JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR

Faculty of Education & Methodology

Department of Science & Technology

SYLLABUS

MASTER OF SCIENCE-MATHEMATICS

M.SC. MATHEMATICS

SESSION – 2022-23

DURATION – 2 YEARS/4 SEMESTER

SYLLABUS FOR:
I -II YEARS

PROGRAM DETAIL

Name of Program	-	M.Sc. Mathematics
Program Code	-	M.Sc.
Mode of Program	-	Semester
Duration of Program	-	2 yrs/ 4 Semester
Total Credits of Program	-	174
Curriculum Type and Medium Choice	-	English

JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR

SYLLABUS DETAIL

I SEMESTER

S. No.	Credit	Name of Course
1	11	Topology
2	11	Complex Analysis
3	11	Classical Mechanics
4	11	Discrete Mathematics
Total	**44**	

II SEMESTER

S. No.	Credit	Name of Course
1	11	Functional Analysis
2	11	Real Analysis
3	12	Programming In C And Applications
4	11	Numerical Computations
Total	**45**	

III SEMESTER

S. No.	Credit	Name of Course
1	11	Differential Equations
2	11	Abstract Algebra
3	12	Theory Of Generalized Function
4	11	Mat lab And Applications
Total	**45**	

IV SEMESTER

S. No.	Credit	Name of Course
1	40	Dissertation
Total	**40**	

I SEMESTER

TOPOLOGY

Objectives: At the end of the course students will be able to:
(i) Understand the concepts of Continuity and related concepts.
(ii) Understand the concept of connected spaces.
(iii) Explain the concept of basis and sub basis.

UNIT I - Basic concept and Metric space (4-0.5-0) Theory (4 credit)
Open and closed interval , Usual Topology, Neighbourhood of a point ,bounded linear set, Limit point, Metric spaces , Usual Metric ,Trivial metric, Quasi metric space , Open and closed sphere, Minkowski inequality, Cauchy's inequality ,Distance of a point from a set , Distance between set.

UNIT II - Topological Spaces (4-0.5-0) Theory (4 credit)
Definition of topology , T-open set, Weakerand strong topology Indiscrete and discrete topology, Co-finite topology, Bases and sub- bases, countability , Hereditory Property , First and second countable

UNIT III - Compactness (4-0.5-0) Theory (4 credit)
T_0 , T_1 , T_2 , spaces, Normal spaces, Hausdroff space Uryson's lemma, cover , compact space , locally compact, theorems on sequentially compact metric space, Bair's category theorem , Banach fixed point theorem

Textbooks:
1. Topology, a first course – J. R. Munkres, Prentice-Hall of India Ltd., New Delhi, 2000.
2. General Topology – J. L. Kelley, Springer Verlag, New York, 1990.
3. An introduction to general topology (2nd edition) – K. D. Joshi, Wiley Eastern Ltd., New Delhi, 2002.

Reference books:
1. General Topology – J. Dugundji, Universal Book Stall, New Delhi, 1990
2. General Topology – S. Willard, Addison-Wesley Publishing Company, Massachusetts, 1970.

Course Outcomes:
On completion of this course, students will:
- Understand the basic concepts of the topology.
- Understand the Continuity Connected spaces and Basis**.**
- Acquire the knowledge of applications of subject.

COMPLEX ANALYSIS

Objectives: At the end of the course students will be able to:
(i) Understand the concepts of Complex plane.
(ii) Understand the concept of Riemnann-Stieltjes integrals.
(iii) Explain the concept of Counting zeroes Contour integration.

UNIT I - Analytic Function and power series(4-0.5-0) Theory (4 credit)
Basic of complex plane , equation of straight line , Equation of sphere, Analytic function , Necessary and sufficient condition of analytic function ,condition of ceases to be analytic function ,necessary condition of analytic function in polar form, Formation of analytic function, Harmonic function, Power series , Radius of convergence, Nature of power series.

UNIT II - Analytic Function as mapping (4-0.5-0) Theory (4 credit)
Definition of transformation , conformal transformation ,Mobius transformation , Kinds of transformation and its applications , Critical points , Zeroes of an analytic function .Definition of Singularity, Classification of singularity ,Closed contour , Multi connected domain , Complex Intregration

UNIT II - Meromorphic Function and Rouche's Theorem. (4-0.5-0)Theory (4 credit)
Meromorphic function ,Rouche's theorem , Mittag Leffler's expansion number of poles and zeros of meromorphic function , Principal of arguments, principal of maximum modulus, schwarz's lemma, Jenson's inequality , Jenson formula ,Hardmard's three circles principal 'convex function ,three circles theorem as a convex function.

