DEPARTMENT OF MATHEMATICS

Scheme & Syllabus
M.Sc. (Mathematics)

W.E.F. 2015-16

CENTRAL UNIVERSITY OF HARYANA
JANT-PALI, MAHENDERGARH
HARYANA-123031
www.cuh.ac.in

Department of Mathematics

Central University of Haryana
Mahendergarh, Haryana-123031

Scheme and Syllabus of M.Sc. Mathematics
(CHOICE BASED CREDIT SYSTEM)

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Course Type

Core Course (CC)
Generic Elective Course (GEC)
Discipline Centric Elective Course (DCEC)
Skill Enhancement Elective Course (SEEC)

Total Credit: 86, Semester wise distribution of credits: 24 + 22 + 22 + 18

CORE COURSE (CC) (Exclusively for M.Sc. Mathematics Students)

S. No.	Course code	Course title	L	T	P	Credit
1.	SPMMAT 01 01 CC 01 3104	Real Analysis	3	1	0	4
2.	SPMMAT 01 01 CC 02 3104	Abstract Algebra	3	1	0	4
3.	SPMMAT 01 01 CC 03 3104	Complex Analysis	3	1	0	4
4.	SPMMAT 01 01 CC 04 3104	Differential Equations and Calculus of Variations	3	1	0	4
5.	SPMMAT 01 02 CC 01 3104	Linear Algebra	3	1	0	4
6.	SPMMAT 01 02 CC 02 3104	Topology	3	1	0	4
7.	SPMMAT 01 02 CC 03 3104	Numerical Analysis	3	1	0	4
8.	SPMMAT 01 02 CC 04 3104	Mathematical Statistics	3	1	0	4
9.	SPMMAT 01 03 CC 01 3104	Integral Equations	3	1	0	4
10.	SPMMAT 01 03 CC 02 3104	Functional Analysis	3	1	0	4
11.	SPMMAT 01 03 CC 03 3104	Operations Research	3	1	0	4
12.	SPMMAT 01 03 CC 04 3104	Number Theory	3	1	0	4

DISCIPLINE CENTRIC ELECTIVE COURSES (DCEC)
(Offered to the students of M.Sc. Mathematics)

S. No.	Course code	Course title	L	T	P	Credit
1.	SPMMAT 01 02 DCEC 01 3104	Advanced Abstract Algebra	3	1	0	4
2.	SPMMAT 01 02 DCEC 02 3104	Measure Theory and Integration	3	1	0	4
3.	SPMMAT 01 02 DCEC 03 3104	Fluid Dynamics	3	1	0	4
4.	SPMMAT 01 02 DCEC 04 3104	Fuzzy Set Theory	3	1	0	4
5.	SPMMAT 01 03 DCEC 01 3104	Wavelet Analysis	3	1	0	4
6.	SPMMAT 01 03 DCEC 02 3104	Theory of Elasticity	3	1	0	4
7.	SPMMAT 01 03 DCEC 03 2124	Object Oriented Programming with C++	2	1	2	4
8.	SPMMAT 01 03 DCEC 04 3104	Information Theory	3	1	0	4
9.	SPMMAT 01 03 DCEC 05 3104	Applied Discrete Mathematics	3	1	0	4
10.	SPMMAT 01 04 DCEC 01 3104	Differential Geometry	3	1	0	3
11.	SPMMAT 01 04 DCEC 02 3104	Mathematical Modelling	3	1	0	3
12.	SPMMAT 01 04 DCEC 03 3104	Finite Element Analysis	3	1	0	3
13.	SPMMAT 01 04 DCEC 04 3104	Mechanics	3	1	0	3
14.	SPMMAT 01 04 DCEC 05 3104	Advanced Complex Analysis	3	1	0	3

GENERIC ELECTIVE COURSE (GEC)
(Offered to PG students of other departments only)

S.N.	Course code	Course title	L	T	P	Credit
1.	SPMMAT 01 01 GEC 01 3104	Introduction to Mathematical Analysis	3	1	0	4
2.	SPMMAT 01 01 GEC 02 3104	Numerical Methods	3	1	0	4
3.	SPMMAT 01 01 GEC 03 3024	Programming in C	3	0	2	4
4.	SPMMAT 01 02 GEC 01 0122	Programming in MATLAB	1	0	2	2
5.	SPMMAT 01 02 GEC 02 0122	Typesetting in LaTeX	1	0	2	2

6.	SPMMAT 01 02 GEC 03 0122	Numerical Programming in C	1	0	2	2
7.	SPMMAT 01 02 GEC 04 2002	Discrete Mathematics	2	0	0	2

Skill Enhancement Elective Course (Compulsory and exclusively for M.Sc. Mathematics students, non-credit, only qualifying in nature) this may include a course based on Theoretical/Experimental/Computational Techniques/Methods. The department may offer more than one courses depending on specialization and strength of faculty members, and the student has to opt one of them.

Semester I

Total credits: 20 (CC: 16, GEC: 4)

S. No.	Course Title	Course Code	L	T	P	Credits
1	Real Analysis	SPMMAT 01 01 CC 01 3104	3	1	0	4
2	Abstract Algebra	SPMMAT 01 01 CC 02 3104	3	1	0	4
3	Complex Analysis	SPMMAT 01 01 CC 03 3104	3	1	0	4
4	Differential Equations and calculus of variations	SPMMAT 01 01 CC 04 3104	3	1	0	4
5	GEC (to be taken from other departments)		-	-	-	4

The following GEC courses are offered to PG students of other departments only.

Introduction to Mathematical Analysis	SPMMAT 01 01 GEC 01 3104
Numerical Methods	SPMMAT 01 01 GEC 02 3104
Programming in C	SPMMAT 01 01 GEC 03 3024

Semester II

Total credits: 22 (CC: 16, DCEC: 4, GEC: 2)

S. No.	Course	Course Code	L	T	P	Credits
1	Linear Algebra	SPMMAT 01 02 CC 01 3104	3	1	0	4
2	Topology	SPMMAT 01 02 CC 02 3104	3	1	0	4
3	Numerical Analysis	SPMMAT 01 02 CC 03 3104	3	1	0	4

S. No.	Course	Course Code	L	T	P	Credits
4	Mathematical Statistics	SPMMAT 01 02 CC 04 3104	3	1	0	4
5	DCEC*		3	1	0	4
6	GEC (to be taken from other departments)		-	-	-	2

***DCEC (For students of M.Sc. (Mathematics) only)**

Advanced Abstract Algebra	SPMMAT 01 02 DCEC 01 3104
Measure Theory and Integration	SPMMAT 01 02 DCEC 02 3104
Fluid Dynamics	SPMMAT 01 02 DCEC 03 3104
Fuzzy Set Theory	SPMMAT 01 02 DCEC 04 3104

GEC courses offered to PG students of other departments only

Programming in MATLAB	SPMMAT 01 02 GEC 01 1022
Typesetting in LaTeX	SPMMAT 01 02 GEC 02 1022
Numerical Programming in C	SPMMAT 01 02 GEC 03 1022
Discrete Mathematics	SPMMAT 01 02 GEC 04 2002

Semester III

Total credits: 22 (CC: 16, DCEC: 4, SEM: 2)

S. No.	Course	Course Code	L	T	P	Credits
1	Integral Equations	SPMMAT 01 03 CC 01 3104	3	1	0	4
2	Functional Analysis	SPMMAT 01 03 CC 02 3104	3	1	0	4
3	Operations Research	SPMMAT 01 03 CC 03 3104	3	1	0	4
4	Number Theory	SPMMAT 01 03 CC 04 3104	3	1	0	4
5	DCEC*		3	1	0	4
6	Seminar/Presentation**	SPMMAT 01 03 SEM 01 2002	-	-	-	2

