SURESH GYAN VIHAR UNIVERSITY, JAIPUR
(CDOE, SGVU)

Program Project Report (PPR)

MASTER OF SCIENCE IN
MATHEMATICS

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Program Project Report

1. Program Mission and Objectives

Suresh Gyan Vihar University, Jaipur, established in 2008, is a leading private University of Rajasthan. SGVU, Jaipur is accredited with Grade A+ by the National Assessment and Accreditation Council (NAAC), and offers courses like Engineering, Management, Hotel Management, Pharmacy, Arts, Humanities, Law, Agriculture, etc. in conventional mode. SGVU is renowned for its innovative academic practices, brilliance in technical education, and consultancy to high-profile industries.

The program's mission is to impart, train, and transform a student completely for high caliber competence through the latest concepts and technology and equip the students as per the demands of the industry.

The program aims to achieve the following objectives

i. To provide an opportunity to get an M.Sc Matematics degree to those who find it difficult or even impossible to pursue regular MSc courses at a university either due to their job commitments or certain other circumstances.

ii. To help the learners, study at their own pace, from their own chosen place.

iii.To provide students with an in-depth understanding of their chosen field of study, including current theories, research methodologies, and significant developments.

iv. To develop students' abilities to critically evaluate existing literature, arguments, and evidence within their field.

v. To encourage the integration of knowledge from various disciplines, promoting a more holistic understanding and innovative approaches to solving complex problems.

vi. To instill a strong sense of ethical responsibility and an understanding of the ethical implications of research and professional practice within their discipline.

2. Relevance of the Program with Suresh Gyan Vihar University, Jaipur Mission and Goals

Suresh Gyan Vihar University (SVGU) was established with a vision to become a University with a commitment to excellence in education, research, and innovation aimed towards human advancement.

The proposed program is highly relevant to the SVGU's mission i.e.

- Facilitate holistic education through knowledge sharing, skilling, research, and development.
- Integrate academic and research work towards the nation's development.
- Mentor students' physical, mental, emotional, secular, and spiritual attributes to become a valued human resource as it aims to provide quality education to those aspiring candidates who are deprived of higher education due to the limited number of intakes in the conventional mode of education in the Universities.

Moreover, to keep the quality intact the curriculum and syllabus have been designed at par with the conventional mode keeping in mind the specific needs and acceptability of the learners' ODL mode and in keeping with the aims and objectives of the University also ensuring the industry and future skills relevance.

Nature of Prospective Target Group of Learners

The curriculum of M.Sc Matematics is designed in such a way that it helps the students to become not only more employable but also encourages them to become entrepreneurs. Primarily the target group of learners will be:

- Those deprived of admission in the regular mode due to limited intake capacity.
- Those employed in various organizations who desire to pursue higher education as a passion or as a means for movement up the promotional ladder.
- Dropouts primarily due to social, financial and economic compulsions as well as demographic reasons.
- Population of any age and those living in remote areas where higher education institutes are not easily accessible.

3. Appropriateness of program to be conducted in ODL mode to acquire specific skills and competence

The degree would be of most value to students which can support the development of critical thinking, research skills, and subject-specific knowledge. In various fields such as education, business, social sciences, humanities, and public administration, it provides professionals with the opportunity to acquire advanced theoretical knowledge and practical skills that are directly applicable to their work environments.

4. Instructional Design

Curriculum Design

The curriculum is designed by experts in the field of Arts and has taken into account to include relevant topics that are contemporary and create environmental awareness. It is approved by the BoS (Board of Studies), the CIQA (Centre for Internal Quality Assurance), and the AC (Academic Council) of the university.

Program Structure and Credits Mapping: M.Sc Mathematics

Semester	Course Code	Paper	Credit	Contact Hours	Internal	External	Total
1	MMT-101	Abstract Algebra	04	15	30	70	100
1	MMT-102	Advance Calculus	04	12	30	70	100
1	MMT-103	Real Analysis	04	12	30	70	100
1	MMT-104	Differential Geometry	04	15	30	70	100
1	MMT-105	Programming In C++	04	15	30	70	100
2	MMT-201	Applied Mechanics	04	15	30	70	100
2	MMT-202	Complex Analysis	04	12	30	70	100
2	MMT-203	Linear Algebra	04	12	30	70	100
2	MMT-204	Partial Differential Equations	04	15	30	70	100

