SYLLABUS FOR TWO YEARS

M.Sc (Mathematics)

[Choice Based Credit System{CBCS}]

(To be implemented from the Academic Year 2020 onwards)

MISSION

The mission of the mathematics department is to provide an environment where students can learn and become competent users of mathematics and mathematical application. The faculty members in this department motivate and simulate our young mathematician to develop their knowledge and discipline. Moreover, the department will contribute to the development of students as mathematical thinkers, enabling them to become lifelong learners, to continue to grow in their chosen professions, and to function as productive citizens. In pursuing this mission, primary departmental functions are the development, dissemination, and application of mathematical knowledge and in the areas of mathematics, mathematics education, and actuarial science. We will serve students who are our majors and minors, general education students, and those from other service areas. In pursuing this mission, primary departmental functions are the development, dissemination, and application of mathematical knowledge and in the areas of: mathematics, mathematics education, and actuarial science. We will serve students who are our majors and minors, general education students, and those from other service areas.

VISION

The mathematics develops calculating, computing, critical thinking, reasoning, problem solving and formulating the skills for the upcoming mathematicians. The discipline theory and techniques taught in mathematics courses are especially important in today's society. The faculty of the department recognizes this and strives to ensure that the student learner obtain this knowledge. Develop the student's ability to intelligently communicate mathematical results in both written and oral because the mathematical background to succeed discipline both academically and professionally. We are the only department to ensure the mathematical background to all other disciplines. We have a duty and respect to encourage the students mathematically for the student's visions.

OBJECTIVES

1. To provides for professional cardres in the field of mathematics to support the national development programs within public and higher education institutes.

2. To encourage scientific research and publications in the accredited scientific publications.

3. To encourage participation in scientific forums and seminars.

4. To encourage follow up of latest scientific research and techniques in the field.

The values that guide our decisions, strategies and actions are:

General Informations:

(1) It is two years Master Degree Programme

(2) There shall be four semester to complete programme, i.e. 1st , 2nd , 3rd and 4th semester.

(3) Each semester shall consist of 15 weeks of academic work equivalent to 90 actual teaching days.

(4) This programme will have two type of courses, i.e. **Core course** and **Elective Course.**

Core course- The core courses are those courses whose knowledge is deemed essential for the students registered for a particular Master's degree programme.

Elective course- The elective course can be chosen from a pool of papers in 2nd and 4th semester.

(5) Each course will have 100 marks in full and divided into 70 marks for end-semester exam and 30 marks for internal assessment work except practical papers.

(6) In practical papers the distribution of marks will be same as prescribed for term end semester practical papers.

Credits- A unit by which the course work is measured. It determines the number of hours of instruction required per week. One credit is equivalent to one hour of teaching (lecture or, tutorial) or two hours of practical work/ Field work per week.

Course Structure for M.Sc. Programme in Mathematics

SEM	COURSE OPTED	END SEM	MID SEM	CA/ ASSIGN MENT	TOTAL
I	FC (Compulsory) (FC-I)	50	30	20	100
	Core Course – 1 (CC-1)	50	30	20	100
	Core Course – 2 (CC-2)	50	30	20	100
	Core Course – 3 (CC-3)	50	30	20	100
II	Core Course – 4 (CC-4)	50	30	20	100
	Core Course – 5 (CC-5)	50	30	20	100
	Core Course – 6 (CC-6)	50	30	20	100
	Core Course – 7 (CC-7)	50	30	20	100
III	Core Course – 8 (CC-8)	50	30	20	100
	Core Course – 9 (CC-9)	50	30	20	100
	Core Course – 10 (CC-10)	50	30	20	100
	Elective – 1 (EC-1)	50	30	20	100
IV	Core Course – 11 (CC-11)	50	30	20	100
	Elective – 2 (EC-2)	50	30	20	100
	Elective – 3 (EC-3)	50	30	20	100
	PROJECT/Dissertation	-	-		100

Semester-wise Distribution of Course

SEM	COURSE	CREDIT	Hrs./Week
I	FC (Compulsory) – (FC-I)	5	5(L)+1(T)
	Core Course – 1 (CC-1)	5	5(L)+1(T)
	Core Course – 2 (CC-2)	5	5(L)+1(T)
	Core Course – 3 (CC-3)	5	5(L)+1(T)
II	Core Course – 4 (CC-4)	5	5(L)+1(T)
	Core Course – 5 (CC-4)	5	5(L)+1(T)
	Core Course – 6 (CC-5)	5	5(L)+1(T)
	Core Course – 7 (CC-6)	5	5(L)+1(T)
III	Core Course – 8 (CC-4)	5	5(L)+1(T)
	Core Course – 9 (CC-4)	5	5(L)+1(T)
	Core Course – 10 (CC-5)	5	5(L)+1(T)
	Elective – 1 (EC-1)	5	5(L)+1(T)
IV	Core Course – 11 (CC-11)	5	5(L)+1(T)
	Elective – 2 (EC-2)	5	5(L)+1(T)
	Elective – 3 (EC-3)	5	5(L)+1(T)
	PROJECT/Dissertation	5	10