***DCEC courses for M.Sc. (Mathematics) students only**

Wavelet Analysis	SPMMAT 01 03 DCEC 01 3104
Theory of Elasticity	SPMMAT 01 03 DCEC 02 3104
Object Oriented Programming C++	SPMMAT 01 03 DCEC 03 2124
Information Theory	SPMMAT 01 03 DCEC 04 3104
Applied Discrete Mathematics	SPMMAT 01 03 DCEC 05 3104

****Seminar Presentation:** This may include subject/research oriented topics.

Semester IV

Total credits: 18 (DCEC: 12, PROJ: 6)

S. No.	Course	Course Code	L	T	P	Credits
1	DCEC*		3	1	0	3
2	DCEC*		3	1	0	3
3	DCEC*		3	1	0	3
4	DCEC*		3	1	0	3
6	Project/Dissertation	SPMMAT 01 04 PROJ	-	-	-	6
6	SEEC**		3	1	0	-

***DCEC courses for M.Sc. (Mathematics) students only**

SPMMAT 01 04 DCEC 01 3104	Differential Geometry	3	1	0	3
SPMMAT 01 04 DCEC 02 3104	Mathematical Modelling	3	1	0	3
SPMMAT 01 04 DCEC 03 3104	Finite Element Analysis	3	1	0	3
SPMMAT 01 04 DCEC 04 3104	Mechanics	3	1	0	3
SPMMAT 01 04 DCEC 05 3104	Advanced Complex Analysis	3	1	0	3

****SEEC** (Skill Enhancement Elective Course**,** non-credit, only qualifying in nature): This may include a course based on Theoretical/Experimental/Computational Techniques/Methods. The department may offer more than one courses depending on specialization and strength of faculty members, and the student has to opt one of them. The course code may be given as: SPMMAT 01 04 SEEC 0X 3100, X=1, 2, 3, etc.

FIRST SEMESTER

REAL ANALYSIS

(SPMMAT 01 01 CC 01 3104)

UNIT - I

Metric Space and examples, open sets, closed sets, neighbourhood, unitary space, Euclidean space, Sequences in Metric spaces and convergence.

UNIT- II

Cauchy sequences, complete metric spaces and examples, Baire's theorem, Continuity, spaces of continuous functions, monotonic functions.

UNIT - III

Compactness, sequential compactness, functions continuous on compact sets, Boazano-Weierstrass property, connectedness, components, Uniform continuity, totally disconnected.

UNIT- IV

Functions of Bounded variation, Total variations, functions of bounded variations expressed as difference of increasing functions, continuous function of bounded variations, Riemann and Riemann-Stieltjes integral.

Text Books:

1. Tom M. Apostol, Mathematical Analysis, Addition –Wesley.
2. G. F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Ltd.

Reference Books:

1. Walter Rudin, Principles of Mathematical Analysis, 3rd edition, McGraw-Hill, Kogakusha, 1976, International Student Edition.
2. S. C. Malik and Savita Arora, Mathematical Analysis, New Age International Publishers.
3. H. L. Royden, Real Analysis, Macmillan Pub. Co., Inc. 4th Edition, New York, 1993.
4. D. Somasundram and B. Chaudhary, A first course in Mathematical Analysis, Narosa Publishing House, New Delhi.
5. Terence Tao, Analysis II, Hindustan Book Agency, 2006.

ABSTARCT ALGEBRA

(SPMMAT 01 01 CC 02 3104)

UNIT - I

Review of group theory, the class equation, Cauchy`s theorem, Sylow p-subgroups and its applications, Direct product of groups, description of group of order p^2 and pq, where p and q are distinct primes(In general survey of groups upto order 15).

UNIT - II

Zassenhaus lemma, Normal and subnormal series, Composition series, Jordan-Holder theorem, Solvable series, Derived series, Solvable groups, Solvability of S_n – the symmetric group of degree $n \geq 2$ Structure theorem for finitely generated abelian groups.

UNIT – III

Extension fields. Finite, algebraic, and transcendental extensions. Splitting fields. Simple and normal extensions. Perfect fields. Primitive elements. Algebraically closed fields.

UNIT – IV

Automorphisms of extensions. Galois extensions. Fundamental theorem of Galois theory. Galois group over the rationals.

Text Books:

1. I. N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
2. Joseph Gallian, Contemporary abstract algebra, Narosa Publishing House.

Reference Books :

1. V. K. Khanna and S. K. Bhammbri, A Course in Abstract Alegebra, Vikas Publishing house.
2. P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, Basic Abstract Algebra, 2nd Edition, Cambridge University Press, Indian Edition, 1997.
3. S. Lang, Algebra, Addison-Wesley, 3rd editioin, 1993.
4. S. Luther and I. B. S. Passi, Algebra, Vol. I-Groups, Vol. II-Rings, Narosa Publishing House (Vol. I – 1996, Vol. II –1990).
5. P. M. Cohn, Algebra, Vols. I & II, John Wiley & Sons, 1991.
6. N. Jacobson, Basic Algebra, Vol. I & II, W. H. Freeman, 1980.

COMPLEX ANALYSIS
(SPMMAT 01 01 CC 03 3104)

UNIT-I

Power series, analytic functions, analytic functions as mapping, Mobius transformations.

UNIT-II

Power series representation of analytic functions, zeros of analytic functions, the index of a closed curve, Cauchy's theorem and integral formula, Homotopic version of Cauchy's theorem and simple connectivity. Counting zeros, the open mapping theorem, Goursat theorem.

UNIT-III

Classification of singularities, residues, argument principle and their applications.

UNIT-IV

Maximum modulus theorem, Schwarz's lemma and their applications.

Text Book: J.B. Conway, Functions of one complex variable, Springer, 1978.

Reference Books :

1. E. T. Copson, Theory of functions of complex variables, Oxford University Press,1970.
2. L. V. Ahlfors, Complex Analysis. McGraw- Hill, 1966
3. J. B. Conway, Functions of one complex variable, Springer, 1978.
4. Ruel V. Churchill, James W. Brown, Complex Variables and Applications, 8th Edition, Tata McGraw-Hill Education.
5. Edward B. Saff and A D Snider, Fundamentals of complex Analysis with applications to Engineering and Sciences, Pearson Education.

DIFFERENTIAL EQUATIONS AND CALCULUS OF VARIATIONS

(SPMMAT 01 01 CC 04 3104)

UNIT-I

Preliminaries of ODE, PDE, Existence and Uniqueness theorem, Existence of independent solutions, Wronskian, Abel's formula, Orthognality, orthonormal set of functions, Gram-Schmidt process of orthonormalization, Sturm-Liouville problems, method of Variation of parameters.

UNIT-II

Fourier Transform, Fourier sine and cosine transforms, Applications of Fourier Transform for solving differential equations. Regular and singular points, Power series solution of differential equation at regular and irregular singular points, Bessel's and Legendre's equations and their solutions.

UNIT-III

Classification of PDEs, Introduction to Lagrange's method, Charpit's method and Jacobi method. Solution of Laplace, Wave and diffusion equations by method of separation of variables in Cartesian coordinates, polar coordinates and cylindrical coordinates.

UNIT-IV

Extrema of Functionals: Euler's equation, sufficient conditions for the Extremum of a Functional, Geodesics, Brachistochrone problem, Extension of the vibrational method. Hamilton's Principle, Principle of Least action. Distinctions between Hamilton's Principle and the Principle of Least Action.

Text Books:

1. George F Simmons, Differential equations with applications and historical notes, Tata McGraw Hill, New Delhi, 1974.
2. I. M. Gelfand, S. V. Fomin, Calculus of Variations, Dover Book Publication.

Books Recommended :

1. N. N. Lebedev, Special functions and their applications, Prentice Hall of India, New Delhi, 1965.
2. W.T. Reid, Ordinary Differential Equations, John Wiley and Sons, New York, 1971.
3. M. D. Raisinghania, Advanced Differential Equations, S. Chand & Company Ltd., New Delhi, 2001.
4. Shepley L. Ross, Differential Equations, Wiley, India, Third edition.