2	MMT-205	Mathematical Statistics	04	12	30	70	100
3	MMT-301	Topology	04	15	30	70	100
3	MMT-302	Functional Analysis	04	12	30	70	100
3	MMT-303	Ordinary Differential Equations	04	15	30	70	100
3	MMT-304	Numerical Analysis	04	12	30	70	100
3	MMT-305	Graph Theory	04	12	30	70	100
4	MMT-401	Integral Transforms And Calculus Of Variations	04	12	30	70	100
4	MMT-402	Probability And Random Processes	04	12	30	70	100
4	MMT-403	Continuum Mechanics	04	12	30	70	100
4	MMT-404	Mathematical Methods	04	15	30	70	100
4	MMT-405	Optimization Techniques	04	15	30	70	100
Total Credits			**80**				

Contact Hours at campus mentioned above are other than the PCP (Personal Contact Program) conducted atcampus.

Programme Outcomes

- Inculcate critical thinking to carry out scientific investigation objectively without being biased with preconceived notions.
- Equip the student with skills to analyze problems, formulate an hypothesis, evaluate and validate results, and draw reasonable conclusions thereof.
- Prepare students for pursuing research or careers in industry in mathematical sciences and allied fields
- Imbibe effective scientific and/or technical communication in both oral and writing.
- Continue to acquire relevant knowledge and skills appropriate to professional activities and demonstrate highest standards of ethical issues in mathematical sciences.
- Create awareness to become an enlightened citizen with commitment to deliver one's responsibilities within the scope of bestowed rights and privileges.

Programme Specific Outcomes:

Upon completing the M. Sc degree in the field of Mathematics, students have/capable of:

• A solid understanding of graduate level algebra, analysis and topology.

• Using their mathematical knowledge to analyze certain problems in day to day life.

• Identifying unsolved yet relevant problems in a specific field.

• Undertaking original research on a particular topic.

• Communicate mathematics accurately and effectively in both written and oral form.

• Conducting scholarly or professional activities in an ethical manner

SYLLABUS

M.Sc. Mathematics (Semester - I)

ABSTRACT ALGEBRA (MMT-101)

COURSE OBJECTIVES

While studying the **ABSTRACT ALGEBRA**, the Learner shall be able to:

- The objective of this course is to introduce the basic ideas of counting principle, Sylow subgroups, finite abelian groups, field theory and Galois Theory and to see its application to the solvability of polynomial equations by radicals.

COURSE OUTCOMES

After completion of the **ABSTRACT ALGEBRA**, the Learner will be able :

- to find the number of Sylow subgroups.
- to find the number of non isomorphic abelian groups.
- to find the splitting field, Galois group of the given polynomial.
- to check whether the given polynomial is solvable by radicals or not.

UNIT- I

SYLOW'S THEOREM

Another Counting Principle – 1st, 2nd and 3rd parts of Sylow's Theorems – double coset – the normalizer of a group.

UNIT- II

FINITE ABELIAN GROUP

External and Internal direct Products – structure theorem for finite abelian groups – non iso-morphic abelian groups - polynomial rings.

UNIT-III

SPLITTING FIELD

Polynomials over rational fields – the Eisenstein criterion - extension fields – roots of polynomials – splitting fields.

GALOIS THEORY

UNIT- IV

More about roots – simple extension – separable extension – fixed fields – symmetric rational functions – normal extension - Galois group – fundamental theorem of Galois theory.

UNIT- V

SOLVABILITY BY RADICALS

Solvable group – the commutator **subgroup** – Solvability by radicals - finite fields- Wedderburn Theorem.

REFERENCE BOOKS:

1.I.N. Herstein, Topics in Algebra, 2nd Edition, John Wiley and Sons, New York, 1975.

UNIT	Chapter(s)	Sections
I	2	2.11 G 2.12
II	2 G 3	2.13, 2.14, 3.9
III	3 G 5	3.10, 5.1, 5.3
IV	5	5.5 G 5.6
V	5 G 7	5.7, 7.1

2. S. Lang, *"Algebra*", 3rd Edition, Addison-Wesley, Mass, 1993.

3. John B. Fraleigh, *"A First Course in Abstract Algebra",* Addison Wesley, Mass, 1982.

4. M. Artin, *"Algebra",* Prentice-Hall of India, New Delhi, 1991.

5. V. K. Khanna and S.K. Bhambri, *"A Course in Abstract Algebra"*, Vikas Publishing House Pvt Limited, 1993.

SYLLABUS
M.Sc. Mathematics (Semester - I)

ADVANCED CALCULUS (MMT-102)

COURSE OBJECTIVES

While studying the **ADVANCED CALCULUS**, the Learner shall be able to:

- To introduce the basic notion of applied aspects of analysis and familiarize with the theoretical sides of the subject.