Course Structure of M.Sc Mathematics First Semester

Sem	Paper	Paper Code	Credit	Name of Paper	Lecture	Tutorial	Practicle
I	Foundation Course	1Y2MAT101	5	Foundation Course in Modern Algebra	5	1	----
	Core Course	1Y2MAT102	5	Real Analysis	5	1	----
	Core Course	1Y2MAT103	5	Topology	5	1	----
	Core Course	1Y2MAT104	5	Complex Analysis	5	1	----

1Y2MAT101: MODERN ALGEBRA

Unit : (1) Commutators and commutator sub groups of a group and their properties, solvable groups, Relation between commutator sub groups and solvability, Some important properties of solvable groups, Normal and composition series and their important properties

Unit : (2) Concept of divisibility in a ring and associates, irreducible and reducible elements, unique factorization domain (U.F.D.), Principal ideal domain (P.I.D.), Euclidean domain, Unique factorization theorem in an Euclidean domain, Relationship between U.F.D.,P.I.D. and Euclidean domain.

Unit : (3) Concept of extension of a field, finite extension and transitivity of finite extensions, Algebraic elements, The field F(a) obtained by adjoining an element a to F, Finiteness of F(a) and algebraicity of a, Algebraic extension and related results, simple extensions.

Unit : (4) Roots of a polynomial over a field F in an extension field of f and related results, splitting field for a polynomial over a field F, Existence of multiple roots of a polynomial and irreducibility of the polynomial, Fixed field G(K,F) of a group of automorphisms of a field K, finiteness of G(K, F), Normal extension.

Reference Books:

1. I. N. Herstein – Topics in Algebra, BLAISDELL PUBLISHING COMPANY, New York.
2. P.B. Bhattarcharya – Basic Abstract Algebra Cambridge University Press, India.
3. K.K. Jha – Advanced Course in Modern Algebra, Nav Bharat Prakashan, Delhi-6.

1Y2MAT102: REAL ANALYSIS

Unit : (1) Riemann-Stieltje's Integral : Definition and existence of the Riemann-Steieltje's integral, Linearity properties of the integral, Integration and differentiation, The fundamental theorem of calculus.

Unit : (2) Rearrangements of term of a series, Riemann's theorem, Power series, Uniqueness theorem for power series, Abel's and Tauber's theorems.

Unit : (3) Sequences and series of function : Point wise and uniform convergence, Cauchy criterion for uniform convergence, Weierstrass M-test, Abel's and Dirichlet's tests for uniform convergence, Uniform convergence and continuity, Uniform convergence & Integration, Uniform convergence & differentiation, Weierstrass approximation theorem

Unit : (4) Functions of several variables : Linear transformations, Derivatives in an open subset of **R**, Chain rule, Partial derivatives interchange of the order of differentiation derivatives of higher orders, Taylor's theorem for functions of two variables

Unit : (5) Jacobians and functions with non-zero Jacobians, Inverse function theorem, Implicit function theorem, Extremum problems with constraints, Lagrange's multiplier method.

Reference Books:

1. W. Rudin – Principles of Mathematical Analysis McGrow-Hill book company, INC.
2. T.M. Apostol – Mathematical Analysis. Narosa Publishing House, New Delhi.

3 L.P. Natanson – Theory of functions of a Real Variable, Vol.-I. Leo F. Boron,

1Y2MAT103: TOPOLOGY

Unit : (1) Notion of a topological space, open set topology and fundamental concepts of open sets, closed sets, neighborhoods, adherent points, accumulation points, closure, interior and boundary in a topological space, subspace. Important interrelations between fundamental concepts. .

Unit : (2) Convergence of sequences in a topological space, continuity and homomorphism, characterizations of continuity and homeomorphism, base and subbase of a topology, continuity and sequential continuity**.**

Unit : (3) Separation axioms in a topological space, T_0, T_1, T_2, Regular find normal space and their mutual implication relationships, unique limit of sequences in a Hansdorff (T_2) space. Hereditary and topological properties.