Textbooks:
1.J. B. Conway, functions of one complex variable, Narosa, Delhi ,2000
2.T.W. Gamelin, Complex Analysis, Springer-Verlag ,2008

Reference books:
1.S. Lang Complex Analysis, Springer-Verlag ,2003
2.L.V. Ahlfors, Complex Analysis, McGraw Hill, New York, 1988

Course Outcomes:
On completion of this course, students will:
- Understand the basic concepts of the Complex Analysis.
- Understand the Complex plane, Riemnann-Stieltjes integrals, Contour integration and mapping**.**
  Acquire the knowledge of applications of subject

Classical Mechanics

Objectives: At the end of the course students will be able to:
(i) Understand the concepts of Dynamical Systems.
(ii) Understand the concept of Transformations.
(iii) Explain the concept of Small Oscillations & Application.

Unit I – Dynamical Systems(4-0-0) Theory (4credit)
Types of constraint on dynamical systems,generalized coordinates,d'Alembert principle,Euler-Lagrange equation of motion,variational calculus and Hamilton's variational principle,Hamilton's equation of motion,Lagrangian and Hamiltonian for central forces,Canonical variables,Poisson's bracket,Jacobi identity.

Unit II –Transformations(4-0-0) Theory (4credit)
Canonical transformations,generators of canonical transformations,symmetry principles and conservation laws,Hamilton-Jacobi theory,Centre of mass and laboratory systems, Kepler problem precessing orbits.

Unit III –Small Oscillations & Application(4-0-0) Theory (4credit)

Small oscillations, normal coordinates and its applications to chain molecules,Degrees of freedom for a rigid body, Angular Velocity and Eulerian Angles, Centrifugal and Coriolis Forces,Euler's Equations of Motion for a rigid body, Force-free Motion of a Rigid Asymmetric Top.

Text Books

1.Classical Mechanics by H. Goldstein (Narosa 2001)
2.Classical Mechanics of particles and rigid bodies by K.C.Gupta(john wiley,1988)

Reference Books

1.Advanced Classical and Quantum dynamics by W.Dittrich,W. and M Reuter,M.(springer,1992)
2.Mathematical Methods of Classical Mechanics by V. I. Arnold(springer 1978)

Course Outcomes:

On completion of this course, students will:

- Understand the basic concepts of the Classical Mechanics.
- Understand the Dynamical Systems, Canonical Transformations, Small Oscillations & Application
- Acquire the knowledge of applications of subject.

Discrete Mathematics

Objectives: At the end of the course students will be able to:
(i) Understand the concepts of Relations,Permutations and Combinations.
(ii) Understand the concept of Boolean Algebra,Lattices.
(iii) Explain the concept of Graph Theory.

UNIT – I (Relations,Permutations and Combinations)(3-0-0) Theory (3 Credits)

Fundamentals: Sets and Relations- Sets, Multi Sets, Operations on Sets, Relations and Properties of Relations, Representation of Relations, Equivalence Relation, Closures of Relations, Method of Contradiction. Permutations and Combinations, Pigeon Hole Principle, Principle of Inclusion and Exclusion.

UNIT – II (Boolean Algebra,Lattices) (2-0.5-0) Theory (2 Credits)

Boolean Algebra, Posets and Lattices: Partial Order Set, Poset, Bounding Elements, Well Ordered Set, Lattices, Principle of Duality, Bounded, Distributed, and Complemented Lattices, Finite Boolean Algebra, Boolean Functions and Expressions, Proposition and Propositional Calculus.

Practice (0.5 Credit)

Practice on Lattices, finite Boolean algebra, Boolean functions and duality.

UNIT – III (Graph Theory)(2-0.5-0) Theory (2 Credits)

Graphs and Group Theory: Basic Introduction of Graphs- Types of Graphs, Path and Circuits, Eulerian Path and Circuits, Hamiltonian Path and Circuits, Trees, tree traversal,

Spanning Trees, Dijkstra, Prim's and Kruscal's Algorithms. Finite state machine, Non Deterministic Finite Automata, Deterministic Finite Automata.

Practice (0.5 Credit)
Practice on Graphs, dijkstras algorithm, prims algorithm and Finite state automata.

Recommended Books:

1. C.L.Liu, "Elements of Discrete Mathematics", TMH, 2000.

Reference Books:

1. Keneth H.Rosen, "Discrete Mathematics and Its Applications", TMH, 1999.
2. Trembly J.P. & Manohar P., "Discrete Mathematical Structure with Applications to Computer Science", McGraw Hill, 1997.
3. Narsingh Deo, "Graph Theory with Application to Engineering and Computer Science", PHI, 2004.

