: Iterative Methods, Bisection Method, Method of false position, Secant Method, Newton-Raphson Method, Muller's Method, Horner's Method, Lin-Bairstow's Method and Graeffe's Root squaring Method.

Solution of Simultaneous Algebraic Equations: Direction methods, Matrix inversion method, Guass elimination, Gauss-Jordan method, Factorization method; Iterative method-Jacobi and Seidal Methods, Relaxation Method.

UNIT II

Interpolation: Newton's Interpolation, Gauss's interpolation, Stirling's formula, Bessel's formula, Everett's formula, Lagranges's interpolation, Divided Differences and Newton's divided difference formula, Hermite's interpolation, Spline interpolation, Double interpolation, Inverse interpolation.

Numerical Differentiation and Integration: Formulae for derivatives, Maxima and Minima of a tabulated function, Newton-Cote's Quadrature Formula, Romberg's Method, Euler-Maclaurin formula, Gaussian integration, Numerical double integration.

UNIT III

Numerical Solution of Ordinary Differential Equations: Picard's Method, Taylor's series method, Euler's Method, Modified Euler's Method, Runge-Kutta Method, Milne's Predictor-Corrector Method, Adams-Bashforth method, Solving simultaneous first order differential equations and second order differential equations. Error analysis, Stability analysis, Boundary-value problems, Finite-difference method, Shooting method.

UNIT IV

Numerical Solution of Partial Differential Equations: Finite – difference approximations to partial derivatives, Solutions of Laplace equation, Poisson's equation, Five point formulae for Laplacian, Concept of compatibility, convergence and stability, explicit, full implicit, Crank-Nicholson, du-Fort and Frankel scheme, ADI methods to solve two-dimensional equations with error analysis.

TEXT BOOK:

B. S. Grewal, *Numerical Methods in Engineering and Science*, Khanna Publishers.

REFERENCE BOOK:

1. M. K. Jain, S. R. K. Iyengar and R. K. Jain; *Numerical Methods for Scientific and Engineering Computation*, New age International Publisher, India.
2. Kresyzig; *Advanced Engineering Mathematics*, John Wiley and Sons.
3. Veerarajan and Ramachandran, Numerical Methods: With Programs In C, Tata McGraw-Hill Education..

BSMA 801	**Abstract Algebra-II**	4	-	-	4

UNIT - I

Modules, General properties of modules, sub modules, Quotient modules, Homomorphism of modules, simple and semi- simple modules, free modules

Cyclic modules, Schur's lemma, Free modules, Fundamental structure theorem of finitely generated modules over principal ideal domain and its applications to finitely generated abelian groups.

UNIT – II

Neotherian and Artinian modules and rings with simple properties and examples, Nil and Nilpotent ideals in Neotherian and Artinian rings, Hilbert Basis theorem.

UNIT - III

HomR(R,R), Opposite rings, Wedderburn – Artin theorem, Maschk's theorem, Equivalent statement for left Artinian rings having non-zero nilpotent ideals, Uniform modules, Primary modules and Neother- Lasker theorem.

UNIT - IV

Canonical forms : Similarity of linear transformations, Invariant subspaces, Reduction to triangular form, Nilpotent transformations, Index of nilpotency, Invariants of nilpotent transformations, The primary decomposition theorem, Rational canonical forms, Jordan blocks and Jordan forms.

TEXT BOOK:

I.N.Herstein; *Topics in Algebra*, Wiley Eastern Ltd., New Delhi.

REFERENCE BOOKS:

1. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul; *Basic Abstract Algebra*, Cambridge University Press, Indian Edition.
2. M. Artin; *Algebra*, Prentice-Hall of India.
3. P.M. Cohn; *Algebra*, Vols. I, II & III, John Wiley & Sons.
4. I.S. Luther and I. B. S. Passi; *Algebra*, Vol. I-Groups, Vol. II-Rings, NarosaPublishing House.
5. K.B. Datta; *Matrix and Linear Algebra*, Prentice Hall of India Pvt., New Delhi.
6. Vivek Sahai and VikasBist; *Algebra*, Narosa Publishing House.

BSMA803	**Measure and Integration**	L	T	P	C
		4	-	-	4

UNIT-I

Semi-algebras, algebras, monotone class, sigma-algebras, measure and outer measures.

UNIT- II

Borel sets, Lebesgue outer measure and Lebesgue measure on R, translation invariance of Lebesgue measure, existence of a non-measurable set, characterizations of Lebesgue measurable sets.

UNIT III

Measurable functions on a measure space and their properties. Lebesgue integral and it's properties, Comparison between Lebesgue and Riemann integral.

UNIT IV

Theorems on convergence of sequences of mesearuble functions, Bounded convergence theorem, Fatou's lemma, Lebesgue monotone convergence theorem, Lebesgue dominated convergence theorem. F-Riesz and D.F.Egorff theorem.