Unit : (4) Compactness concept in a topological space, compact subsets of a topological space with Hansdorff property, characterization of compactness by closed sets with finite intersection property, compactness and continuity, compact sets in real line R (under usual topology)

Unit : (5) Connected and disconnected spaces, connectedness and continuity, characterizations of connected and disconnected spaces, connected sets in a topological space, sufficient conditions under which union of connected sets is connected, connected sets in R (under usual topology).

Reference Books:

1. Prof. K.K. Jha – Advanced General Topology, Nav Bharat Prakashan, Delhi-6.
2. G.F.Simmons – Introduction to General Topology and Modern Analysis, McGraw Hill Book Company, INC.

1Y2MAT104: COMPLEX ANALYSIS

Unit : (1) Complex integration, Cauchy-Goursat theorem, Cauchy's integral formula Higher order derivatives, Morera's theorem**.**

Unit : (2) Cauchy inequality, Liouville's theorem, Fundamental theorem of Algebera, Taylor's theorem, Laurents series, Maximum modulus principle, Schwar lemma**.**

Unit : (3) Singularities, Zeros & poles, Residues, Cauchy's residue theorem Evaluation of real integrals, Branches of many valued functions with special reference to argz, Log z and z^n**.**

Unit : (4) Meromorphic functions, Principle of argument, analytic continuation uniqueness of direct analytic continuation.

Unit : (5) Bilinear transformation, their properties and classifications, Definition a examples of conformal mappings, Necessary and sufficient condition of conformal mappings, Preservance of cross-ratio under the bilinear transformation.

Reference Books:

1. Shanti Narayan – Theory of functions of a complex variable S. Chand and company Ltd., New Delhi.
2. John W. Dettman – Applied complex variable, Macmillan Company, New York.

Course Structure of M.Sc Mathematics Second Semester

	Paper	code	Credit	Name of the paper	L	T	P
II	Core Course	1Y2MAT201	5	Programming in C & MATLAB	5	1	----
	Core Course	1Y2MAT202	5	Ordinary Differential Equations	5	1	----
	Core Course	1Y2MAT203	5	Differential Geometry and Tensor Analysis	5	1	----
	Core Course	1Y2MAT204	5	Programming in C & MATLAB (Practical)		-	3

1Y2MAT201: PROGRAMMING IN C & MATLAB

Unit : (1) Planning the Computer Program: Concept of problem solving, Problem definition, Program design, Debugging, Types of errors in programming, Documentation. Techniques of Problem Solving: Flowcharting, algorithms, pseudo code, decision table, Structured programming concepts, Programming methodologies viz. top-down and bottom-up programming. Overview of C: History of C, Importance of C, Structure of a C Program. Elements of C: C character set, identifiers and keywords, Data types, Constants and Variables, Assignment statement, Symbolic constant. Input/output: Unformatted & formatted I/O function, Input functions viz. scanf(), getch(), getche(), getchar(), gets(), output functions viz. printf(), putch(), putchar(), puts(). Operators & Expression: Arithmetic, relational, logical, bitwise, unary, assignment, conditional operators and special operators. Arithmetic expressions, evaluation of arithmetic expression, type casting and conversion, operator hierarchy & associativity. Decision making & branching: Decision making with IF statement, IF-ELSE statement, Nested IF statement, ELSE-IF ladder, switch statement, goto statement. Decision making & looping: For, while, and do-while loop, jumps in loops, break, continue statement. Understanding header files: stdio.h, math.h, ctype.h and its function prototypes.

Unit : (2) Functions: Definition, prototype, passing parameters, recursion. Storage classes in C: auto, extern, register and static storage class, their scope, storage, & lifetime. Structure, Union, enum Arrays: Definition, types, initialization, processing an array, Strings & arrays. Pointer and Its implementation using Function, Structure, Union, Array File Handling: Needs of File Handling, File Modes, Type of Files, Open/Create, Read, Write, Delete, Copy, Rename, Searching etc.

Unit : (3) Introduction to MATLAB, Elementary MATH Built-in –Functions, Creating Arrays, one dimensional, two dimensional arrays, Variables, Strings. Mathematical operations with arrays, Sript files, Two dimensional plots, Functions and Function files.

Unit : (4) Programming in MATLAB, Relational and Logical operators, Conditional statements, the switch-case statement., Loops, Nested Loops and Nested conditional statements, The break and continue commands, , Polynomials, Curve Fitting and Interpolation, Applications to Numerical Analysis.