Course Outcomes:
On completion of this course, students will:

- Understand the basic concepts of the Discrete Mathematics.
- Understand the Relations,Permutation, Combinations, Boolean Algebra, Lattices and Graph Theory.
- Acquire the knowledge of applications of subject.

Semester II

FUNCTIONAL ANALYSIS

Objectives: At the end of the course students will be able to:

(i) Understand the concepts of Normed spaces, Banach spaces, Functional.
(ii) Understand the concept of Inner product spaces.
(iii) Explain the concept of Hahn-banach theorems.

UNIT I- Basic concepts (4-0.5-0) Theory (4credit)
Linear spaces ,General properties of linear spaces ,Hamel basis of linear spaces, linear sum of two subspaces, Direct sum, Dimension of a linear space, homomorphism and isomorphism of linear spaces, Linear functional, linear functional on finite dimensional space ,Dual space.

UNIT II- Inner product space and Hilbert space (4-0.5-0) Theory (4credit)
Inner product space, norm of a vector space, unit vector, Schwarz's inequality , Cauchy inequality , Normed vector space, orthogonal vector , orthogonal complements, Hilbert space, operator , adjoint operator and related theorems

UNIT III- Banach Spaces (4-0.5-0) Theory (4credit)
Introduction, normed linear spaces, properties of normed linear spaces, Continuous linear transformations,linear functional and Hahn- banach theorem for real and complex vector spaces, Application to boundedlinear functional on C [a,b] , Category theorem ,Open mapping theorem , Closed graph theorem , Banach fixed point theorem

Text Books

1.Erwin Kreyszig, Introductory Functional Analysis With Applications, John Willey and sons.
2.George Bachman and Lawrence Narici, Functional Analysis, Dover 2000.

Reference Books

1. Martin Schechter, Principles of functional analysis,second edition ,AMS book store,2002
2. V. S. Sunder, Functional Analysis, Spectral theory,Birkhauser Texts, Basel 1997

Course Outcomes:

On completion of this course, students will:

- Understand the basic concepts of the Functional Analysis.
- Understand the Normed spaces, Banach spaces, Inner product spaces, Hahn-banach theorems
- Acquire the knowledge of applications of subject.

Real Analysis

Unit I - Riemann-Stieltjes integrals (4-0.5-0) Theory

(4credit)

Riemann-Stieltjes integrals, Refinements, Riemann sum of functions, Liouvilles theorem, some theorems on Riemann-Stieltjes integrals , Cauchy inequality, Fundamental theorem of differential calculus in first form, Rectifiable curve.

Unit II – Uniform Convergence (4-0.5-0) Theory

(4credit)

Uniform convergence , Uniform convergence of series , Cauchy criteria for convergence, Weierstrass m- test , Abel test, Dirichlet's test, Weierstrass approximation test, Power series , Function of several variables, Schwartz's inequality, Taylors theorem ,Chain Rule.

Unit III – Jacobi function and measure theorem (4-0.5-0) Theory

(4credit)

Jacobian function , Jacobi of two function , Jacobi of explicit function and implicit function , Measure , measure space , Lebesque outer space measurable set , Inner measure, measurable function , Examples and theorems on measurable function , Lebesque integrals, Lebesque Upper and lower integrals

Text Books

1.G.De Barra , Measure theory and Integration, Wiley Eastern Limited.
2.H.L. Royden ,Real Analysis , Pearson,2008
3 Gupta K PReal Analysis Pragrati prakashan

Reference Books

1.E. Hewitt and K. Stromberg, Real and Abstract Analysis, Springer.

PROGRAMMING IN C AND APPLICATIONS

Objectives: At the end of the course students will be able to:

(i) Understand the concepts of Character sets for C.
(ii) Understand the concept of the Logical IF statements in C.
(iii) Explain the concept and significance of Algorithms.

UNIT I- Character sets for C (4-0.5-0) Theory

(4credit)

Character sets for C; constants and variables in C; arithmetic expressions in C;assignment and multiple assignments and mode of statements in C; built-in functions and libraries in C; input and output statements in C; comment statements; data types; TYPE declarations; statement labels; elementary programs in C.

UNIT II- Logical IF statements in C (4-0.5-0) Theory

(4credit)

Logical IF statements in C; switch, break, continue GOTO statements in C;WHILE, FOR, DO WHILE loops in C. Subscripted variables and arrays in C; array variables, syntax rules, use of multiple subscripts in arrays, reading and writing multi-dimensional arrays, for loops, for arrays in C; format specifications in C.