TEXT BOOK:

H. L. Royden and P. M. Fitzpatrick, Real Analysis, (Fourth edition), P.H.l. New Delhi.

REFERENCE BOOKS:

1. P. R. Halmos; *Measure Theory*, Grand Text Mathematics, 14, Springer.
2. I. K. Rana; *An Introduction to Measure and Integration*, Narosa Publishing House, New Delhi.
3. E. Hewit and K. Stromberg; *Real and Abstract Analysis*, Springer, 1975.

BSMA 805	**Advanced Partial Differential Equations**	L	T	P	C
		4	-	-	4

UNIT-I

Cauchy Problems for First Order Hyperbolic Equations: method of characteristics, Monge cone.

Classification of Second Order Partial Differential Equations: normal forms and characteristics.

UNIT-II

Initial and Boundary Value Problems: Lagrange-Green's identity and uniqueness by energy methods.

Stability theory, energy conservation and dispersion.

UNIT-III

Laplace equation: mean value property, weak and strong maximum principle, Green's function, Poisson's formula, Dirichlet's principle, existence of solution using Perron's method (without proof).

Heat equation: initial value problem, fundamental solution, weak and strong maximum principle and uniqueness results.

UNIT-III

Wave equation: uniqueness, D'Alembert's method, method of spherical means and Duhamel's principle.

Methods of separation of variables for heat, Laplace and wave equations.

TEXT BOOK:

1. E. DiBenedetto; *Partial Differential Equations*, Birkhauser, Boston.
2. L.C. Evans; *Partial Differential Equations, Graduate Studies in Mathematics*, Vol. 19, AMS, Providence.

REFERENCE BOOKS:

1. F. John; *Partial Differential Equations*, 3rd ed., Narosa Publ. Co., New Delhi.
2. E. Zauderer; *Partial Differential Equations of Applied Mathematics*, 2nd ed., John Wiley and Sons, New York.

BSMA 807	**Operational Research**	L	T	P	C
		4	-	-	4

UNIT - I

Operations Research: Origin, definition, methodology and scope. Linear Programming: Formulation and solution of linear programming problems by graphical and simplex methods, Big - M and two phase methods, Degeneracy, Duality in linear programming.

UNIT - II

Transportation Problems: Basic feasible solutions, optimum solution by stepping stone and modified distribution methods, unbalanced and degenerate problems, transshipment problem. Assignment problems: Solution by Hungarian method, unbalanced problem, case of maximization, travelling salesman and crew assignment problems.

UNIT - III

Queuing models: Basic components of a queuing system, General birth-death equations, steady-state solution of Markovian queuing models with single and multiple servers (M/M/1. M/M/C, M/M/1/k, M/MC/k) Inventory control models: Economic order quantity(EOQ) model with uniform demand and with different rates of demands in different cycles, EOQ when shortages are allowed, EOQ with uniform replenishment, Inventory control with price breaks.

UNIT - IV

Game Theory: Two person zero sum game, Game with saddle points, the rule of dominance; Algebraic, graphical and linear programming methods for solving mixed strategy games. Sequencing problems: Processing of n jobs through 2 machines, n jobs through 3 machines, 2 jobs through m machines, n jobs through m machines.

TEXT BOOK:

Kanti Swarup, P.K. Gupta and Manmohan, Operations Research,Sultan Chand & Sons.

RFERENCE BOOK:

1. Taha, H.A., Operation Research-An introducton, Printice Hall of India.
2. Gupta, P.K. and Hira, D.S., Operations Research, S. Chand & Co.
3. Sharma, S.D., Operation Research, Kedar Nath Ram Nath Publications.

BSMA 809	**Fluid Dynamics**	L	T	P	C
		4	-	-	4

UNIT-I

Kinematics of fluid in motion: Velocity at a point of a fluid. Lagrangian and Eulerian methods. Stream lines, path lines and streak liens, vorticity and circulation, Vortex lines, Acceleration and Material derivative, Equation of continuity (vector or Cartesian form). Reynolds transport Theorem. General analysis of fluid motion. Properties of fluids- static and dynamic pressure. Boundary surfaces and boundary surface conditions. Irrotational and rotational motions. Velocity potential.

UNIT-II

Equation of Motion: Lagrange's and Euler's equations of Motion (vector or in Cartesian form). Bernculli's theorem. Applications of the Bernoulli Equation in one –dimensional flow problems. Kelvins circulation theorem, vorticity equation.Energy equation for incompressible flow.Kinetic energy of irrotational flow. Kelvins minimum energy theorem ,mean potential over a spherical surface. Kinetic energy of infinite liquid. Uniqueness theorems.