Reference Books:

1. Yashwant Kanetker, Working with C, BPB
2. Reema Tharej., Programming with C, Oxford
3. Balagurusamy, E., Computing Fundamentals and C Programming, Tata McGraw-Hill
4. Jeri R. Hanly & Elliot P. Koffman, Problem Solving and Program Design in C, Addison Wesley

1Y2MAT202: ORDINARY DIFFERENTIAL EQUATIONS

Unit : (1) Existence and uniqueness of the solution to ODE, Picard's existence theorem, Lipschitz condition, Uniqueness theorem, Picard's method of successive approximation

Unit : (2) Algebraic properties of solutions of homogeneous equations & Wronskian of second order ODE, nth order ODE, Wronskian of n functions and its properties, Annihilator method to solve non homogeneous ODE with constant coefficients, initial value problem, Existence and uniqueness theorem.

Unit : (3) Linear system of ODEs, Existence and Uniqueness of linear system, linear homogeneous system with constant coefficients, method of eigen value and eigen vectors, Fundamental solution, Reduction of higher order linear equation into first order linear equations.

Unit : (4) Strum-Lioville boundary value problem with homogenous boundary conditions.Green's function, Green's function techniques for solving self-adjoint boundary value problem

Reference Books:

1. E.A. Coddington and N. Levinson. Theory of Ordinary Differential Equations. Mc Graw-Hill, NY

2. M. Brawn, Differential equations and their applications, Springer-Verlag New York ,1992.

3. Chakrabarti, Elements of ordinary differential equations and special functions, New Age, Int.Publ.,1990.
4. M.D. Raisinghania, Advanced differential equations, S. Chand and Company, 2001.

1Y2MAT203: DIFFERENTIAL GEOMETRY AND TENSOR ANALYSIS

Unit : (1) Curvature and torsion. Serret-Frenet formula. Circular helix, the circle of curvature. Osculating sphere, Bertrand curves.

Unit : (2) Curves on a surface-parametric curves. fundamental magnitude, curvature of normal section. Principal directions and principal curvatures, lines of curvature, Rodrigue's formula. Dupin's theorem, theorem of Euler, Conjugate directions and Asymptotic lines.

Unit : (3) One parameter family of surfaces – Envelope the edge of regression, Developables associated with space curves. Gaussian curvature, Surface of constant curvature.

Unit : (4) Tensors, Tensor Algebra, Contraction, Quotient theorem. Metric Tensor, Angle between two vectors.

Reference Books:

1. C. E. Weatherburn. Differential geometry of three dimensions.

2. R.S. Mishra, Tensor Calculus and Riemanian Geometry.

1Y2MAT201: PROGRAMMING IN C & MATLAB (PRACTICAL)

Programming in C:

(I) Write programs to understand different logics using Flow chart.

(II) Write programs to understand printf, scanf, gets, getchar, puts, sqrt etc functions.

(III) Write programs to illustrate the concepts of constants, variables and data types.

(IV) Write programs to illustrate operators and expressions in C.

(V) Write programs to illustrate decision making and branching in C.

(VI) Write programs to illustrate decision making and looping in C Analysis of various programs, i.e, Find the syntax error, logical error and outputs.

(VII) Write programs to illustrate array in C. Write programs to illustrate of user defined functions. Write programs to illustrate structures and unions.

(VIII) Write programs to illustrate concept of pointers, character strings and string manipulations.

(IX) Write programs to illustrate of user defined functions using pointers, array, structure, union etc.

(X) Write programs to illustrate File Handling in C.

Programming in MATLAB:

(XI) Write programs to illustrate Built-in functions and Arrays Write Programs to illustrate Script files, functions and function files

(XII) Write programs to illustrate two dimensional plots

(XIII) Write programs to illustrate curve fitting and interpolation

Course Structure of M.Sc Mathematics Third Semester

	Paper	code	Credit	Name of the paper	L	T	P
III	Ability Enhancement Course	1Y2MAT301	5	**A.** Adv. Discrete Mathematics/ **B.** Fourier & Wavelet Analysis/ **C.** Fluid Dynamics/ **D.** Hadamard Matrices and Combinatorial Designs	5	1	----
	Core Course	1Y2MAT302	5	Partial Differential Equation (PDE)	5	1	----
	Core Course	1Y2MAT303	5	Functional Analysis	5	1	----
	Core Course	1Y2MAT304	5	Analytical Dynamics and Calculus of Variations	5	1	----

1Y2MAT301A: ADVANCE DISCRETE MATHEMATICS

Unit : (1) Finite state automata & types of automata, deterministic and non deterministic finite state automata, non deterministic finite state automata (NDFSA), transition diagram. Moor Machine, Mealy Machine Turing Machine..

Unit : (2) Eulerian graph and its characterizations, Hamiltonian graph and sufficient conditions for a graph to be Hamiltonianlines.

Unit : (3) Planar graphs, Platonic graphs. Euler's theorem for planar graphs. Vertex coloring, chromatic number, chromatic polynomial, Brooks theorem, edge coloring, chromatic index, map coloring, Five color theorem.