GEC COURSES OFFERED TO PG STUDENTS OF OTHER DEPARTMENTS

INTRODUCTION TO MATHEMATICAL ANALYSIS

(SPMMAT 01 01 GEC 01 3104)

UNIT-I

Sets, different kinds of sets, infinite and finite sets, countability. Types of relations – void, universal, reflexive, symmetric, transitive and equivalence classes. Complex numbers, graphic representation and properties, polar form of complex numbers, de Movier's theorem.

UNIT-I

Functions, domain, co-domain, range, classification of real functions, algebraic and transcendental functions, even and odd functions, periodic functions, graphs of some important functions.

UNIT-III

Definition of sequence and its convergence, series and convergence. Quadratic equations and roots, nature of roots.

UNIT-IV

Limits, continuity and differentiability: Limit of a function, fundamental theorem on limits, methods of evaluating limits, existence of limit, left hand and right hand limit, continuity at a point, continuity in an interval, Differentiability of a function at a point and in an interval, Geometrical interpretation.

Reference Books:

1. H. L. Royden, Real Analysis, Macmillan Pub. Co., Inc. 4th Edition, New York, 1993.
2. D. Somasundram and B. Chaudhary, A first course in Mathematical Analysis, Narosa Publishing House, New Delhi.
3. S. C. Malik and Savita Arora, Mathematical Analysis, New Age International Publishers.

NUMERICAL METHODS

(SPMMAT 01 01 GEC 02 3104)

UNIT-I

Errors in approximation, Absolute, Relative and percentage errors. Solution of algebraic and transcendental equations: Bisection method, Regula-Falsi method, Newton Raphson method, Secant method. Systems of simultaneous Equations: Crammer's rule, Inversion method, Gauss elimination method, Gauss Jordon method, LU decomposition method, Iterative methods: Jacobi method and Gauss-Seidel method.

UNIT-II

Eigen values and Eigen vectors: Eigen values, Eigen vectors, Cayley Hamilton theorem, Power method for finding largest Eigen value. Curve fitting: Least square curve fit- Straight line fitting, parabolic curve fitting, fitting of exponential curve, fitting of other curves.

UNIT-III

Finite Differences: Forward difference, Backward difference, Central difference, Newton's forward, backward interpolation formulae, Lagrangian interpolation formula, Gauss forward, backward formulae, Stirling formula, Bessel formula.

UNIT-IV

Numerical Differentiation and Integration: Newton's forward difference, Newton's backward difference Formula for differentiation, Trapezoidal and Simpson's one third rules, Simpson's three eight rule for numerical integration, Boole's rule, Weddle's rule, Double integrals using trapezoidal and Simpsons's rules.

Text Book: M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific & Engg. Computation, New Age International, 2003.

Reference Books:

1. E. Isacson and H. B. Keller, Analysis of Numerical methods, John Wiley & Sons, 1994.
2. K. E. Atkinson, An Introduction to Numerical Analysis, John Wiley & Sons, 1989.
3. A. Maritava Gupta and Subash Chander Bose, Introduction to Numerical Analysis, Academic Publishers.
4. S.D. Conte and Carl De Boor, Elementary Numerical Analysis, An Algorithmic Approach, Tata McGraw Hill, New Delhi, 1981.

PROGRAMMING IN C
(SPMMAT 01 01 GEC 03 3024)

Unit-I

An overview of programming, Programming languages, Classification, C Essentials Program Development, Anatomy of a C Function. Variables, Constants, Expressions, Assignment Statements, Formatting Source files, Continuation character, The Preprocessor. Scalar Data Types-Declarations, Different Types of Integers, Different kinds of integer constants, Floating point types, Initialization, Mixing types, Explicit conversions-casts. Data Types.

Unit-II

Operators and expressions - Precedence and Associatively. Unary Plus and Minus operators. Binary Arithmetic Operators. Arithmetic Assignment Operators. Increment and Decrement Operators. Comma Operator. Relational Operators. Logical Operators. Bit Manipulation Operators. Bitwise Assignment Operators. Cast Operator. Size of Operators. Conditional Operator. Memory Operators, Input/Output functions..

Unit-III

Control Flow - Conditional Branching, The Switch Statement. Looping. Nested Loops, The break and continue Statements. The goto statement. Infinite loops. Arrays - Declaring an array, Arrays and Memory. Initializing arrays, Encryption and Decryption. Multidimensional arrays, Strings.

Unit-IV

Functions - Passing Arguments, declarations and calls. Recursion, The main ( ) Function, Passing Arrays as Function Arguments. Pointers - Pointer Arithmetic, Accessing Array Elements through pointers, Passing Pointers as Function arguments, Arrays of pointers.

Text Books: E. Balagurusamy, Programming in ANSI C, TATA McGraw Hill.

Reference Books:

1. Yashavant P. Kanetkar, Let Us C, BPB, Publication.
2. Byrons, Gottfried. - Programming in C Schaum's Series.
3. Brain W. Kernighan & Dennis M.Ritchie - The C Programme Language 2nd Edi, ANSI features)
   Prentice Hall 1989.
4. Peter A. Darnell and Phillip E.Margolis - C : A Software Engineering Approach, Narosa Publishing, House (Springer International student Edition) 1993.

SEMESTER – II

LINEAR ALGEBRA

(SPMMAT 01 02 CC 01 3104)

UNIT-I

Vector Spaces: Definition and Examples, Subspaces, Linear dependence, Basis and Dimension, Sum and Direct Sum, Quotient spaces, Linear Transformations: Kernel and Image of a Linear Transformation, Rank and Nullity of a Linear Transformation, Matrix Mappings.

UNIT-II

Linear Mappings and matrices: Matrix representation of Linear Transformation, Change of Basis, Similarity. Polynomial of matrices, Characteristic polynomial, Cayley Hamilton Theorem, diagonalization, minimal polynomial, companion matrix.

UNIT-III

Canonical and Bilinear Forms: Triangular form, invariance, Primary decomposition, Jordon canonical form, Rational canonical Form, Bilinear and Quadratic forms.

UNIT-IV

Inner Product Space, examples and properties, Norms and Distances, Orthonormal basis, The Gram-Schmidt Orthogonalization, Orthogonal complements. The Adjoint of a Linear operator on an inner product space, Normal and self-Adjoint Operators, Unitary and Normal Operators.

Text Books: Seymour Lipschutz, Marc Lipson: Linear Algebra, Third Edition, Tata McGraw-Hill.
Reference Books:

1. K. Hoffman and R. Kunze: Linear algebra, Second Edition, Prentice Hall.
2. S. Axler: Linear Algebra Done Right, Second Edition, Springer-Verlag, 2004.
3. S. Lang: Undergraduate Texts in Mathematics, Third Edition, Springer-Verlag, NewYork, 2004.

TOPOLOGY

(SPMMAT 01 02 CC 02 3104)

UNIT – I

Definition and examples of topological spaces, basis and sub-basis, Open sets, Closed sets. Interior points, Closure points. Limit points, Boundary points, exterior points of a set, Closure of a set, Derived set, Hausdorff spaces.

UNIT – II

Subspace topology, Continuous functions, convergence of sequences, sequential continuity, open and closed mappings, Homeomorphism, pasting lemma, Product topology.

UNIT – III

Connectedness, Continuity and connectedness, Connected subsets of the real line, components, path connectedness, locally connected, locally path connected. Separation axioms, T_0, T_1, T_2 (Hausdorff) spaces.

UNIT – IV

Compactness and its characterizations, Compact subspace of the real line, Continuity and compact sets, Lindelof spaces, Compactness and finite intersection property, Tychonoff theorem, countability and compactness.