COURSE OUTCOMES

After completion of the **ADVANCED CALCULUS**, the Learner will be able to:

- This course prepares the student to take up other courses in Mathematics. It provides theoretical foundation for calculus of one and several variables at advanced level.
- Apply knowledge of Mathematics to become successful in national level examinations like NET, SLET, GATEetc.
- Engage in research in the fieldof pure and applied Mathematicsand involve in lifelong learning

UNIT –I

PARTIAL DIFFERENTIATION

Functions of several variables - Homogeneous functions - Total derivative - Higher order Derivatives, Equality of cross derivatives - Differentials - Directional Derivatives.

UNIT- II:

IMPLICIT FUNCTIONS AND INVERSE FUNCTIONS

Implicit functions - Higher order derivatives - Jacobians - Dependent and independent variables - The inverse of a transformation - Inverse function theorem - Change ofvariables - Implicit function theorem - Functional dependence - Simultaneous equations.

UNIT – III

TAYLOR'S THEOREM AND APPLICATIONS

Taylor's theorem for functions of two variables - Maxima and Minima of functions of two and three variables - Lagrange Multipliers.

UNIT- IV

LINE AND SURFACE INTEGRALS

Definition of line integrals - Green's theorem - Applications - Surface integrals - Gauss theorem - Verification of Green's and Gauss theorems.

UNIT-V

TRANSFORMATION AND LINE INTEGRALS IN SPACE

Change of variables in multiple integrals - Definition of line integrals in space - Stoke's theorem - Verification of Stoke's theorem.

REFERENCE BOOKS :

1. Widder D.V.,"Advanced Calculus", Prentice Hall of India, New Delhi, 12th Print, Second Edition, 2002.
2. Kaplan W., "Advanced Calculus", Addison Wesley (Pearson Education, Inc.), Fifth Edition, 2003.

3. Malik S.C., “Mathematical Analysis”, New Age International Publishers, New Delhi, 1992.

4. Burkill J.C. and Burkill H., “A Second course in Mathematical Analysis”, Cambridge University Press, New York, 2002.

5. Apostol T.M., “Mathematical Analysis”, Second Edition, Narosa Publishing House, New Delhi,2013.

SYLLABUS
M.Sc. Mathematics (Semester - I)

REAL ANALYSIS (MMT-103)

COURSE OBJECTIVES

While studying the **REAL ANALYSIS**, the Learner shall be able to:

- Real Analysis is the fundamental behind almost all other branches of Mathematics.
- The aim of the course is to make the students understand the basic concepts of Real analysis..

COURSE OUTCOMES

After completion of the **REAL ANALYSIS**, the Learner will be able to:

- Understand the treatment of Integration in the sense of both Riemann and Lebesgue.
- The students get introduce to the approach of integration via measure, rather than measure via integration.
- The students will be able to understand the methods of Decomposing signed measures which has applications in probability theory and Functional Analysis.

UNIT- I

CONTINUITY AND RIEMANN - STIELTJES INTEGRAL

Limit – Continuity - Connectedness and Compactness - Definition and existence of the integral - Properties of the integral - Integration and Differentiation.

UNIT- II

SEQUENCES AND SERIES OF FUNCTIONS

Pointwise convergence - Uniform convergence - Uniform convergence and continuity - Uniform convergence and Integration, Uniform Convergence and differentiation. Equi – continuous families of functions, Weierstrass and Stone-Weierstrass theorem.

UNIT- III

MEASURE AND MEASURABLE SETS

Lebesgue Outer Measure - Measurable Sets - Regularity - Measurable Functions - Abstract Measure - Outer Measure - Extension of a Measure - Measure Spaces.

UNIT- IV

LEBESGUE INTEGRAL

Integrals of simple functions - Integrals of Non Negative Functions - Fatou's Lemma, Lebesgue monotone convergence Theorem - The General Integral - Riemann and Lebesgue Integrals - Integration with respect to a general measure - Lebesgue Dominated Convergence Theorem.

UNIT- V

LEBESGUE DECOMPOSITION

Signed measures and Hahn Decomposition- Radon-Nikodym Theorem and Lebesgue Decomposition Theorem - Riez Representation Theorem for L1 and Lp.