Unit : (4) NP - complete problems, good algorithms, Connector problem and Kruskal's algorithm. Algorithms for Chinese postman problem. The Shortest path problem, Dijkstra's algorithm.

Reference Books:

1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", Mc.Graw Hill, 2002.
2. J.P.Tremblay & R. Manohar, "Discrete Mathematical Structure with Applications to Computer Science" Mc.Graw Hill, 1975.
3. V. Krishnamurthy, "Combinatories:Theory and Applications", East-West Press.
4. Seymour Lipschutz, M.Lipson, "Discrete Mathemataics" Tata Mc Graw Hill, 2005.
5. Kolman, Busby Ross, "Discrete Matheamatical Structures", Prentice Hall International.

1Y2MAT301B: FOURIER & WAVELET ANALYSIS

Unit : (1) Fourier Coefficients, partial sums, the Dirichlet and Fejer kernels, convergence theorems. Fourier integrals: convolution, inversion, Plancherel's formula. Generalized Fourier Series, Orthogonality and completeness

Unit : (2) Basic properties, Inversion, Convolution, Plancherrel Theorem, The Fourier Transform for L2 functions, Dilatations, Translations, and Modulations. Windowed Fourier Transform, Discrete Fourier Transform

Unit : (3) The Haar System, Dyadic Step Functions, Haar bases on [0, 1]. Comparison of Haar series and Fourier Series. The Discrete Haar Transform (DHT), the DHT in two dimensions, Image analysis with the DHT.

Unit : (4) Definition and examples, Construction of Orthonormal wavelet bases, Scaling functions and their properties. The Discrete Wavelet Transform, Wavelet frames, Multiscale Analysis, DWT for finite signals.The Continuous Wavelet Transform, Inverse CWT and admissibility conditions.

Reference Books:

1. D F Walnut, An Introduction to Wavelet Analysis, Birkhauser.
2. M A Pinsky, Introduction to Fourier Analysis and Wavelets,AMS.
3 R M Rao, A S Bopardikar, Wavelet Transforms, Pearsons, India,2010
4. S V Narasinmhan et al, Introduction to Wavelet Transform, Narosa, India, 2012.
5. A K Louis et al, Wavelets: Theory and Applications, John Wiley & Sons, 1998.

1Y2MAT301C: FLUID DYNAMICS

Unit : (1) Lagrangian and Eulerian methods, Equation of continuity in different coordinate systems, Boundary surfaces, Stream lines, Path lines and streak lines. Velocity potential, Irrotational and rotational motions. Vortex lines.

Unit : (2) Lagrange's and Euler's equations of motion. Bernoulli's theorem. Equation of motion by flux method. Impulsive actions. Stream function, Irrotational motion.

Unit : (3) Complex velocity potential. Sources, sinks doublets and their images in two dimension. Conformal mapping. Milne-Thomson circle theorem..

Unit : (4) Two-dimensional Irrotational motion produced by motion of circular, co-axial and elliptic cylinders in an infinite mass of liquid. Theorem of Blasius. Motion of a sphere through a liquid at rest at infinity. Liquid streaming past a fixed sphere. Equation of motion of a sphere.

Reference Books:

1. W.H.Besaint & A. S. Ramsey. A Treatise on Hydro mechanics. Part II. CBS Publishers. Delhi. 1988.
2. G.K. Batchelor. An Introduction of Fluid Mechanics. Foundation Books. New Delhi. 1994.
3. F. Choriton. Textbook of Fluid Dynamics. C.B.S. Publishers. Delhi 1985.
4. Fluid mechanics – Bansal. 5. Fluid dynamics, M.D. Raisinghania, S.Chand Publication.

1Y2MAT301D: HADAMARD MATRICES AND COMBINATORIAL DESIGNS

Unit : (1) Order of Hadamard Matrix, Hadamard Matrix Conjecture, Kronecker Product of Hadamard Matrices, Sylvestor Hadamard Matrices, Equivalence of Hadamard matrices, Maximum Determinant Theorem.

Unit : (2) Hadamard matrices by Paley type I and type II methods, Williamson's method of construction. Number of in-equivalent Hadamard matrices of order 16 & 20,

Unit : (3) Orthogonal-design, Weighing and Conference matrices, Baumert-Hall method for the construction of Hadamard matrices.

Unit : (4) Construction of BIBD's from Hadamard matrices. Error correcting codes. Application of Hadamard matrices in the construction of error correcting codes.