Text Book: J. R. Munkres, Toplogy, PHI learning Pvt. Ltd., 2002.
Reference Books:

1. George F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, 1963.
2. K. D. Joshi, Introduction to General Topology, Wiley Eastern Ltd, 1983.
3. J. L. Kelly, General Topology, Springer Verlag, New York, 1991.
4. W. J. Pervin, Foundations of General Topology, Academic Press, 1964.
5. T.B.Singh, Elements of Topology, CRC Press, Taylor francis.

NUMERICAL ANALYSIS

(SPMMAT 01 02 CC 03 3104)

UNIT-I

Errors in approximation, Absolute, Relative and percentage errors. Solution of algebraic and transcendental equations: Bisection method, Regula Falsi method, Newton Raphson method. Systems of simultaneous Equations: Gauss elimination method, Gauss Jordon method, LU decomposition method, Iterative methods: Jacobi method and Gauss-Seidel method. Curve fitting: Straight line fitting, parabolic curve fitting, fitting of exponential curve, fitting of other curves. Introduction to splines, B-Splines.

UNIT-II

Finite Differences, Interpolation techniques: Interpolation with equal intervals-Newton Forward, Newton Backward, Gauss forward, Gauss Backward, Stirling, Bessel formulae. Interpolation with unequal intervals-Newton's divided difference, Lagrange interpolation technique. Numerical Differentiation using Newton Forward, Newton Backward formulae.

UNIT-III

Numerical Integration: Newton-Cotes Formulas, Trapezoidal rule, Simpson rule, Romberg's integration, Gauss-Legendre, Gauss-Chebychev formulas.

Solution of Ordinary differential equations: Single step methods: Taylor series method, Picard's method, Euler method, Euler modified method, Runge – Kutta methods, Multistep methods: Milne's and Adam's predictor and corrector methods

UNIT-IV

Classification of PDEs. Solution of partial differential equations by finite difference method. Solution of Laplace equation: standard and diagonal five point formula for solving Laplace and Poisson equations, Solution of One dimensional Heat equation: Schmidt method, Crank-Nicolson method, Solution of wave equation. Introduction to finite elements methods, Solution of boundary value problems by finite element methods.

Text Books: John H. Mathews, Numerical Methods for Mathematics, Science and Engineering, Prentice-Hall International Editions, 1992.

Reference Books:

1. Steven C. Chapra and Raymond P. Canale, Numerical Methods for Engineers, McGraw Hill International Edition, 1998.
2. Richard H. Bartels, John C. Bealty, and John C. Beatty, An Introduction to Spline for use in Computer Graphics and Geometric Modeling, Morgan Kaufmann Publisher, 2006.
3. Carl de Boor, A Practical Guide to Splines, Springer Verlag, 2001.

MATHEMATICAL STATISTICS

(SPMMAT 01 02 CC 04 3104)

UNIT - I

Measures of central tendency and dispersion, moments, Measures of skewness and kurtosis, Correlation and regression. Axiomatic approach to the theory of probability, Sample space, additive and multiplicative law of probability, conditional probability. Definition and properties of random variables, discrete and continuous random variables, probability mass and density functions, distribution function. Concepts of bivariate random variables.

UNIT - II

Mathematical Expectation: Definition and its properties. Variance, Covariance, Moment generating function- definitions and their properties. Discrete distributions: Binomial, Poisson and geometric distributions with their properties.

UNIT - III

Continuous distributions: Uniform, Exponential, Gamma and Normal distributions with their properties. Chebychev's inequality, Central Limit Theorem.

UNIT – IV

Statistical estimation, Testing of Hypothesis: Null and alternative hypotheses, Simple and composite hypotheses, Two types of errors, t, F and Chi-Square as sampling distribution and applications.

Text Book: S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 2002.

Reference Books:

1. Baisnab and M. Jas, Element of Probability and Statistics, Tata McGraw Hill, 1993.
2. P. L. Meyer, Introductory Probability and Statistical Applications, Addison-Wesley Publishing Company, 1970.

DCEC COURSES OFFRED TO M.SC. (MATHEMATICS) STUDENTS ONLY

ADVANCED ABSTRACT ALGEBRA

(SPMMAT 01 02 DCEC 01 3104)

UNIT – I

Cyclic modules, Simple and semi-simple 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

Uniform modules, Primary modules and Neother- Lasker theorem. Neotherian and Artinian modules and rings with simple properties and examples.

Unit – III

Nilpotent ideals in Neotherian and Artinian rings, Hilbert Basis theorem, Nakayama's lemma, Nilradical and Jacobson radicals, Opertions on ideals , Extension and contraction.

UNIT – IV

Hom(R,R), Opposite rings, Wedderburn – Artin theorem, Maschk's theorem, Equivalent statement for left Artinian rings having non-zero nilpotent ideals.

Text Books: I. N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.

Reference Books:

1. P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, Basic Abstract Algebra (2nd Edition), Cambridge University Press, Indian Edition, 1997.
2. M. F. Atiyah & I. G. Macdonald, Introduction to Commutative Rings, Addison Wesley.
3. P. M. Cohn, Algebra, Vols. I, II & III, John Wiley & Sons, 1982, 1989, 1991.
4. C. W. Curtis and I. Reiner, Representation Theory of finite Groups and Associative Algebras, Wiley and Sons, 1962.
5. F. W. Anderson and K. R. Fuller, Rings and Categories of Modules, Springer-Verlag New York, 1992.
6. T. Y. Lam, Lectures on Modules and Rings, GTM Vol. 189, Springer-Verlag, 1999.

MEASURE THEORY AND INTEGRATION

(SPMMAT 01 02 DCEC 02 3104)

UNIT - I

Length of an open set, concept of measure, Lebesgue outer measure and measurable sets, example of non-measurable set, sigma algebra, Borel sets, G_δ and F_σ –sets, outer and inner regularity of Lebesgue measure.

UNIT - II

Set function, abstract measure spaces, properties of measures, some examples of measures, measurable spaces, measurable functions, combinations of measurable functions, limits of measurable functions.

UNIT- III

Review of Riemann integral, integrable simple functions, the Lebesgue integration of a measurable function, integration with respect to a measure.

UNIT - I V

Almost everywhere convergence, convergence in measure, Fatou's Lemma, Monotone and Dominated Convergence Theorems.

Text Books:

G. de Barra, Measure and Integration. New Age International (P) Ltd., New Delhi, 2006.
S. K. Berberian, Measure and Integration, Amer. Math. Soc. (reprint), 2011.

Reference Books:

1. H. L. Royden, Real Analysis, Macmillan Pub. Co., Inc. 4th Edition, New York, 1993.
2. P. R. Halmos, Measure Theory, Springer-Verlag New York, 1974.
3. E. Hewitt and K. Stromberg, Real and Abstract Analysis, Springer,
4. G. B. Folland, Real analysis, John Wiley & Sons, 1999.

FLUID DYNAMICS

(SPMMAT 01 02 DCEC 03 3104)

UNIT-I

Kinematics of fluid-Lagrangian and Eulerian methods, Stream lines, Path lines, Streak lines, Velocity potential, Irrotational and rotational motions. Vortex lines, Equation of Continuity. Lagrangian and Eulerian approach, Euler's equation of motion.

UNIT-II

Bernoulli's theorem, Kelvin circulation theorem, Vorticity equation, Energy equation for an incompressible flow. Boundary conditions, Kinetic energy of liquid, Axially symmetric flows, Motion of a sphere through a liquid at rest at infinity, Liquid streaming past a fixed sphere.

UNIT-III

Equation of motion of a sphere, Sources, Sinks and doublets, Images in a rigid impermeable infinite plane and in impermeable spherical surfaces. Two-dimensional irrotational motion produced by motion of circular, co-axial and elliptic cylinders in an infinite mass of liquid, Stream functions, Stokes stream functions.