UNIT-III

Stress components in a real fluid. Relations between rectangular components of stress. Connection between stresses and gradients of velocity. Navier- Stoke's equations of motion. Steady flows between two parallel plates.

UNIT-IV

Reduction of Navier-Stock equations in flows having axis of symmetry, steady flow in circular pipe: the Hagen-Poiseuille flow, steady flow between two coaxial cylinders, flow between two concentric rotating cylinders. Steady flows through tubes of uniform cross-section in the form (i) Ellipse, (ii) equilateral triangle, (iii) rectangle, under constant pressure gradient, uniqueness theorem.

TEXT BOOK:

G. K. Batchelor; *An Introduciton to Fluid Mechanics*, Foundation Books, New Delhi.

RFERENCE BOOK:

1. W. H. Besant and A.S. Ramsey; *A Treatise on Hydromechanics,* Part-II, CBS Publishers.
2. F. Chorlton; *Text-book of Fluid Dynamics*, C. B. S. Publishers, Delhi.
3. Michael E.O. Neill and F. Chorlton; *Ideal and Incompressible Fluid Dynamics*, John Wiley &Sons.
4. R.K. Rathy. *An Introduction to Fluid Dynamics,* Oxford and IBH Publishing Company.
5. A.J. Chorin and A. Marsden, *A Mathematical Introduction to Fluid Dynamics* Springer-Verlag, New York.
6. L.D. Landau and E.M. Lipschitz, *Fluid Mechanics*, Pergamon Press, London.

BSMA 811	**Advanced MATLAB Programming**	L	T	P	C
		2	-	-	2

UNIT-I

Input output of data from MATLAB command. File types. Creating, saving and executing the script file. Creating and executing functions file. Working with files and directories.

UNIT-II

Matrix manipulation. Creating vectors. Arithmetic operations. Relational operations. Logical operations. Matrix functions. Determinant of matrix. Eigen values and Eigen vectors. Programming in Matlab: function files, sub functions, global variations, loops, branches and control flow. Interactive input. Recursion. Publishing a report. Controlling command windows. Command line editing.

UNIT-III

Linear Algebra and interpolation: Solving the linear equation. Gaussian elimination, matrix factorization, curve fitting, polynomial curve fitting, least squares curve fitting. General non linear fits. Interpolation.

UNIT-IV

Differential equations and graphics: First order and second order ODE. Double integration. Roots of polynomial. Two and three dimensional plots. Matlab plotting tools. Mesh and surface plots.

TEXT BOOK:

Won Young Yang, Tae-Sang-Chung, John Morris; *Applied numerical Methods using MATLAB*, John Wiley and Sons.

REFERENCE BOOKS:

1. L.F. Shampine, I Gladwell, S. Thompson; *Solving ODE's with MATLAB*, Cambridge University Press.
2. Rudra Pratap; *Getting Started with MATLAB 7*, Oxford Press.
3. S.R. Otto and J.P. Denier, *An Introduction to Programming and Numerical Methods in MATLAB*, Springer.

BSMA 851	**Advanced MATLAB Programming Lab**	L	T	P	C
			-	2	1

LIST OF EXPERIMENTS

Write down and execute the following programs using MATLAB

1. Compute the sum of *n* integers.
2. Find the factorial of *n* numbers.
3. Plot the graph of any function.
4. Solutions of simultaneous linear equations.
5. Solution of algebraic / transcendental equations.
6. To find the largest Eigen value of a matrix using power-method.
7. Inversion of matrices
8. Numerical differentiation
9. Numerical integration
10. Solution of ordinary differential equations
11. Statistical problems on central tendency and dispersion
12. Fitting of curves by least square method.
13. To find the numerical solution of Laplace equation.
14. To find the numerical solution of Wave equation.

NOTE: Ten experiments are to be performed, out of which at least seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & setup by the concerned person as per the scope of the syllabus.

BSMA 802	**Functional Analysis**	4	-	-	4

UNIT- I

Normed linear spaces, Examples and its topological properties, Banach spaces, Continuous linear transformations, Spaces of continuous linear transformations from a linear space to a Banach space, Continuous linear functional.

UNIT-II

Hahn-Banach Theorem, Open mapping theorem, Closed graph theorem, Banach-Steinhaus theorem, Uniform boundedness principle.

UNIT- III

Hilbert Spaces, Schwarz's inequality, orthogonal complement of a subspace, orthonormal bases, Continuous linear functional on Hilbert spaces, Riesz Representation Theorem, Reflexivity of Hilbert Spaces

UNIT- IV

Unitary operators on a Hilbert space, self-adjoint and normal operators, adjoint of an operator on a Hilbert space, projections of Hilbert spaces. Spectral Theorem.

TEXT BOOK:

1. Kreyszig; *Introductory Functional analysis with Applications*, Wiley India publication**.**
2. G. F. Simmons; *Introduction to Topology and Modern Analysis*, McGraw-Hill.