Reference Books:

1.Marshal Hall (Jr.), Combinatorial Theory, Blaisdel Publishing house, 1986

1Y2MAT302: FUNCTIONAL ANALYSIS

Unit : (1) Normed Linear Space: Definition and Examples, NLS as a metric space, Open sets, closed sets etc in a NLS, Convergence and Continuity. Banach spaces and examples. Quotient space of normed linear spaces and its completeness, equivalent norms.

Unit : (2) Bounded linear transformations, normed linear spaces of bounded linear transformations, dual spaces with examples. Hahn-Banach theorem Open mapping and closed graph theorem, the natural imbedding of N in N**. Reflexive spaces.

Unit : (3) Inner product spaces. Hilbert spaces. Orthonormal Sets. Bessel's inequality. Complete orthonormal sets and Parseval's identity. Projection theorem. Rietz representation theorem Reflexivity of Hilbert spaces.

Unit : (4) Linear transformation & linear functionals. Adjoint of an operator on a Hilbert space.. Self-adjointoperators. Positive, normal and Unitary operators.

Reference Books:

1. K. K. Jha - Functional Analysis with Applications, Students Friends, Patna
2. A. H. Siddiqui, Functional Analysis with Applications, Tata McGraw Hill, Publishing Company Ltd., New Delhi
3. G. F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Book Company, New York, 1963.
4. P. K. Jain, O.P. Ahuja and Khalial Ahmad, Functional Analysis, New Age International (P) Ltd. And Wiley Eastern Ltd. New Delhi, 1997

1Y2MAT301: PARTIAL DIFFERENTIAL EQUATION

Unit : (1) Classification of second order PDE & reduction to Canonical forms, Fundamental solutions of two dimensional Laplace equation in Cartesian form.

Unit : (2) Derivation and fundamental solution of one dimensional Heat equation in Cartesian form. Application problems.

Unit : (3) Derivation and fundamental solution of one dimensional wave equation in Cartesian form. Application problems.

Unit : (4) Solutions of p.d.e. using Separation of variables, Fourier transform and Laplace transform, Green's function and solutions of boundary value problems using Laplace transformation.

Reference Books:

1. M.D. Raisinghania – Ordinary and partial Differential Equation, S. Chand & Company Ltd.
2. Bhargava & Chandramouli – Differential Equation, Pragati Prakashan
3. Garrett Birknoff – Ordinary Differential Equation, John Wiley Sons
4. R.K.Gupta – Partial Differential Equation, Krishna Publication.
5. Pundir & Pundir – Advanced Partial Differential Equation, Pragati Prakashan.

1Y2MAT301: ANALYTICAL DYNAMICS AND CALCULUS OF VARIATIONS

Unit : (1) Generalized coordinates, Holonomic and Non-holonomic systems, Scleronomic and Rheonomic systems, Generalized potential. Lagrange's equations of first and second kind, Energy equation for conservative fields.

Unit : (2) Hamilton canonical equations. Equation of energy from Hamilton's equations, Cyclic coordinates, Routh's equations, Jacobi-Poisson Theorem.

Unit : (3) Motivating problems of calculus of variations fundamental lemma of calculus of variations Euler's equation, Brachistochrone problem Shortest distance, Geodesic, Minimum surface of revolution.

Unit : (4) Hamilton's Principle, Principle of least action. Jacobi's equations. Hamilton-Jacobi equations. Jacobi theorem. Lagrange brackets and Poisson brackets. Invariance of Langrange brackets and Poisson brackets under canonical transformations.

Reference Book:

1. H.Goldstein,Classical Mechanics(2nd edition),Narosa Publishing House, New Delhi.
2. I.M.Gelfand and S.V.Fomin, Calculus of variation, prentice Hall.
3. S.L. Loney, An elementary treatise on Statics, Kalyani Publishers, N. Delhi 1979.
4. A.S.Ramsey, Newtonian Gravitation. The English Language Book Society and the Cambridge University Press.

Course Structure of M.Sc Mathematics Fourth Semester

Paper	code	Credit	Name of the paper	L	T	P
Elective	1Y2MAT401	5	A. Optimization Techniques/ B. Integral Transforms/ C. Probability & Statistics	**L**	**T**	**P**
Elective	1Y2MAT402	5	A. Operations Research/ B. Integral Equations/ C. Mathematical Modelling	5	1	----
Core Course	1Y2MAT403	5	Numerical Analysis	5	1	----
PROJECT/ Dissertation	IY2MAT404	5	Project	5	-	----

1Y2MAT401A:OPTIMIZATION TECHNIQUES

Unit: (1) Infeasible optimal initial solution, Dual simplex method, Its advantage over simplex method, difference between simplex and dual simplex method.

Unit : (2) Changes in coefficients in the objective function, Changes in the structure of the LPP due to addition of new variable/Deleting of existing variable/ Addition of new constraints/Deletion of existing constraints.