UNIT-IV

Complex velocity potential, Conformal mapping, Milne-Thomson Circle theorem, Blasius theorem, Vortex Motion and its elementary properties, Kelvin's proof of permanence, Motion due to rectilinear vortices.

Text Book: W.H. Besaint and A.S. Ramsey, A Treatise on Hydromechanics, Part II, CBS Publishers, Delhi,1988.

Reference Books:

1. N. Curle & H. J. Davies, Modern Fluid Dynamics, Vol – I, D Van Nostrand Company Ltd, London.
2. S.W. Yuan, Foundations of Fluid Mechanics, Prentice Hall of India Private Limited, New Delhi,
   1976.
3. F. Chorlton, Fluid Dynamics, C.B. S. Publishers Delhi.
4. M. E. O'Neil, and F Choriton, Ideal and Incompressible Fluid Dynamics, John Wiley & Sons.

FUZZY SET THEORY

(SPMMAT 01 02 DCEC 04 3104)

UNIT-I

Concepts of Fuzzy Set, Standard Operations of Fuzzy Set, Fuzzy Complement, Fuzzy Union, Fuzzy Intersection, Other Operations in Fuzzy Set, T- norms and T- conorms. Interval, Fuzzy Number, Operation of Interval, Operation of - cut Interval, Examples of Fuzzy Number Operation.

UNIT-II

Definition of Triangular Fuzzy Number, Operation of Triangular Fuzzy Number, Operation of General Fuzzy Numbers. Approximation of Triangular Fuzzy Number, Operations of Trapezoidal Fuzzy Number, Bell Shape Fuzzy Number. Function with Fuzzy Constraint, Propagation of Fuzziness by Crisp Function, Fuzzifying Function of Crisp Variable, Maximizing and Minimizing Set, Maximum Value of Crisp Function.

UNIT-III

Integration and Differentiation of Fuzzy Function Product Set, Definition of Relation, Characteristics of Relation, Representation Methods of Relations, Operations on Relations, Path and Connectivity in Graph, Fundamental Properties, Equivalence Relation, Compatibility Relation, Pre-order Relation, Order Relation, Definition and Examples of Fuzzy Relation, Fuzzy Matrix, Operations on Fuzzy Relation.

UNIT-IV

Composition of Fuzzy Relation, - cut of Fuzzy Relation, Projection and Cylindrical Extension, Extension by Relation, Extension Principle, Extension by Fuzzy Relation, Fuzzy distance between Fuzzy Sets. Graph and Fuzzy Graph, Fuzzy Graph and Fuzzy Relation, - cut of Fuzzy Graph.

Text Book:

1. Kwang H. Lee, First Course on Fuzzy Theory and Applications, Springer International Edition, 2005.
2. Chander Mohan , An Introduction to Fuzzy Set Theory and Fuzzy Logic, Anshan Publishers.

Reference Books:

1. H.J. Zimmerman, Fuzzy Set Theory and its Applications, Allied Publishers Ltd., New Delhi, 1991.
2. John Yen, Reza Langari, Fuzzy Logic - Intelligence, Control and Information, Pearson Education.

GEC COURSES OFFRED TO PG STUDENTS OF OTHER DEPARTMENTS

PROGRAMMING IN MATLAB

(SPMMAT 01 02 GEC 01 0122)

Overview of MATLAB, operators, Display format, elementary built-in functions, working with variables, General commands, data types, data import, arrays, operations with arrays. Matrices: Eigenvalues and Eigenvectors, Similarity Transformation and Diagonalization, Functions, Script files, operators, Loops and Conditional Statements, Programming in MATLAB, Graphics- 2-D and 3-D Plots, input and output.

Applications in Numerical Methods: System of linear equations, L U Decomposition, Gauss elimination method, Gauss Seidel Method, Gauss Jordan Method. Interpolation: Lagrange and Newton Polynomials, curve fitting, Bisection Method, False Position (Regula-Falsi) Method, Newton–Raphson) Method, Secant Method, Newton Method for a System of Nonlinear Equations, Symbolic Solution for Equations. Applications to Numerical differentiation and integrations: Trapezoidal Method and Simpson Method, Runge–Kutta Method, Introduction to working with modules in MATLAB.

Text Book: S.R. Otto and J.P. Denier, An Introduction to Programming and Numerical Methods in MATLAB, Springer-Verlag London.

Reference Books:

1. Won Young Yang, Wenwu Cao, Tae-Sang Chung and John Morris, Applied numerical methods using MATLAB, John Wiley Interscience.
2. Rudra Pratap, Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers, Oxford University Press.

OTHER USEFUL READING:

Getting started with Matlab, Maths Works Inc. www. in.mathsworks.com

TYPESETTING IN LATEX

(SPMMAT 01 02 GEC 02 1022)

Defining command and environments, Producing and including graphics in a LaTeX file, figures and other floating bodies, lining it up in columns, table of content, cross-reference, bibliography and citation, making index and glossary, slides, overlays and notes, letters.

Design it yourself: document class, page style, title page, customizing the style, line and page breaking, numbering, length, spaces and boxes, formatting with boxes, centring and flushing, list making environments, changing font type size and special symbols, picture, picture environments, picture objects, text, boxes, straight lines, arrow, stacks, circles, oval, framing, curve, grid, repeat patterns.
Making presentation slides in beamer class LaTeX, various styles in beamer presentation, dynamic slides.

Text Book: Leslie Lamport , A Document Preparation System User's Guide and Reference Manual, Addison-Wesley Publishing Company.

Reference Books:

1. Stefan Kottwitz , LaTeX Beginner's Guide, Packt Publishing, UK.

Other Sources for reading:

1. Till Tantau , User Guide to the Beamer Class, http://latex-beamer.sourceforge.net.
2. Tobias Oetiker , The Not So Short Introduction to L ATEX2E, https://tobi.oetiker.ch/lshort/lshort.pdf

NUMERICAL PROGRAMMING IN C

(SPMMAT 01 02 GEC 03 1022)

This course is based on the following courses:

NUMERICAL METHODS--SPMMAT 0101 GEC 02 3104

PROGRAMMING IN C--SPMMAT 0101 GEC 03 3104

DISCRETE MATHEMATICS

(SPMMAT 01 02 GEC 04 2002)

UNIT-I

Mathematical Logic: Statement and notations, proposition and logic operations, connectives (conjunction, disjunction, negation), statement formulas and truth tables, equivalence of formulas and implication laws of logic, variables, quantifiers, , principal of mathematical induction.

Relation and Function: Binary relations, Properties of binary relation in a set, Equivalence relations, Composition of binary relations, Partial ordering and Partial Order set, Hasse diagram, Function and Pigeon hole Principle. Recursion definition, recurrence relations, generating functions and their solutions.

Text Books: Kenneth H. Rosen , Discrete Mathematics and Its Applications, Seventh Edition, Tata McGraw Hill.

Reference Books:

1. J. P. Trembley and R. Manohar, A First Course in Discrete Structure with applications to Computer Science, Tata McGraw Hill (1999).
2. Vijay K. Khanna, Lattices and Boolean Algebras, PHI publication.
3. Babu Ram, Discrete Mathematics, Vinayak Publications.
4. C. L. Liu, Elements of Discrete Mathematics, Tata McGraw Hill.

SEMESTER – III

INTEGRAL EQUATIONS

(SPMMAT 01 03 CC 01 3104)

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.

UNIT- II

Iterated kernels and Neumann series for Volterra equations. Resolvent kernel as a series, Solution of a Volterra integral equation of the first kind. Boundary value problems reduced to Fredholm integral equations, Methods of successive approximation and successive substitution to solve Fredholm equations of second kind.

UNIT - III

Iterated kernels and Neumann series for Fredholm equations. Resolvent kernel as a sum of series. Fredholm equations with separable kernels, Approximation of a kernel by a separable kernel, Non homogenous Fredholm equations with degenerate kernels.