REFERENCE BOOKS:

1. A. E. Taylor; *Introduction to Functional Analysis*, John Wiley.
2. B. V. Limaye; *Functional Analysis*, Wiley Eastern.
3. N. Dunford and J. T. Schwartz; *Linear Operators*, Part-I, Interscience.
4. R. E. Edwards; *Functional Analysis*, Holt Rinehart and Winston.
5. C. Goffman and G. Pedrick; *First Course in Functional Analysis*, Prentice- Hall of India.
6. K. K. Jha; *Functional Analysis and Its Applications*, Students' Friend.

BSMA804	Mathematical Programming	L	T	P	C
		4	-	-	4

UNIT-I

Existence theorems, First order optimality conditions and second order optimality conditions for unconstrained optimization problems, Ekeland's variational principle.

UNIT-II

Convex functions, Differentiable convex functions, Optimization on convex sets, Separation theorems, Fritz John optimality conditions for constrained nonlinear programming problems, Constraint qualifications, Karush Kuhn Tucker conditions in nonlinear programming, Second order conditions in nonlinear programming

UNIT-III

Lagragian saddle points, Duality in nonlinear programming, Strong duality in convex programming, duality for linear and quadratic problems.

UNIT-IV

Quadratic programming, Wolfe's method as application of Karush Kuhn Tucker conditions, convex simplex method, Penalty function methods.

TEXT BOOKS:

1. Mokhtar S. Bazaraa, Hanif D. Sherali and C.M. Shetty; *Nonlinear Programming: Theory and Algorithms*, John Wiley & Sons, 2006.

REFERENCE BOOKS:

1. Jan Brinkhuis and Vladimir Tikhomirov; *Optimization : Insights and Applications*, Princeton University Press.
2. Kenneth Lange; *Optimization*, Springer.
3. Osman Gler; *Foundations of Optimization*, Springer.
4. David G. Luenberger and Yinyu Ye; *Linear and Nonlinear Programming*, Springer.

BSMA806	Fuzzy Sets and Applications	L	T	P	C
		4	-	-	4

UNIT I

Definition of a fuzzy set and membership function, representation of membership function, General definitions and properties of fuzzy sets, Support, height, equality of two fuzzy sets.

UNIT II

Union and Intersection of fuzzy sets, Complement of a fuzzy set, normal fuzzy set, α- cut set, strong α-cut, convex fuzzy set, Necessary and Sufficient condition for convexity of a fuzzy set, Decomposition of fuzzy sets, Level set of a fuzzy set, Cardinality, fuzzy cardinality, Product of fuzzy sets, Product of a fuzzy set with a crisp number, Power of a fuzzy set, Difference of fuzzy sets, Disjunctive sum of fuzzy sets.

UNIT III

General properties of operations on fuzzy sets, Commutativity, associativity, distributivity, Idempotent law, identities for operations, Transitivity, involution, Demorgans laws, proofs and examples, Some important theorems on fuzzy sets, set inclusion of fuzzy sets and corresponding α-cuts and strong α-cuts.

UNIT IV:

Comparison of α-cut and strong α-cut, Order relation of scalars α is inversely preserved by set inclusion of corresponding α-cuts and strong α-cuts, α-cut of union and intersection of two fuzzy sets, α-cut of complement of a fuzzy set, α-cuts and strong α-cuts of union and intersection of arbitrary collection of fuzzy sets.

TEXT BOOK:

Pundir and Pundir; *Fuzzy Sets and their Applications*, PragatiPrakashan

REFERENCE BOOKS:

1. G.J. Klir, B.Yuan; *Fuzzy Sets and Fuzzy Logic: Theory and Applications*, Prentice Hall.
2. Hao Ying; *Fuzzy Control and Modeling: Analytical Foundations and Applications*, IEEE Press.
3. T.J. Ross; *Fuzzy Logic with Engineering Applications*, John Wiley & Sons.
4. H.J. Zimmermann; *Fuzzy set theory and its Applications*, Allied Publishers Ltd, New Delhi.

BSMA 808	**Applied Stochastic Processes**	**4**	**-**	**-**	**4**

UNIT-I

Stochastic processes: Description and definition. Markov chains with finite and countably infinite state spaces. Classification of states, irreduci-bility, ergodicity. Basic limit theorems.

UNIT-II

Markov processes with discrete and continuous state spaces. Poisson process, pure birth process, birth and death process. Brownian motion.

UNIT-III

Applications to queuing models and reliability theory.

UNIT-IV

Basic theory and applications of renewal processes, stationary processes. Branching processes. Markov Renewal and semi-Markov processes, regenerative processes.