Unit : (3) Characteristics of game theory, maximin criteria and optimal strategy, solution of game with saddle points, Rectangular games without saddle points and its solutions by linear programming.

Unit : (4) Basic characteristics of queueing system, different performance measures, Steady state solution of Markovian queueing models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space.

Reference Book:

1. Hamdy A. Taha Operations Research - An introduction, Macmillan Co. INC, New York.
2. Dr. B. S. Geoel & S. K. Mittal - Operations Research Pragati Prakashan.

1Y2MAT401B: INTEGRAL TRANSFORMS

Unit: (1) Laplace Transform: Definition and convergence theorems, Absolute convergence, Uniform Convergence, Complex inversion formula. Convolution theorem, Tauberian Theorems. Stieltjes Transform: Definition and convergence theorem, Hardy and Littlewood theorem.

Unit : (2) Fourier Transform, Fourier Cosine Transform, Fourier Sine Transform, Conditions for existence of Fourier Transforms, Convolution Integral, Parseval's Theorem, Inversion Theorem.

Unit : (3) Definition and elementary properties of Mellin transform, Mellin Transform of derivatives and integrals, The Mellin inversion theorem, Convolution theorems, solution of some integral equations via Mellin transform.

Unit : (4) Definition and elementary properties of Hankel Transform, Inversion theorem, Transform of elementary functions, Transform of derivatives of functions, Parseval relation, Relation between Fourier and Hankel transform.

Reference Book:

1. W. V. Lovitte ,Linear Integral Equations, over Publications; Reissue edition , (2005).
2. R. P. Kanwal ,Linear Integral Equations, Birkhäuser; 2nd edition , (1996).
3 S.G. Mikhlin, Linear Integral Equations , Routledge, (1961).
4. D V Widder, The Laplace Transform, Princeton Univ. Press.
5. Ian N. Sneddon, The use of Integral Transforms, McGraw Hill.

1Y2MAT401C: PROBABILITY & STATISTICS

Unit: (1) Introduction to descriptive statistics and exploratory data analysis, sample space, discrete probability, independent events, Bayes theorem, random variables distribution functions, expectation and moments, marginal probability distribution, central limit theorem.

Unit : (2) Theoretical distributions, Standard discrete and continuous univariable distributions, Sampling distributions, standard errors such as statistical, biased or unibiased etc, Methods of estimation, Properties of estimators, Confidence intervals, Tests of hypothesis.

Unit : (3) Large sample tests, tests of single proportions, difference of proportions, tests of significance for single mean, difference of mean and difference of standard deviation. Chi-square distribution, goodness of fit, Chi-square, test for independence of attributes, degree of freedom, population variance

Unit : (4) Tests of significance based on t, F and Z distributions.

Reference Book:

1. S.C. Gupta: Fundamental of Statistics. Himalaya Publishing House, 1981.
2. Richard A. Johson, Miller and Freonts: Probability and Statistics for Engineers.
3. B. Rouser: Fundamental of Biostatistics, Duxbury Thompson Learning, 2000.

1Y2MAT402A: OPERATIONS RESEARCH

Unit: (1) Branch and bound technique, Gomory's cutting plane method.

Unit : (2) One and multi variable, Unconstrained optimization, Kuhn-Tucker Conditions for costrained optimization, Quadratic programming, Wolf's and Beal's method.

Unit : (3) Known demand, probabilistic demand, Deterministic Models and probabilistic models without leadtime.

Unit : (4) Rules of network construction, Time calculation in networks, Critical path method, PERT, PERT calculation, advantages of network (PERT/CPM), Difference between CPM and PERT.

Reference Book:

1. S.D.Sharma, Operation Research, Kedar Nath, Ram Nath and Company (1972).

2. H.A.Taha, Operations Research, PHI,2003.

3. R. K. Gupta, Operations Research, Krishna Prakashan.

1Y2MAT402B: INTEGRAL EQUATIONS

Unit: (1) Fredholm, Volterra, Integro-Differential Equations, Singular Integral Equations, Converting Volterra Equation to ODE, Conversion of IVP to Volterra equation, Conversion of BVP to Fredholm equation.

Unit : (2) Linear growth and decay models, non linear growth and decay models, Compartment models, Mathematical modeling in dynamics through ordinary differential equations of first order..