UNIT - IV

Green's function, Use of method of variation of parameters to construct the Green's function for a nonhomogeneous 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.

Text Book: R.P. Kanwal, Linear Integral Equation. Theory and Techniques, Academic Press, New York, 1971.

Reference Books:

1. S.G. Mikhlin, Linear Integral Equations (translated from Russian), Hindustan Book Agency, 1960.
2. Abdul J. Jerri, Introduction to Integral Equations with Applications, John Wiley & Sons,1985.
3. Francis B. Hildebrand, Method of Applied Mathematics, Dover Publications; 2nd edition 1992.

FUNCTIONAL ANALYSIS

(SPMMAT 01 03 CC 02 3104)

UNIT-I

Normed linear spaces. Banach spaces. Examples of Banach spaces and subspaces. Continuity of linear maps. Equivalent norms. Normed spaces of bounded linear maps. Bounded linear functionals. Dual spaces of l^p, $\mathbb{R}^n$ and Reflexivity.

UNIT-II

Hilbert spaces, examples, Orthogonality, Orthonormal sets, Bessel's inequality, Parsevals's theorem. The conjugate space of a Hilbert space.

UNIT-III

Adjoint operators, Self-adjoint operators, Normal and Unitary operators. Projection operators. Weak convergence. Completely continuous operators.

UNIT-IV

Hahn-Banach theorem and its applications, Uniform boundedness principle. Open mapping theorem, Projections on Banach spaces, Closed graph theorem.

Text Book: E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley.

Reference Books:

1. H. L. Royden, Real Analysis, MacMillan Publishing Co., Inc., New York, 4th Edition, 1993.
3. George F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, 1963.
4. G. Bachman and L. Narici, Functional Analysis, Academic Press, 1966.

OPERATIONS RESEARCH

(SPMMAT 01 03 CC 03 3104)

UNIT - I

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

UNIT - II

Transportation Problems: Basic feasible solutions, optimum solution by stepping stone and modified distribution methods, unbalanced and degenerate problems, transhipment 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)

UNIT- IV

Game Theory : Two person zero sum game, Game with saddle points, rule of dominance; Algebraic, graphical and linear programming, concept of mixed strategy. 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 & Man Mohan, S. Chand publisher.

Reference Books:

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.
4. Sharma, J.K., Mathematical Model in Operation Research, Tata McGraw Hill.

NUMBER THEORY

(SPMMAT 01 03 CC 04 3104)

UNIT - I

Representation of the real numbers by decimals, Divisibility, G.C.D and L.C.M., Primes, Fermat numbers, congruences and residues, theorems of Euler, Fermat and Wilson, solutions of congruences, linear congruences, Chinese remainder theorem,

UNIT -II

Arithmetical functions $\varphi(n)$, $\mu(n)$ and $d(n)$ and $\sigma(n)$, Mobius inversion formula, congruences of higher degree, congruences of prime power modulli and prime modulus, power residue,

UNIT - III

Quadratic residue, Legendre symbols, lemma of Gauss and reciprocity law. Jacobi symbols, irrational numbers, irrationality of e and π. Finite continued fractions, simple continued fractions, infinite simple continued fractions.

UNIT - IV

Periodic continued fractions, Approximation of irrational numbers by convergence, best possible approximation, Farey series, rational approximation, Pell's equations, Hurwitz theorem , Lagrange four sphere theorem.

Text Books: D. M. Burton, Elementary Number Theory, Tata McGraw Hill Publishing House, 2006.

***Reference Books*:**

1. G. H. Hardy and E. M. Wright, Theory of Numbers, Oxford Science Publications, 2003.
2. I. Niven and H. S. Zuckerman, Introduction to the Theory of Numbers, John Wiley & Sons, 1960.
3. H. Davenport, Higher Arithmetic, Cambridge University Press, 1999.
4. T. M. Apostol, Introduction to Analytic Number Theory, Narosa Publishing House.

DCEC COURSES OFFRED TO M.SC. (MATHEMATICS STUDENTS)

WAVELET ANALYSIS

(SPMMAT 01 03 DCEC 01 3104)

UNIT-I

Review of Inner Product spaces, orthonormal systems. Frames in C^n. Frames algorithms. Frames and Bessel sequences in infinite dimensional Hilbert spaces, Frame sequence, the Gram matrix associated with Bessel sequences.

UNIT-II

Frames and Operators, characterization of frames, dual frames, tight frames. Riesz bases, Frames versus Riesz bases, conditions for a frame being a Riesz basis, frames containing a Riesz basis. Perturbation of frames.

UNIT-III

Wavelets, Haar Wavelets, basic properties of the Haar scaling function, Haar decomposition And reconstruction algorithms. The Daubechies wavelets, wavelet bases, scaling function. Multiresolution analysis (MRA). Construction of wavelets from MRA.

UNIT-IV

Windowed Fourier Transform (WFT). Continuous Fourier Transform (CFT). Continuous Wavelet Transform (CWT). Comparison between CFT and CWT. Continuous Wavelet Transform as an operator. Inversion formula for Continuous Wavelet Transform.

Text Books:

1. O. Christensen, An introduction to frames and Riesz bases, Birkhauser (2003)
2. S. Mallat , a wavelet tour of signal processing, Academic Press (2009).
3. E. Harnendez and G. Weiss, A first course on wavelets, CRC Press (1996).

Reference Books:

1. D. Han, K.Kornelson , D. Larson and E. Weber, Frames for undergraduates, Student Math. Lib.,(AMS) Vol. 40 (2007). 28
2. Boggess and F.J Narcowich, A first course in Wavelets and Fourier Analysis, Wiley(2009)

THEORY OF ELASTICITY

(SPMMAT 01 03 DCEC 02 3104)

UNIT-I

Cartesian Tensor : Coordinate transformation, Cartesian Tensor of different order, Sum or difference and product of two tensors. Contraction theorem, Quotient law, Symmetric & Skewsymmetric tensors, Kronecker tensor, alternate tensor and relation between them, Scalar invariant of second order tensor, Eigen values & vectors of a symmetric second order tensor, Gradient, divergence & curl of a tensor field. Analysis of Strain : Affine transformations. Infinitesimal affine deformation. Geometrical interpretation of the components of strain.

UNIT-II

Strain quadric of Cauchy. Principal strains and invariants. General infinitesimal deformation. Saint-Venant' s equations of Compatibility, Analysis of stress: Stress tensor. Equation of equilibrium. Transformation of co-ordinates. Stress quadric of Cauchy. Principal stress and Invariants. Maximum normal and shear stresses.

UNIT-III

Equations of elasticity: Generalized Hooke's law. Homogeneous isotropic media. Elastic moduli for isotropic media. Equilibrium and dynamic equations for an isotropic elastic solid. Strain energy function and its connection with Hooke's law. Beltrami-Michell compatibility equations.

UNIT- IV

Two-dimensional problems. Plane stress. Generalized plane stress. Airy stress function. General solution of Biharmonic equation. Stresses and displacements in terms of complex potentials. Waves: Propagation of waves in an isotropic elastic sold medium. Waves of dilation and distortion. Plane waves. Elastic surface waves such as Rayleigh and Love waves.

Text Books:

1. Shanti Narayan, Text Book of Cartesian Tensors, S. Chand & Co., 1950.
2. I.S. Sokolnikoff, Mathematical Theory of Elasticity.

Reference Books:

1. A.E.H. Love, A Treatise on Mathematical Theory of Elasticity.
2. S Timoshenko and I.N. Goodier, Theory of Elasticity.

OBJECT ORIENTED PROGRAMMING WITH C++

(SPMMAT 01 03 DCEC 03 2124)

UNIT - I

Basic concepts of Object-Oriented Programming (OOP). Advantages and applications of OOP. Object-oriented languages. Introduction to C++. Structure of a C++ program. Creating the source files. Compiling and linking. C++ programming basics: Input/Output, Data types, Operators, Expressions, Control structures, Library functions.