TEXT BOOKS:

1. V.N. Bhat; *Elements of Applied Stochastic Processes*, Wiley.
2. V.G. Kulkarni; *Modeling and Analysis of Stochastic Systems*, Chapman and Hall, London.

REFERENCE BOOKS:

1. J. Medhi; *Stochastic Models in Queueing Theory*, Academic Press.
2. R. Nelson; *Probability, Stochastic Processes, and Queuing Theory: The Mathematics of Computer Performance Modeling*, Springer-Verlag, New York.
3. S. Ross, *Stochastic Processes*, 2nd ed., Wiley, New York.

BSMA 810	Theory of Relativity	L	T	P	C
		4	-	-	4

Unit I

Tensor Algebra, Riemannian geometry, Curvature Tensor: Covariant Curvature tensor, Ricci tensor, Einstein Tensor, The Bianchi identity.

Unit II

The principle of covariance, The principle of equivalence, Geodesic principle, Newton's equations of motion as an approximation of geodesic equations, Poisson's equations as an approximation to Einstein field equations.

Unit III

Gravitational field equations in free space, Exterior Schwarzchild's solution and its isotropic form, Birkhoff's theorem, Schwarzchild singularity, planetary orbit, Advance of Perihelion of a planet, Bending of light rays in the gravitational filed, Gravitational Red shift in the spectral lines.

Unit IV

Gravitational field equations for non empty space, Linearization of the field equations, The Weyl's solution of linearized Field equations, Interior Schwarzchild's solution.

Text Book :

Ronald Adler, Maurice Bezin and Manamen Schiffer; *Introduction to General Relativity*, McGraw-Hill Kogakusha Ltd.

References Books:

1. Rosser W.G.V.; *Introduction to theory of relativity*, ELBS.
2. Rindler W.; *Relativity Special, General and Cosmology*, Pub. Oxford University Press.
3. Landau I.D. and Lifshitz E.M.; *The Classical Theory of Fields*, Pub. Pergamon Press.

BSMA 812	**Mathematical Biology**	L	T	P	C
		4	-	-	4

UNIT-I

Epidemic models : Deterministic models without removal, general deterministic model with removal, general deterministic model with removal and immigration, control of an epidemic.

UNIT-II

Mathematical models in Pharmacokinetics: basic equations and their solutions, solutions for special cases, determination of transfer coefficients and compartment volumes, mathematical techniques used in compartment analysis, stochastic compartment models.

UNIT-III

Models for blood flows: some basic concepts for fluid dynamics, basic concepts about blood, cardiovascular system and blood flows, steady non-Newtonian fluid flow in circular tubes, Newtonian pulsatile flows in rigid and elastic tubes, blood flow through artery with mild stenosis, peristaltic flow in tubes and channels, models for air flow in lungs, Diffusion and Diffusion-reaction models, the diffusion equations, oxygen diffusion living tissues.

UNIT-IV

Non-linear populations growth models, models in genetics, basic model for inheritance, models for genetic improvement, selection and mutation, applications in ecological and environmental subject areas, urban waste, water management, planning.

TEXT BOOKS:

J. N. Kapur; *Mathematical Modelling in Biology Medicine*, Affiliated East-West press Nasher, New Delhi

REFERENCE BOOKS:

1. J. N. Kapur; *Mathematical Modelling*, Affiliated East-West press Nasher, New Delhi
2. K. E. F. Watt; *Ecology and Resource Management*, McGraw-Hill.
3. J. D. Murray; Mathematical Biology, Springer.

BSMA 814	Differential Geometry	L	T	P	C
		4	-	-	4

UNIT I

Curves in spaces; Space curve, class or a function of a curve, tangents, order of contact between curves and surfaces, Osculating plane, Serret-Ferret formulae, Curvature and Torsion, Helix, Osculating sphere, involutes and evolutes.

UNIT II

First fundamental form and Second fundamental form of surfaces, Wein-Gartem equations, direction coefficient, Family of curves and orthogonal Trajectory, Normal curvature, Meusnier's Theorem, Principal directions and principal curvatures, Minimal and developable surfaces.

UNIT III

Lines of curvature; Rodrick's, Monge's and Euler's Theorem; Conjugate lines and Assymptotic lines.

UNIT IV

Fundamental equation of surface theory, Guass Characteristic equation and Mainardi-Cadazzi equations, Geodesic equations, Normal properties of Geodesics.

TEXT BOOK:

T. J. Willmore; *An Introduction to Differential Geometry*, Oxford University Press.

REFERENCE BOOKS:

1. Pressley; *Elementary Differential Geometry*, Under-graduate Mathematics Series, Springer.
2. D. Somasundaram; *Differential Geometry: A First Course*, Narosa.