UNIT III- Algorithms (4-0.5-0) Theory

(4credit)

Some algorithms and programs on theory of matrices and numbers like Sieve method for primality test, generation of twin primes, solution of congruence using complete residue system, addition, subtraction and multiplication of matrices. transpose,determinant .

Textbooks:

1. Computer Programming in C – V. Rajaraman, Prentice-Hall of India Pvt. Ltd.,2005.
2. Computer Applications of Mathematics and Statistics – A. K. Chattapadhyay and T.Chattapadhyay, Asian Books Pvt. Ltd., New Delhi, 2005.

Reference books:

1. The C Programming Language – B. W. Kernighan and D. M. Ritchie, Prentice Hall,India, 1995.
2. Primes and Programming – An Introduction to Number Theory with Programming– P. Goblin, Cambridge University Press, 1993.

Course Outcomes:

On completion of this course, students will:

1. Understand the basic concepts of the Programming in C and Applications.
2. Understand the Character sets for C, Logical IF statements in C and significance of Algorithms.
3. Acquire the knowledge of applications of subject.

Numerical Computations

Objectives: At the end of the course students will be able to:
(i) Understand the concepts of Statiscal Methods.
(ii) Understand the concept of the Interpolation and Integration.
(iii) Explain the concept and significance of Errors and Approximations in Digital Computers.

UNIT-I Statical Methods (2.5-0.5-0) Theory (2.5 Credits)

Statistical Methods : Treatment of data, Frequency Distribution, measures of central tendency, dispersion & partition values. Probability Probability distribution – Binomial, Poisson & Normal. Method of least square, correlation and regression.

Practice (0.5 Credit)

Practice Based on Probability distribution, correlation and regression.

UNIT-II (Interpolation and Integration) (3.5-0.5-0)Theory (3.5 Credits)

Interpolation: Newton's forward and backward difference formulae, Lagrange's Interpolation formula, inverse interpolation. Numerical Differentiation, derivatives from Newton-Goegory Forward Polynomial. Numerical Integration: Newton-Cotes formulae, Weddle's, Trapezoidal & Simpson's rule, Numerical solution of ordinary differential equations: ODE's as a system of first order ODE's, Euler's, and Picard's.

Practice (0.5 Credit)

Practice Based on Numerical differentiation, numerical integration and ODE.

UNIT-III (Errors and Approximations in Digital Computers) (3.5-0.5-0) Theory (3.5 Credits)

Errors and Approximations in Digital Computers, Number representation, Floating point Arithmetic. Solution of system of linear equations – direct method, Gauss Jordan & Gauss Elimination methods, Pivoting, Iterative methods – Jacobi & Gauss Seidel methods. Solution of Nonlinear equations in n variable: Localization of the roots, Bisection and Regula- Falsi methods, Newton-Raphson method, successive Approximation method.

Practice **(0.5 Credit)**

Practice Based on Linear equations, guass jordan gauss elimination and newton raphson method.

Recommended text Books:

1) Computer Oriented Numerical Methods: Raja Raman, V., Prentice Hall.

Reference Books:

1) Introductory Methods of Numerical Analysis, S.S. Sastry, Prentice Hall, India
2) Computer Based Numerical Algorithms: Krishnamurthy E.V.;East West Press
3) Elementary Numerical Analysis : Conte de Boor.

Mathematical Statistics with Applications, John E. Freund's, Pearson publications, New Delhi

Course Outcomes:

On completion of this course, students will:

- Understand the basic concepts of the Numerical Computations.
- Understand the Statiscal Methods, Interpolation and Integration, Errors and Approximations in Digital Computers
- Acquire the knowledge of applications of subject.

III Semester

DIFFERENTIAL EQUATIONS

UNIT I - Differential equations and related concept (3.5-0)
Theory (3.5 Credits) Practice

(0.4 Credits)

Review of fundamentals of differential equation (ODEs). Existance and uniqueness solution of ordinary differential equation of first order. Existance and uniqueness solution of simultaneous differential equations existance and uniqueness solution of ordinary differential equation of higher order.

UNIT II - Concept of power series solution and system of differential equ. (3.5-0)
Theory (3.5 Credits) Practice

(0.3 Credits)

Power Series solution. System of linear ODEs (Homogeneous and nonhomogeneous). Stability of liner systems Two points boundary value problem. Stability of autonomous system of differential equations. Critical point of an autonomous system of differential equations and their classification..

UNIT III- Classification of PDEs and related concept of their solution (3-0)
Theory (3 Credits) Practice

(0.3 Credits)

Solution of linear PDEs by method of integral transforms (Laplace and Fourier).Classification of second order PDEs. Characteristics. Well posed problem. Solution of hyperbolic, papabolic, elliptic equations. Drichlet and Neumann problem. Strum-lioville systems. Green functions and their construction Eigen value and Eigen functions.