REFERENCE BOOKS :

1. Rudin, W., "Principles of Mathematical Analysis", Mc Graw-Hill, Third Edition, 1984.
2. G. de Barra, "Measure Theory and Integration", New Age International Pvt. Ltd, Second Edition, 2013.
3. Avner Friedman, "Foundations of Modern Analysis", Hold Rinehart Winston, 1970.
4. Rana I. K., "An Introduction to Measure and Integration", Narosa Publishing House Pvt. Ltd., Second Edition, 2007.
5. Royden H. L., "Real Analysis", Prentice Hall of India Pvt. Ltd., Third Edition, 1995.

SYLLABUS
M.Sc. Mathematics (Semester - I)

DIFFERENTIAL GEOMETRY (MMT-104)

COURSE OBJECTIVES

While studying the **DIFFERENTIAL GEOMETRY**, the Learner shall be able to:

- This course gives students basic knowledge of classical differential geometry of curves and surfaces such as the catenary, the tractrix, the cycloid and the surfaces of constant Gaussian curvature and minimal surfaces

COURSE OUTCOMES

After completion of the **DIFFERENTIAL GEOMETRY,** the Learner will be able to:

- calculate the curvature and torsion of a curve.
- find the osculating surface and osculating curve at any point of a given curve.
- calculate the first and the second fundamental forms of surface.
- calculate the Gaussian curvature, the mean curvature, the curvature lines, the asymptotic lines, the geodesics of a surface.

UNIT-I

SPACE CURVES

Definition of a space curve – Arc length – Tangent – Normal and binormal – Curvature and torsion – Contact between curves and surfaces – Tangent surface – Involutes and evolutes – Intrinsic equations – Fundamental existence theorem for space curves – Helics.

UNIT-II

INTRINSIC PROPERTIES OF A SURFACE

Definition of a surface – Curves on a surface – Surface of revolution – Helicoids – Metric – Direction coefficients – Families of curves – Isometric correspondence – Intrinsic properties.

UNIT-III

GEODESICS

Geodesics – Canonical geodesic equations – Normal property of geodesics – Existence theorems – Geodesic parallels – Geodesics curvature- Gauss- Bonnet Theorem – Gaussian curvature – Surface of constant curvature.

UNIT-IV

NON INTRINSIC PROPERTIES OF A SURFACE

The second fundamental form – Principal curvature – Lines of curvature – Developable - Developable associated with space curves and with curves on surface – Minimal surfaces – Ruled surfaces.

UNIT-V

DIFFERENTIAL GEOMETRY OF SURFACES

Compact surfaces whose points are umblics – Hilbert's lemma – Compact surface of constant curvature –Complete surface and their Characterization – Hilbert's Theorem – Conjugate points on geodesics.

REFERENCE BOOKS :

1. T.J. Willmore, *"An Introduction to Differential Geometry"*, Oxford University press, (17th Impression), New Delhi, 2002. (Indian Print)

UNIT	Chapter(s)	Sections
I	I	1 – 9
II	II	1 – 9
III	II	10 – 18
IV	III	1 – 8
V	IV	1 – 8

2. D.T. Struik, *"Lectures on Classical Differential Geometry"*, Addition –Wesley, Mass, 1950.

3. S. Kobayashi and K. Nomizu, *"Foundations of Differential Geometry",* Interscience Publishers, 1963.

4. W. Klingenberg, *"A Course in Differential Geometry*", Graduate Texts in Mathematics, Springer – Verlag 1979.

5. C.E.Weatherburn, *"Differential Geometry of Three Dimensions*",University Press, Cambridge, 1930.

6. Polynomial, Newton Interpolation Polynomial,Divided differencetable, Interpolation with equidistance points, Spline interpolation

SYLLABUS
M.Sc. Mathematics (Semester - I)

PROGRAMMING IN C++, (MMT-105)

COURSE OBJECTIVES

While studying the **PROGRAMMING IN C++**, the Learner shall be able to:

- To develop programming skills in C++ and its object oriented concepts.
- To expose the standard numerical techniques as a powerful tool in scientific computing

COURSE OUTCOMES

After completion of the **PROGRAMMING IN C++**, the Learner will be able to:

- understand the basic principles of scientific and engineering programming
- proficient in object oriented programming concept in C++ tokens, operators, class declaration and definition and its objects ,constructors, destructors , operator overloading and the concept inheritance.
- efficiently use the techniques, skills, and computational skills to solve real time numerical problems

UNIT- I

INTRODUCTION

Beginning with C++ G Tokens, Expressions and Control Structures, Applications of C++– A simple C++ Program— An Example with Class– Structure of C++ Program–Creating the Source File– Compiling and Linking–Introduction– Token and Keyword.