BSMA 816	Cryptography	L	T	P	C
		4	-	-	4

UNIT I

Introduction to Cryptography – Security Attacks – Security Services –Security Algorithm - Stream cipher and Block cipher - Symmetric and Asymmetric-key Cryptosystem

UNIT II

Secure communications, Shift ciphers, Affine ciphers, Vigenere cipher key, Symmetric key, Public key, Block ciphers, One-time pads, Secure random bit generator, Linear feedback shift register sequences.

Public-key Cryptosystem: Introduction to Number Theory - RSA Algorithm – Key

UNIT III

Management - Diffie-Hell man Key exchange – Elliptic Curve Cryptography Message Authentication and Hash functions – Hash and Mac Algorithm – Digital Signatures and Authentication Protocol.

UNIT IV

Differential cryptanalysis, Modes of DES, Attack on DES, Advanced encryption standard.

RSA, Attacks on RSA, Diffie-Hellman key exchange, ElGamal public key cryptosystem, cryptographic hash function.

RSA signatures, ElGamal signature, Hashing and signing, Digital signature algorithm.

TEXT BOOK:

A Johannes; Buchmann; *Introduction to Cryptography*, Springer 2000.

REFERENCE BOOKS:

1. Douglas Robert Stinson; *Cryptography - Theory and Practice*, Chapman Hall / CRC.
2. Wade Trappe and Lawrence C. Washington; *Introduction to Cryptography with Coding Theory*, Pearson Prentice Hall.
3. Bruce Schneir; *Applied Cryptography*, CRC Press.
4. A.Menezes, P Van Oorschot and S.Vanstone; *Hand Book of Applied Cryptography*, CRC Press,.

BSMA 818	Discrete Mathematics	L	T	P	C
		4	-	-	4

UNIT I

Counting: Basic counting principles, Permutations and Combinations, Binomial theorem, Multinomial theorem, Counting subsets, Set-partitions, Stirling numbers. Principle of Inclusion and Exclusion, Derangements, Inversion formulae.

Generating functions: Algebra of formal power series, Generating function models, Calculating generating functions, Exponential generating functions.

UNIT II

Boolean Algebra: Lattices, Complete lattices, Lattices as algebraic structures, Sublattices, Products and Homomorphisms, Modular and Distributive lattices, Boolean polynomials, minimal forms of Boolean polynomials, Quinn-McCluskey method, Karnaugh diagrams, Switching circuits.

UNIT III

Graph theory: Directed graph, Euler graph, Hamiltonian graph, Matrix representation of graphs, Shortest path in a weighted graph, K- connected and K- edge connected graphs, Planar graphs, Coloring of graphs, Vizing's theorem.

UNIT IV

Trees: Rooted trees, Spanning tree and Cut set, Minimum-spanning tree, Flow network in a graph, max-flow-min cut theorem.

TEXT BOOKS:

Kenneth H. Rosen; *Discrete Mathematics and Its Applications*, McGraw-Hill Education.

REFERENCE BOOKS:

1. C.L. Liu & Mahopatra; *Elements of Discrete mathematics*, Tata McGraw Hill.
2. N. Deo, Graph Theory with Applications to Computer Science, Prentice-Hall of India.
3. T.H. Coremen, C.E. Leiserson, R. L. Rivest; *Introduction to algorithms*, Prentice Hall on India.
4. M. O. Albertson and J. P. Hutchinson; *Discrete Mathematics with Algorithms*, Johnwiley Publication.
5. J. L. Hein; *Discrete Structures, Logic, and Computability*, Jones and Bartlett Publishers.

BSMA 820	Mathematical Theory of Reliability	L	T	P	C
		4	-	-	4

Unit-I

Coherent Structures, Reliability of systems of independent components.

Unit-II

Bounds of system reliability, shape of the system reliability function, notion of ageing, parametric families of life distributions with monotone failure rate.

Unit-III

Classes of life distributions based on notions of ageing, classes of distributions in replacement policies.

Unit-IV

Limit distributions for series and parallel systems. Statistical inferential aspects for (i) standard reliability models, (ii) parametric and non-parametric classes of aging distributions.

TEXTS BOOK:

1. H. Ascher and H. Feingold; *Repairable Systems Reliability: Modeling, Inference, Misconceptions and Their Causes,* Marcel Dekker.
2. L.J. Bain and M. Engelhardt; *Statistical Analysis of Reliability and Life Testing Models: Theory and Methods,* Marcel Dekker, New York.

Reference Books:

1. R.E. Barlow and F. Proschan; Statistical Theory of Reliability and Life Testing, Holt, Reinhart and Winston.
2. J.D. Kalbfleisch and R.L. Prentice; *The Statistical Analysis of Failure Time Data,* Wiley.
3. J.F. Lawless; *Statistical Models and Methods for Life Time Data,* John Wiley & Sons.
4. S.K. Sinha; *Reliability and Life Testing,* Wiley Eastern, New Delhi.