Recommended Text Books:

1. E. A. Coddington and N. Levinson, Theory of Ordinary Differential Equations, Tata McGraw Hill, 1990.
2. S. L. Ross, Differential Equations, 3rd Edn., Wiley India, 1984.
3. I. N. Sneddon, Elements of Partial Differential Equations, Dover Publications, 2006.
4. F. John, Partial Differential Equations, Springer, 1982.

Suggested Readings:

1. S. J. Farlow, Partial Differential Equations for Scientists and Engineers, Dover Publications, 1993.
2. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.

ABSTRACT ALGEBRA

UNIT I - Group theory and related concept (3.5-0)
Theory (3.5 Credits) Practice **(0.4 Credits)**

Group, subgroup, Homomorphism, Group action, Sylow theorem**.** Solvable and nilpotent group.

UNIT II - Ring theory and related concept (3.5-0)
Theory (3.5 Credits) Practice

(0.3 Credits)

Ring, ideal and quotient ring, maximal, prime and principle ideal. Euclidean and polynomial ring.

UNIT III - Field theory and related concept (3-0)
Theory (3 Credits) Practice

(0.3 Credits)

Field, field extensions, finite field.

Recommended Text Books:

1. D. Dummit and R. Foote, Abstract Algebra, Wiley, 2004.
2. N. McCoy and G. Janusz, Introduction to Abstract Algebra, 7th Edn.,Trustworthy Communications, Llc, 2009

Suggested Readings:

1. I. N. Herstein, Topics in Algebra, Wiley, 2008.
2. J. Fraleigh, A First Course in Abstract Algebra, Pearson, 2003.
3. P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, Basic Abstract Algebra, Cambridge University Press, 1995.

Theory of Generalized Function

UNIT I - Gamma and Related Function (3.5-0)
Theory (3.5 Credits) Practice

(0.4 Credits)

Eulerian Definition , Weirstrass Definition , Euler's Product, Beta Function , Formula of Γz . $\Gamma 1\text{-}z = \pi$ cosec πz , Gauss multiplication formula ,Hypergeometric function , Integral representation of Hypergeometric differential equation, Transformations of F(a,b,c) .

Unit II - Generalized Hypergeometric function (3.5-0)
Theory (3.5 Credits) Practice

(0.3 Credits)

Differential equation satisfied by ${}_pF_q$, Salschut'z Theorem, Whipples theorem, Dixon theorem, Integrals involving generalized hypergeometric function, Kummers theorem , Ramanujan's theorem , Generating function for $J_n(x)$, Alternating form of Generating function for $J_n(x)$, Recurrence relations , Bessel's Integral.

Unit III – Polynomials and Elliptic Function (3-0)
Theory (3 Credits) Practice **(0.3 Credits)**

Recurrence relations for $P_n(x)$,Christoffels summations formula, Rodrigue Formula , Hypergeometric form , Hermite polynomial , Recurrence relation for $H_n(x)$, Hermite polynomial in terms of pFq , Elliptic Function, Zero of theta function , Differential equation satisfied by theta function .

Recommended Texts Books:

1. Krishna prakashan An introduction of special function By N Saran 2012
2. Theory of generalized function By . Eral D rainwilley

MATLAB AND APPLICATIONS

UNIT I –Introduction and operation on matrices (3.5-0)
Theory (3.5 Credits) Practice (0.4 Credits)
Introduction on matlab. Creating vector and matrices. Matrix and Array operations (Add, sub, mult., determinant)Plotting simple graphs.

UNIT II- Programming and related concept (3.5-0)
Theory (3.5 Credits) Practice (0.3 Credits)
Programming in matlab. Solving a linear system, Gaussian elimination. Finding Eigen value and Eigen vectors.

UNIT III – Application in numerical computations (3-0)
Theory (3 Credits) Practice (0.3 Credits)
Numerical integration, Ordinary differential equation, roots of nonlinear equations, Graphics, Basic 2-D plots.

Recommended Texts Books:

1. Rudra Pratap, Getting Started With Matlab: A Quick Introduction For Scientists And Engineers,
2. Sharma, Bansal, Goel, MATLAB and its Applications in Engineering, Marc E. Herniter, PROGRAMMING IN MATLAB 1st Edition,

Suggested Readings:

1. Shailendar Jain, Modeling & Simulation Using Matlab Simulink, Wiley India Pvt Ltd.2011

IV SEMESTER

DISSERTATION