UNIT- II

Functions in C++ and classes

Introduction– the Main Function– Function Prototyping– Call by Reference–Return by Reference– Inline Function– Defaults Arguments– const Arguments– Function Overloading– Friend and Virtual Functions– C Structures Revisited– Specifying a Class– Defining Membership Functions– A C++ Program with Class– Making an Outside Function Inline– Nesting of Member Functions– Private Member Functions– Arrays with an Class

UNIT- III

Objects E Constructors

Introduction– – MemoryAllocation for Objects– Static Data Member– Static Member Functions– Arrays of Objects– Objects as Function Arguments– Friendly Functions– Returning Objects– const Member Functions– Pointers of Members– Local Classes– Constructors–Parameterized Constructors– Multiple constructors in a class– Constructors with Default Arguments.

UNIT- IV

Destructors E Operator Overloading and Types Conversions

Introduction — Dynamic Initialization of Objects– Copy Constructor– Dynamic Constructors– Constructing Two–Dimensional Arrays– const Objects –Destructors– Introduction– Defining Operator Overloading– Overloading Unary Operators– Overloading Binary Operators– Overloading Binary Operators Using Friends– Manipulation of Strings Using Operators– Rules For Overloading Operators– Type Conversions.

UNIT- V

Inheritance: Extending Classes and Pointers, Virtual Functions and Polymorphism

Introduction–Defining Derived Classes– Single Inheritance–Making a Private Member Inheritance– Making a Private Member Inheritable–Multilevel Inheritance–Multiple Inheritance– Hierarchical Inheritance–Hybrid Inheritance–Virtual Base Classes–Abstract Classes– Constructors in Derived Classes– Member Classes: Nesting of Classes–Introduction– Pointers to Objects–this Pointer–Pointers to Derived Classes–Virtual Functions–Pure Virtual Functions.

REFERENCE BOOKS:

1. E.Balagurusamy, Object Oriented Programming with C++, 4th Edition, The McGraw– Hill CompanyLtd, New Delhi, 2008.
2. V. Ravichandran, Programming with C++, Second Edition Tata McGraw – Hill, New Delhi, 2006.
3. H. Schildt, The complete Reference of C++, Tata–McGraw–Hill publishing Company Ltd. New Delhi, 2003.
4. S.B. Lipman and J.Lafer, C++ Primer, Addition Wesley, Mass., 1998.
5. Ashok N.Kamthane, Object Oriented Programming with ANSI and TURBO C++, Pearson Education(P) Ltd, 2003.
6. BjarmeStroustrup, The C++ Programming Language, AT G T Labs, Murray Hills, NewJersey, 1998.

SYLLABUS
M.Sc. Mathematics (Semester – II)

APPLIED MECHANICS (MMT-201)

COURSE OBJECTIVES

While studying the **APPLIED MECHANICS**, the Learner shall be able to:

Tostudythe fundamentals of wave mechanics.

- Classical Mechanics is one of the two major sub fields of mechanics. It emphasis the motion of macroscopic objects from projectiles to the pass of machinery as well as astronomical objects on the qualitative structure of phase space

COURSE OUTCOMES

After completion of the **APPLIED MECHANICS**, the Learner will be able to:

- This subject emphasis the analysis of problems in which quantum and relativistic effects are negligible and its principle and mathematics are the foundation upon which numerous branches of modern physics are founded

UNIT- I

KINEMATICS

Kinematics of a particle and a rigid body - Moments and products of inertia - Kinetic energy - Angular momentum.

UNIT- II

METHODS OF DYNAMICS IN SPACE

Motion of a particle - Motion of a system - Motion of a rigid body.

UNIT- III

APPLICATIONS OF DYNAMICS IN SPACE

Motion of a rigid body with a fixed point under no forces - Spinning top - General motion of top.

UNIT- IV

EQUATIONS OF LAGRANGE AND HAMILTON

Lagrange's equation for a particle - Simple dynamical system - Hamilton's equations.

UNIT- V

HAMILTONIAN METHODS

Natural Motions - Space of events - Action - Hamilton's principle - Phase space -Liouville's theorem.