BSMA 822	Normed Linear Spaces	L	T	P	C
		4	-	-	4

UNIT-I

L^p spaces, convergence sequence and Cauchy's sequence, complete of L^p space, Holder and Minkowski's and Schwarz inequalities, L^p space in a normed linear space. Reisz Fisher theorem.

UNIT-II

Signed Measure, positive and negative sets, theorem on positive and negative set on decomposition theorem, Singular measure, Jordan- Decomposition theorem, Absolutely continuous measure function, Randon - Nikodym theorem, Lebesgue decomposition theorem.

UNIT-III

Product measure; Fubinni's theorem; Baire's set; Baire's mesure.

UNIT-IV

Continuous functions with compact support, regularity of measures on compact spaces, Integration of continuous functions with compact support. Reisz- Markov's theorem.

TEXT BOOK:

H. L. Royden and P. M. Fitzpatrick; *Real Analysis*, (Fourth edition), P. H. l.

REFERENCE BOOKS:

1. Indra K. Rana; *An introduction to measure and integration*, Wiley Eastern Limited

2. G. de. Barra; *Measure Theory and Integration*, Wiley Eastern Limited.

BSMA 824	Theory of Elasticity	L	T	P	C
		4	-	-	4

UNIT-I

Tensor Algebra: Coordinate-transformation, Cartesian Tensor of different order.

Properties of tensors, Isotropic tensors of different orders and relation between them, Symmetric and skew symmetric tensors. Tensor invariants, Deviatoric tensors, Eigen-values and eigen-vectors of a tensor.

Tensor Analysis: Scalar, vector, tensor functions, Comma notation, Gradient, divergence and curl of a vector / tensor field.

UNIT -II

Analysis of Strain : Affine transformation, Infinitesimal affine deformation, Geometrical Interpretation of the components of strain. Strain quadric of Cauchy. Principal strains and invariance, General infinitesimal deformation. Saint-Venant's equations of compatibility. Finite deformations

Analysis of Stress : Stress Vecotr, Stress tensor, Equations of equilibrium, Transformation of coordinates.

UNIT -III

Stress quadric of Cauchy, Principal stress and invariants. Maximum normal and shear stresses. Mohr's circles, examples of stress. Equations of Elasticity : Generalised Hooks Law, Anisotropic symmetries, Homogeneous isotropic medium.

UNIT -IV

Elasticity moduli for Isotropic media. Equilibrium and dynamic equations for an isotropic elastic solid. Strain energy function and its connection with Hooke's Law, Uniqueness of solution. Beltrami-Michell compatibility equations. Clapeyron's theorem. Saint-Venant's principle.

TEXT BOOK:

I.S. Sokolnikoff; *Mathematical Theory of Elasticity*, Tata-McGraw Hill Publishing Company Ltd., New Delhi.

Reference books

1. I.H. Shames; *Introduction to Solid Mechanics*, Prentice Hall, New Delhi.
2. A.E.H. Love; *A Treatise on the Mathematical Theory of Elasticity*, Dover Publications, New York.
3. Y.C. Fung; *Foundations of Solid Mechanics*, Prentice Hall, New Delhi.
4. D.S. Chandrasekharaiah and L. Debnath; *Continuum Mechanics*, Academic Press.
5. Shanti Narayan; *Text Book of Cartesian Tensor*, S. Chand & Co., 1950.
6. S. Timeshenki and N. Goodier; *Theory of Elasticity*, McGraw Hill, New York, 1970.

BSMA 826	Classical Mechanics	L	T	P	C
		4	-	-	4

UNIT I

The linear momentum and the angular momentum of a rigid body in terms of inertia constants, kinetic energy of a rigid body, equations of motion, examples on the motion of a sphere on horizontal and on inclined planes. Euler's equations of motion, motion under no forces, the invariable line and the invariable cone, the theorems of Poinsot and Sylvester, Eulerian angles and the geometrical equations of Euler.

UNIT II

Generalized co-ordinates, geometrical equations, holonomic and non-holonomic systems, configuration Space, Lagrange's equations using D' Alembert's Principle for a holonomic conservative system, deduction of equation of energy when the geometrical equations do not contain time t explicitly, Lagrange's multipliers case, deduction of Euler's dynamical equations from Lagrange's equations.

UNIT III

Theory of small oscillations, Lagrange's method, normal (principal) co-ordinates and the normal modes of oscillation, small oscillations under holonomic constraints, stationary property of normal modes, Lagrange equations for impulsive motion.

UNIT IV

Generalized momentum and the Hamiltonian for a dynamical system, Hamilton's canonical equations of motion, Hamiltonian as a sum of kinetic and potential energies, phase space and Hamilton's

Variational principle, the principle of least action, canonical transformations, Hamilton-Jacobi theory, Integrals of Hamilton's equations and Poisson- Brackets, Poisson-Jacobi identity.