Unit : (3) Some simple mathematical models, basic theory of linear difference equations with constant coefficients

Unit :(4) Mathematical modeling through difference equations in economics and finance, mathematical modeling through difference equations in population dynamics and genetics

Reference Book:

1. Murry R. Spiegal, Laplace Transform(SCHAUM Outline Series), McGraw-Hill.

2. Abdul J. jerry, Introduction to integral equations with applications, Marcel Dekkar Inc. NY.

3. R. P. Kanwal, Linear Integral equations, Springer Sc.,1997.

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1Y2MAT402C: MATHEMATICAL MODELING

Unit: (1) Simple situations requiring mathematical modeling, techniques of mathematical modeling, classifications, characteristics and limitations of mathematical models, some simple illustrations.

Unit : (2) Linear growth and decay models, non linear growth and decay models, Compartment models, Mathematical modeling in dynamics through ordinary differential equations of first order.

Unit : (3) Some simple mathematical models, basic theory of linear difference equations with constant coefficients

Unit : (4) Mathematical modeling through difference equations in economics and finance, mathematical modeling through difference equations in population dynamics and genetics

Reference Book:

1. J. N. Kapur, Mathematical Modeling, Wiley Eastern.

2. D. N. Burghes, Mathematical modeling in social Management and Life Science, Ellie Herwood and John Wiley.

3. F. Charlton, Ordinary Differential and Difference Equations, Van Nostrand.

1Y2MAT403: NUMERICAL ANALYSIS

Unit: (1) Numerical computation and Error analysis: Numbers and their accuracy, Floating point arithmetic Errors in numbers, Error estimation, General error formulae, Error propagation in computation.Inverse problem of error analysis and Numerical instability. Algebraic and transcendental equations: Bisection method, Iteration method, Regula-Falsi method, Secant method, Newton-Raphson's method. Convergence of these methods. Lin-Bairstow's method, Muller's method, Graeffe's root squaring method, Solution of system of nonlinear equations, Complex roots by Newton-Raphson's method.

Unit: (2) System of linear algebraic equations: Gauss elimination method without pivoting and with pivoting, Gauss-Jordon method, LU-factorization method, Jacobi and Gauss-Seidal methods, Convergence of iteration methods, Round-off errors and refinement, ill-conditioning, Partitioning method, Inverse of matrices. Eigen values and eigen vectors: Rayleigh Power method, Given's method and Householder's method.

Unit: (3) Interpolation: Finite differences, Newton's interpolation formulae, Gauss, Stirling's and Bessel's formulae, Lagrange's, Hermite's and Newton's divided difference formulae. Numerical differentiation and integration: differentiation at tabulated and non-tabulated points, Maximum and minimum values of tabulated function, Newton-Cotes Formulae-Trapezoidal, Simpson's, Boole's and Weddle' rules of integration with errors, Romberg integration, Gaussian integration, Double integration by Trapezoidal and Simpson's rules.

Unit: (4) Ordinary differential equations: Taylor series and Picard's methods, Euler's and modified Euler methods, Runge-Kutta methods, Predictor-Corrector methods: Adams-Bashforth's and Milne's methods. Error analysis and accuracy of these methods. Solution of simultaneous and higher order equations, Boundary value problems: Finite difference and Shooting methods.

Reference Book:

1. Rajaraman, V., Computer Oriented Numerical Analysis. Prentice-Hall of India Pvt. Ltd., 2002.
2. Sharma, J.N., Numerical Methods for Engineers and Scientists, 2nd Edition. Narosa Publ. HouseNew Delhi/Alpha Science International Ltd., Oxford UK, 2007.
3. Balagurusamy, E., Numerical Methods. New Delhi: Tata McGraw Hill, 1999.
4. Bradie, B., A Friendly Introduction to Numerical Analysis. Pearson Prentice Hall, 2006.
5. Atkinson, K.E., Introduction to Numerical Analysis, 2nd Edition. John Wiley, 1989.
6. Conte, S.D. and Boor, C. De, Elementary Numerical Analysis: An Algorithmic Approach, 3rd Edition. New York: McGraw Hill, 1980.

1Y2MAT404: PROJEECT

Guidelines to Examiners for End Semester Examination (ESE):
Evaluation of project dissertation work may be as per the following guidelines:
Project model (if any) and the Project record notebook = 70 marks
Project presentation and viva-voce = 30 marks
Overall project dissertation may be evaluated under the following heads:
(i)Motivation for the choice of topic
(ii)Project dissertation design
(iii)Methodology and Content depth
(iv)Results and Discussion
(v)Future Scope & References
(vi)Presentation style
(vii)Viva-voce

DISSRERTATION/ PAPER PRESENTATION

Student alone or in a group of not more than five, shall undertake one Project approved by the¬ Subject Teacher/H.O.D. of the Department/College concerned. The progress of the Project shall be monitored by the faculty members at regular intervals.

OR

PROJECT ON ANY ONE OF SPECIAL PAPER

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