REFERENCE BOOKS :

1. Synge L. and Griffith B.A., “Principles of Mechanics”, Tata McGraw Hill, 1984.

2. Rana N.C. and Joag P.S., “Classical Mechanics”, Tata McGraw Hill, 1991.

3. Berger V.D. and Olsson M.G., “Classical Mechanics - a modern perspective”, Tata McGraw Hill International,1995.

4. Bhatia V.B., “Classical Mechanics with introduction to non-linear oscillations and chaos”, Narosa Publishing House, 1997.

5. Sankara Rao K. “Classical Mechanics”, Prentice Hall of India Pvt. Ltd., New Delhi, 2005.

6. Greenwood D. T., “Principles of Dynamics”, Prentice Hall of India Pvt. Ltd., New Delhi, 1988.

7. David Morin, “Introduction to Classical Mechanics with problems and solutions”, Cambridge University Press, New Delhi, 2007.

SYLLABUS
M.Sc. Mathematics (Semester – II)

COMPLEX ANALYSIS (MMT-202)

COURSE OBJECTIVES

While studying the **COMPLEX ANALYSIS**, the Learner shall be able to:

- Introduce a modern treatment to classical Complexanalysis
- Develop clear thinking and analyzing capacity forresearch.

COURSE OUTCOMES

After completion of the **COMPLEX ANALYSIS**, the Learner will be able to:

- Complex analysis, in particular the theory of conformal mappings, has many physical applications and is also used throughout analytic number theory.
- In modern times, it has become very popular through a new boost from complex dynamics and the pictures of fractals produced by iterating holomorphic functions.
- Another important application of complex analysis is in string theory which studies conformal invariants in quantum field theory.

UNIT- I

COMPLEX INTEGRATION

Fundamental Theorems: Cauchy's Theorem for a Rectangle- Cauchy's Theorem in a Disk. Cauchy's Integral Formula: The Index of a point with respect to a closed curve – The Integral formula – Higher derivatives. Local Properties of analytical Functions:Removable Singularities-Taylors's Theorem – Zeros and poles – The local Mapping – The Maximum Principle.

UNIT- II

COMPLEX INTEGRATION

The Genral Form of Cauchy's Theorem: Chains and cycles- Simple Continuity – Homology - The General statement of Cauchy's Theorem - Proof of Cauchy's theorem - Locally exact differentials- Multilply connected regions - Residue theorem - The argument principle. Evaluation of Definite Integrals and Harmonic Functions: Evaluation of definite integrals - Definition of Harmonic function and basic properties - Mean value property - Poisson formula.

UNIT- III

SERIES AND PRODUCT DEVELOPMENTS

Partial Fractions and Entire Functions: Partial fractions - Infinite products – Canonical products – Gamma Function- Jensen's formula – Hadamard's Theorem

Riemann Theta Function and Normal Families: Product development – Extension of (s) to the whole plane – The zeros of zeta function – Equicontinuity – Normality and compactness – Arzela's theorem – Families of analytic functions – The Classical Definition.

UNIT- IV

CONFORMAL MAPPINGS

Riemann mapping Theorem: Statement and Proof – Boundary Behaviour – Use of the Reflection Principle. Conformal mappings of polygons: Behaviour at an angle – Schwarz-Christoffel formula – Mapping on a rectangle. Harmonic Functions: Functions with mean value property – Harnack's principle.

UNIT- V

ELLIPTIC FUNCTIONS

Simply Periodic Functions : Representation by Exponentials-The Fourier Development - Functions of Finite Order. Doubly Periodic Functions:The Period Module-Unimodular Transformations - The Caninical Basis-General Properties of Elliptic Functions. Weierstrass Theory: The WeierstrassÃ-function – The functions z(s) and s(s) – The differential equation – The modular equation l(t) – The Conformal mapping by l(t).

REFERENCE BOOKS:

1. Lars F. Ahlfors, Complex Analysis, (3rd Edition) McGraw Hill Book Company, New York, 1979.
2. H.A. Presfly, Introduction to complex Analysis, Clarendon Press, oxford, 1990.
3. J.B. Corway, Functions of one complex variables, Springer - Verlag, International student Edition, Narosa Publishing Co.
4. E. Hille, Analytic function Thorey (2 vols.), GonmG Co, 1959.
5. M.Heins, Complex function Theory, Academic Press, New York,1968.