TEXT BOOK: H. Goldstein, Classical Mechanics, Addison-Wesley Publishing Company, London, 1969

REFERENCE BOOKS:

1. A. S. Ramsey, Dynamics, Part II, CBS Publishers & Distributors, Delhi, 1985.
2. K. C. Rana And P. C. Joag, Classical Mechanics, Narosa.Pub.

BSMA 828	Number Theory	L	T	P	C
		4	-	-	4

UNIT I

The equation ax+by = c, simultaneous linear equations, Pythagorean triangles, assorted examples, ternary quadratic forms, rational points on curves.

UNIT II

Elliptic curves, Factorization using elliptic curves, curves of genus greater than 1. Farey sequences, rational approximations, Hurwitz theorem, irrational numbers, Geometry of Numbers, Blichfeldt's principle, Minkowski's Convex body theorem Lagrange's four square theorem.

UNIT III

Euclidean algorithm, infinite continued fractions, irrational numbers, approximations to irrational numbers, Best possible approximations, Periodic continued fractions, Pell's equation.

UNIT IV

Partitions, Ferrers Graphs, Formal power series, generating functions and Euler's identity, Euler's formula, bounds on P(n), Jacobi's formula, a divisibility property.

TEXT BOOK:

Ivan Niven, Herbert S. Zuckerman, Hugh L. Montgomery; *An Introduction to the Theory of Number*s, John Wiley & Sons(Asia)Pte.Ltd.

REFERENCE BOOKS:

1. G.H. Hardy, and E.M. Wright; *An Introduction to the Theory of Numbers*, Oxford Science Publications
2. D.M. Burton; *Elementary Number Theory*, McGraw Hill
3. N.H. McCoy; *The Theory of Number*, McMillan.

BSMA852 Dissertation (Credits 6)

Dissertation based on Research project: Suitable Topics in Mathematical Sciences Presentation & Viva-voce

1. Students will be divided among faculty members for the supervision of the research work.

2. In the first week of Semester III, each faculty member will assign a suitable research topic to the students from the selected topics in the areas of Mathematical Sciences.

3. The student will work on the assigned research topic during semesters III and IV in regular consultation with his/her assigned teacher.

4. The student will write a dissertation based on the research work carried out during Semesters III and IV and prepare two copies to be submitted to the office of the Dean of School duly signed by the student and the supervisor in the sixth week of IV semester or a date decided by the Dean of School.

5. Before preparing power point presentation and submission of dissertation, each student has to deliver a seminar talk on his/ her research project work on a date fixed by Dean of School necessary suggestions has to be incorporated in the final draft of dissertation.

6. The student will make a power point presentation based on the work carried out and mentioned in the dissertation to the board of examiners appointed by the University.

BSMA711 Seminar-I (Credits 2)

A seminar is a focused and organized event designed to facilitate the exchange of knowledge, foster discussion, and promote learning among students interested in a particular subject or theme. Students will choose a topic of interest and presents before all the faculty members.

The objectives of a seminar include:

- **Knowledge Sharing:** Share expertise and information on a specific topic.
- **Skill Development:** Enhance participants' skills through workshops and activities.
- **Networking:** Facilitate connections and collaboration among participants.
- **Discussion and Debate:** Encourage exploration of ideas and diverse perspectives.
- **Professional Development:** Contribute to the ongoing learning and development of attendees.
- **Research Promotion:** Provide a platform for the presentation and discussion of research.
- **Awareness and Education:** Raise awareness and educate participants on important topics.
- **Promotion of Products or Services:** Showcase and promote products or services in a business context.

- **Community Building:** Foster a sense of community among participants with common interests.
- **Continuing Education:** Fulfill ongoing education needs and requirements.

BSMA712 Seminar-II (Credits 2)

A seminar is a focused and organized event designed to facilitate the exchange of knowledge, foster discussion, and promote learning among students interested in a particular subject or theme. Students will choose a topic of interest and presents before all the faculty members.

The objectives of a seminar include:

- **Knowledge Sharing:** Share expertise and information on a specific topic.
- **Skill Development:** Enhance participants' skills through workshops and activities.
- **Networking:** Facilitate connections and collaboration among participants.
- **Discussion and Debate:** Encourage exploration of ideas and diverse perspectives.
- **Professional Development:** Contribute to the ongoing learning and development of attendees.
- **Research Promotion:** Provide a platform for the presentation and discussion of research.
- **Awareness and Education:** Raise awareness and educate participants on important topics.
- **Promotion of Products or Services:** Showcase and promote products or services in a business context.
- **Community Building:** Foster a sense of community among participants with common interests.
- **Continuing Education:** Fulfill ongoing education needs and requirements.