UNIT - II

Functions in C++ : Passing arguments to and returning values from functions, Inline functions, Default arguments, Function overloading. Classes and objects : Specifying and using class and object, Arrays within a class, Arrays of objects, Object as a function arguments, Friendly functions, Pointers to members.

UNIT - III

Constructors and destructors. Operator overloading and type conversions. Inheritance : Derived class and their constructs, Overriding member functions, Class hierarchies, Public and private inheritance levels. Polymorphism, Pointers to objects, this pointer, Pointers to derived classes, virtual functions.

UNIT - IV

Streams, stream classes, Unformatted I/O operations, Formatted console I/O operations, Managing output with manipulators. Classes for file stream operations, Opening and Closing a file. File pointers and their manipulations, Random access. Error handling during file operations, Command-line arguments. Exceptional handling.

Text Book: E. Balagrusamy, Object Oriented Programming with C++, 2nd Edition, Tata Mc Graw Hill Pub. Co, 2001.

Reference Books:

1. I. S. Robert Lafore, Object Oriented Programming using C++, Waite's Group Galgotia Pub, 1994.
2. Byron S. Gottfried, Object Oriented Programming using C++, Schaum's Outline Series, Tata Mc-Graw Hill Pub. Co. 2000.
3. J. N. Barakaki, Object Oriented Programming using C++, Prentice Hall of India, 1996.

INFORMATION THEORY

(SPMMAT 01 03 DCEC 04 3104)

UNIT-I

Measure of Information – Axioms for a measure of uncertainty. The Shannon entropy and its properties. Joint and conditional entropies. Transformation and its properties. Axiomatic characterization of the Shannon entropy due to Shannon and Fadeev.

UNIT-II

Noiseless coding - Ingredients of noiseless coding problem. Uniquely decipherable codes. Necessary and sufficient condition for the existence of instantaneous codes. Construction of optimal codes.

UNIT-III

Discrete Memoryless Channel - Classification of channels. Information processed by a channel. Calculation of channel capacity. Decoding schemes. The ideal observer. The fundamental theorem of Information Theory and its strong and weak converses.

UNIT-IV

Continuous Channels - The time-discrete Gaussian channel. Uncertainty of an absolutely continuous random variable. The converse to the coding theorem for time-discrete Gaussian channel. The time-continuous Gaussian channel. Band-limited channels.

Text Book: R. Ash, Information Theory, Interscience Publishers, New York, 1965.

Reference Books:

1. F.M. Reza, An Introduction to Information Theory, MacGraw-Hill Book Company Inc., 1961.
2. J. Aczel and Z. Daroczy, On Measures of Information and their Characterizations, Academic Press, New York.

APPLIED DISCRETE MATHEMATICS

(SPMMAT 01 03 DCEC 05 3104)

UNIT-I

Formal Logic: Statements, Symbolic Representation and Tautologies, Quantifiers, Proposition Logic.

UNIT-II

Lattices - Lattices as partially ordered sets, Their properties, Lattices as Algebraic systems, Some special Lattices, e.g., complete, complemented and Distributive Lattices. Sets Some Special Lattices e.g., Bounded, Complemented & Distributive Lattices..

UNIT-III

Boolean Algebra - Boolean Algebra as Lattices, Various Boolean Identities, The Switching Algebra example, Join - irreducible elements, Atoms and Minterms, Boolean Forms and Their Equivalence, Minterm Boolean Forms, Sum of Products canonical Forms, Minimization of Boolean Functions, Applications of Boolean Algebra to Switching Theory (using AND, OR and NOT gates).

UNIT-IV

Graph Theory - Definition of Graphs, Paths, Circuits, Cycles and Subgraphs, Induced Subgraphs, Degree of a vertex, Connectivity, Planar Graphs and their properties, Trees, Euler's Formula for Connected Planar Graph, Complete and Complete Bipartite Graphs.

Text Book: Kenneth H. Rosen , Discrete Mathematics and Its Applications, Seventh Edition, Tata McGraw Hill.

References Books:

1. J.P. Tremblay & R.Manohar, Discrete Mathematical Structures With Applications To Computer Science, Mcgraw Hill Book Co., 1997.
2. Seymour Lepschutz, Finite Mathematics (International Edition 1983), Mcgraw-Hili Book Company, New York.
3. C.L. Liu, Elements Of Discrete Mathematics, Mcgraw-Hili Book Co.
4. N. Deo, Graph Theory With Applications To Engineering And Computer Sciences, Prentice Hall Of India.

SEMESTER – IV

DIFFERENTIAL GEOMETRY

(SPMMAT 01 04 DCEC 01 3103)

UNIT-I

Curves with torsion: Tangent, Principal Normal, Curvature, Binormal, Torsion, Serret Frenet formulae, Locus of centre of spherical Curvature.

UNIT-II

Envelopes: Surfaces, Tangent plane, Envelope, Characteristics, Edge of regression, Tangent, Principal normal. Curvature, Binomial Torsion, Serret-Frenet formulae, Loous of centre of curvature, Spherical curvature.

UNIT-III

Curvilinear Co-ordinates: First order magnitude, Directions on a surface, Second order magnitudes, Derivative of unit normal, Principal directions and curvatures.

UNIT-IV

Geodesics: Geodesic property, Equations of geodesics, Torsion of a geodesic.

Text Books: C.E., Weatherburn, Differential Geometry of Three Dimensions, Cambridge University Press.

Reference Books*:*

1. S. Sokolnikoff, Tensor Calculus and Application to Geometry and Mechanics.
2. T. T. Wilmore, An Introduction to Differential Geometry, Willy & sons.
3. Bary Spain, Tensor Calculus: A concise course, Dover Publications.

MATHEMATICAL MODELING

SPMMAT 01 04 DCEC 02 3103

Unit-I

Simple situations requiring mathematical modelling, techniques of mathematical modeling, Classifications, Characteristics and limitations of mathematical models, Some simple illustrations. Mathematical modelling in population dynamics, Mathematical modelling of epidemics through systems of ordinary differential equations of first order Mathematical Models in Medicine, Arms Race, Battles and international Trade in terms of Systems of ordinary differential equations, Mathematical modelling in dynamics through systems of ordinary differential equations of first order.

Unit-II

The need for Mathematical modelling through difference equations, linear growth and decay models, Non linear growth and decay models, Basic theory of linear difference equations with constant coefficients, Mathematical modelling through difference equations in economics and finance.

Unit-III

Mathematical modelling through difference equations in population dynamics and genetics. Mathematical Modelling through difference equations in probability theory. Miscellaneous examples of Mathematical modelling through difference equations.

Unit-IV

Situations that can be modeled through graphs, Mathematical models in terms of directed graphs Mathematical models in terms of signed graphs, Mathematical models in terms of weighted graphs.

Text Book: J. N. Kapur, Mathematical Modelling, Willey Eastern Limited, Reprint, 2000.

Reference Books:

1. D. J. G. James and J. J. Macdonald, Case studies in Mathematical Modelling, Stanly Thames, Cheltonham.
2. J.N. Kapur, Mathematical entropy Models.
3. M. Crossand A. O. Moscrcadini, The art of Mathematical Modelling, Ellis Harwood and John Wiley.
4. C. Dyson, Elvery, Principles of Mathematical Modelling, Academic Press, New York.
5. D. N. Burghes, Modelling with Difference Equations, Ellis Harwood and John Wiley.

FINITE ELEMENT ANALYSIS

(SPMMAT 01 04 DCEC 03 3103)

UNIT I

General theory of finite element methods, Difference between finite element and finite difference, Review of some integral formulae, Concept of discretization, Different coordinates, One dimensional finite elements, shape functions, stiffness matrix, connectivity, boundary conditions, equilibrium equation, FEM procedure.