SYLLABUS
M.Sc. Mathematics (Semester - II)

LINEAR ALGEBRA (MMT-203)

COURSE OBJECTIVES

While studying the **LINEAR ALGEBRA**, the Learner shall be able to:

- Develop a strong foundation in linear algebra that provide a basic for advanced studies not only in mathematics but also in other branches like engineering, physics and computers, etc. Particular attention is given to canonical forms of linear transformations, diagonalizations of linear transformations, matrices and determinants.

COURSE OUTCOMES

After completion of the **LINEAR ALGEBRA**, the Learner will be able to:

- Describe a diagonalizable operator T and a triangulable operator
- Find the minimal polynomials, Jordan forms and the rational forms of real matrices.

UNIT- I

LINEAR TRANSFORMATIONS

Linear transformations – Isomorphism of vector spaces – Representations of linear transformations by matrices – Linear functionals.

UNIT- II

ALGEBRA OF POLYNOMIALS

The algebra of polynomials –Polynomial ideals - The prime factorization of a polynomial - Determinant functions.

UNIT- III

DETERMINANTS

Permutations and the uniqueness of determinants – Classical adjoint of a (square) matrix – Inverse of an invertible matrix using determinants – Characteristic values – Annihilating polynomials.

UNIT- IV

DIAGONALIZATION

Invariant subspaces – Simultaneous triangulations – Simultaneous diagonalization – Direct-sum decompositions – Invariant direct sums – Primary decomposition theorem.

UNIT- V

THE RATIONAL AND JORDAN FORMS

Cyclic subspaces – Cyclic decompositions theorem (Statement only)– Generalized Cayley– Hamilton theorem-Rational forms–Jordan forms.

REFERENCE BOOKS :

1. Kenneth M Hoffman and Ray Kunze, Linear Algebra, 2nd Edition, Prentice-Hall of India Pvt. Ltd, New Delhi, 2013.

UNIT	Chapter(s)	Sections
I	3	3.1 – 3.5
II	4 G 5	4.1, 4.2, 4.4, 4.5 and 5.1, 5.2
III	5 G 6	5.3, 5.4 and 6.1 – 6.3
IV	6	6.4 – 6.8
V	7	1.1 – 7.3

2. M. Artin, *"Algebra"*, Prentice Hall of India Pvt. Ltd., 2005.
3. S.H. Friedberg, A.J. Insel and L.E Spence, *"Linear Algebra*", 4th Edition, Pritice-Hall of India Pvt. Ltd., 2009.
4. I.N. Herstein, *"Topics in Algebra*", 2nd Edition, Wiley Eastern Ltd, New Delhi, 2013.
5. J.J. Rotman, *"Advanced Modern Algebra*", 2nd Edition, Graduate Studies in Mathematics, Vol. 114, AMS, Providence, Rhode Island, 2010.
6. G. Strang, *"Introduction to Linear Algebra*", 2ndEdition, Prentice Hall of India Pvt. Ltd, 2013.

SYLLABUS
M.Sc. Mathematics (Semester - II)

PARTIAL DIFFERENTIAL EQUATIONS (MMT-204)

COURSE OBJECTIVES

While studying the **PARTIAL DIFFERENTIAL EQUATIONS**, the Learner shall be able to:

- Familiarize the students with the fundamental concepts of Partial differential equations which will be used as background knowledge for the specialized courses in any field. This course provides an introduction to the study and solution methods of solving Heat, Wave, Laplace, and Diffusion Equations and integral Transforms. To increase self confidence in conducting research independently or within a team.

COURSE OUTCOMES

After completion of the **PARTIAL DIFFERENTIAL EQUATIONS**, the Learner will be able to:

- Describe real world system using Partial Differential Equations
- Identify, analyse, and subsequently solve physical situations whose behavior can be described by Partial Differential Equations.
- Apply knowledge of Mathematics to become successful in national level examinations like NET, SLET, GATEetc.

UNIT- I

PARTIAL DIFFERENTIAL EQUATIONS OF THE FIRST ORDER

Partial Differential Equations – Origins of First Order Differential Equations – Cauchy's Problem for first order equations – Linear Equations of the first order – Nonlinear partial differential equations of the first order – Cauchy's method of characteristics – Compatible system of First order Equations – Solutions satisfying Given Condition, Jacobi's method

UNIT- II

PARTIAL DIFFERENTIAL EQUATIONS OF THE 2nd ORDER

The Origin of Second Order Equations – Linear partial Differential Equations with constant coefficients – Equations with variable coefficients – Separation of variables – The method of Integral Transforms – Non – linear equations of the second order.