UNIT II

Generalization of the finite element concepts-weighted residual and variational Approaches (Ritz method, Galerkin method, collocation method etc.) Numerical integration, Interpolation formulas and shape functions, Axis symmetric formulations, solving one-dimensional problems.

UNIT III

Two dimensional finite element methods, Element types: triangular, rectangular, quadrilateral, sector, curved, isoperimetric elements and numerical integration, two dimensional boundary value problems, connectivity and nodal coordinates, theory of elasticity, variational functions, triangular elements and area coordinates, transformations, cylindrical coordinates.

UNIT IV

Three dimensional finite elements, higher order finite elements, element continuity, plate finite elements, Application of finite element methods to practical elasticity problems, Computer procedures for Finite element analysis.

Text Book: D. Braess, Finite Elements: Theory, Fast Solvers, and Applications in Solid Mechanics, Cambridge University Press.

Reference Books:

1. C. S. Desai, Introductory Finite Element Method, CRC Press, 2001.
2. G. D. Smith, Numerical solution of Partial Differential Equations: Finite difference methods, Oxford Applied Mathematics and Computing Science Series, 1985.
3. B. Bradie, A friendly introduction to Numerical Analysis, Pearson Education, India, 2007.

MECHANICS

(SPMMAT 01 04 DCEC 04 3103)

UNIT-I

Moments and products of Inertia, Theorems of parallel and perpendicular axes, principal axes, The momental ellipsoid, Equimomental systems, Coplanar distributions.

UNIT-II

Generalized coordinates, Holonomic and Non-holonomic systems. Scleronomic and Rheonomic systems. Lagrange's equations for a holonomic system., Lagrange's equations for a conservative and impulsive forces. Kinetic energy as quadratic function of velocities. Generalized potential, Energy equation for conservative fields.

UNIT-III

Hamilton's variables. Donkin's theorem. Hamilton canonical equations. Cyclic coordinates. Routh's equations. Poisson's Bracket. Poisson's Identity. Jacobi-Poisson Theorem. Hamilton's Principle. Principle of least action.

UNIT-IV

Poincare Cartan Integral invariant. Whittaker's equations. Jacobi's equations. Statement of Lee Hwa Chung's theorem. Hamilton-Jacobi equation. Jacobi theorem. Method of separation of variables. Lagrange Brackets. Condition of canonical character of a transformation in terms of Lagrange brackets and Poisson brackets. Invariance of Lagrange brackets and Poisson brackets under canonical transformations.

Text Book: F.Chorlton, A Text Book of Dynamics, CBS Publishers & Dist., New Delhi.

Reference Books:

1. F. Gantmacher, Lectures In Analytic Mechanics, Mir Publishers, Moscow, 1975.
2. Louis N. Hand And Janet D. Finch , Analytical Mechanics, Cup, 1998.
3. K. Sankra Rao , Classical Mechanics, Prentice Hall Of India, 2005.
4. M.R. Speigal, Theoretical Mechanics, Schaum Outline Series
5. A.S. Ramsey, Newtonian Gravitation, the english language book society and the cambridge university press.

ADVANCED COMPLEX ANALYSIS

SPMMAT 01 04 DCEC 05 3103

UNIT-I

Convex functions and Hadamard's Three Circles Theorem Phragmen-Lindelof Theorem

Unit-II

The space of continuous functions, Spaces of analytic functions, The Riemann Mapping Theorem, Weierstrass Factorization Theorem.

Unit-III

Runge's Theorem, Simple connectedness, Mittag-Leffier's Theorem, Schwarz Reflection Principle.

Unit-IV

Basic Properties of harmonic functions, Harmonic functions on a disk, Jensen's Formula, Bloch's Theorem, The Little Picard Theorem, Schottky's Theorem, The Great Picard Theorem

Text Book: J.B. Conway, Functions of one complex variable, Springer, 1978.

Reference Books:

1. E.T.Copson,: Theory of functions of complex variables, Oxford University Press,1970.
2. L.V .Ahlfors: Complex Analysis. McGraw- Hill, 1966
3. Ruel V. Churchill, James W. Brown, Complex Variables and Applications 8th Edition, Tata McGraw-Hill Education.
4. Edward B. Saff and A D Snider, Fundamental of complex Analysis with applications to Engineering and Sciences, Pearson Education.

SKILL ENHANCEMENT ELECTIVCE COURSES

Department may also offer skill enhancement courses besides the following two courses depending on the availability and expertise of the faculty members in the Department.

PROGRAMMING IN MATLAB
(SPMMAT 01 04 SEEC 01 0120)

UNIT-I

Overview of MATLAB, operators, Display format, elementary built-in functions, working with variables, General commands, data types, data import, arrays, operations with arrays.

Unit-II

Matrices: Eigenvalues and Eigenvectors, Similarity Transformation and Diagonalization, Functions, Script files, operators, Loops and Conditional Statements, Programming in MATLAB, Graphics- 2-D and 3-D Plots, input and output.

Unit-III

Applications in Numerical Methods: System of linear equations, L U Decomposition, Gauss elimination method, Gauss Seidel Method, Gauss Jordan Method. Interpolation: Lagrange and Newton Polynomials, curve fitting, Bisection Method, False Position (Regula-Falsi) Method, Newton–Raphson) Method, Secant Method, Newton Method for a System of Nonlinear Equations, Symbolic Solution for Equations.

Unit-IV

Applications to Numerical differentiation and integrations: Trapezoidal Method and Simpson Method, Runge–Kutta Method, Introduction to working with modules in MATLAB.

Reference Books:

3. Won Young Yang, Wenwu Cao, Tae-Sang Chung and John Morris, Applied numerical methods using MATLAB, John Wiley Interscience.
4. S.R. Otto and J.P. Denier, An Introduction to Programming and Numerical Methods in MATLAB, Springer-Verlag London.
5. Rudra Pratap, Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers, Oxford University Press.

Other Useful Reading: Getting started with Matlab, Maths Works Inc. www. in.mathsworks.com

TYPESETTING IN LATEX

(SPMMAT 01 04 SEEC 02 0120)

UNIT I

Preparing an input file, sentences and paragraphs, the document class, sectioning, display material, running LaTeX, changing the type style, producing mathematical symbols and mathematical formulae, arrays, delimiters, multiline formulae, putting one thing on other, spacing in math mode.

UNIT II

Defining command and environments, Producing and including graphics in a LaTeX file, figures and other floating bodies, lining it up in columns, table of content, cross-reference, bibliography and citation, making index and glossary, slides, overlays and notes, letters.

UNIT III

Design it yourself: document class, page style, title page, customizing the style, line and page breaking, numbering, length, spaces and boxes, formatting with boxes, centring and flushing, list making environments, changing font type size and special symbols, picture, picture environments, picture objects, text, boxes, straight lines, arrow, stacks, circles, oval, framing, curve, grid, repeat patterns.

UNIT IV

Making presentation slides in beamer class LaTeX, various styles in beamer presentation, dynamic slides. PostScript macros for Generic TeX (PsTrix): arguments, dimension, coordinates, angles, line styles, fill styles, custom styles, custom graphics, picture tools, text tricks, node and connection special tricks. Basics of MathJax, Mathjax configuration options.

Reference Books:

1. Leslie Lamport , A Document Preparation System User's Guide and Reference Manual, Addison-Wesley Publishing Company.
2. Stefan Kottwitz , LaTeX Beginner's Guide, Packt Publishing, UK.

Other Sources for reading:

1. Till Tantau , User Guide to the Beamer Class, http://latex-beamer.sourceforge.net.
2. Tobias Oetiker , The Not So Short Introduction to L ATEX2E, https://tobi.oetiker.ch/lshort/lshort.pdf