UNIT- III

LAPLACE'S EQUATION

Elementary solutions of Laplace equation – Families of Equipotential Surfaces – Boundary value problems – Separation of variables – Surface Boundary Value Problems – Separation of Variables– ProblemsWithAxialSymmetry–TheTheoryofGreen'sFunctionforLaplaceEquation.

UNIT- IV

THE WAVE EQUATION

The Occurrence of the wave equation in Physics – Elementary Solutions of the One – dimensional Wave equations – Vibrating membrane, Application of the calculus of variations – Three dimensional problem – General solutions of the Wave equation.

UNIT- V

THE DIFFUSION EQUATION

Elementary Solutions of the Diffusion Equation – Separation of variables – The use of Integral Transforms – The use of Green's functions

REFERENCE BOOKS :

1. Ian Sneddon – Elements of Partial Differential Equations – McGraw Hill International Book Company, New Delhi, 1983

2. M.D. Raisinghania Advanced Differential Equations S. Chand and Company Ltd., New Delhi, 2001

3. K. Sankara Rao, Introduction to Partial Differential Equations, Second edition – Prentice – Hall of India, New Delhi 2006

4. J.N. Sharma G K. Singh Partial Differential Equations for Engineers G Scientists, Narosa Publishing House, 2001

5. R. Dennemeyer, Introduction to Partial Differential Equations and Boundary value Problems, McGraw Hill Book Company, New York, 1968.

SYLLABUS
M.Sc. Mathematics (Semester - II)

MATHEMATICAL STATISTICS (MMT-205)

COURSE OBJECTIVES

While studying the **MATHEMATICAL STATISTICS,** the Learner shall be able to:

- Teach various statistical techniques from both applied and theoretical points of view
- Impart extended knowledge of characteristic function and its properties in the theoretical statistical distributions
- Introduce essential concepts of convergence for statistical distributions and estimation theory

COURSE OUTCOMES

After completion of the **MATHEMATICAL STATISTICS**, the Learner will be able to:

- acquire knowledge of Probability Distributions and Limit theorems
- familiarize with sampling distribution and to find estimators for the parameters
- determine the estimators for the parameters
- Apply knowledge of Mathematics to become successful in national level examinations like NET, SLET, GATEetc.

UNIT- I

SAMPLING DISTRIBUTIONS AND ESTIMATION THEORY

Sampling distributions - Characteristics of good estimators - Method of Moments - Maximum Likelihood Estimation - Interval estimates for mean, variance and proportions.

UNIT- II

TESTING OF HYPOTHESIS

Type I and Type II errors - Tests based on Normal, t, c2 and F distributions for testing of mean, variance and proportions - Tests for Independence of attributes and Goodness of fit.

UNIT- III

CORRELATION AND REGRESSION

Method of Least Squares - Linear Regression - Normal Regression Analysis - Normal Correlation Analysis - Partial and Multiple Correlation - Multiple Linear Regression.

UNIT- IV

DESIGN OF EXPERIMENTS

Analysis of Variance - One-way and two-way Classifications - Completely Randomized Design - Randomized UNIT- Design - Latin Square Design.

UNIT- V

MULTIVARIATE ANALYSIS

Mean Vector and Covariance Matrices - Partitioning of Covariance Matrices - Combination of Random Variables for Mean Vector and Covariance Matrix - Multivariate, Normal Density and its Properties - Principal Components: Population principal components - Principal components from standardized variables.

REFERENCE BOOKS :

1. Freund J.E.," Mathematical Statistics", Prentice Hall of India, Fifth Edition, 2001.

2. Johnson R.A. and Wichern D.W., "Applied Multivariate Statistical Analysis", Pearson Education Asia, Sixth Edition, 2007.

3. Gupta S.C. and Kapoor V.K.," Fundamentals of Mathematical Statistics", Sultan Chand G Sons, Eleventh Edition, 2003.

4. Devore J.L. "Probability and Statistics for Engineers", Brooks/Cole (Cengage Learning), First India Reprint, 2008.

SYLLABUS
M.Sc. Mathematics (Semester - III)

TOPOLOGY (MMT-301)

COURSE OBJECTIVES

While studying the **TOPOLOGY,** the Learner shall be able to:

- Introduce the basic notion of a topological space, continuous mappings between topological spaces connectedness and compactness of a topological space. Also to teach them the countability and separation axioms, Urysohn metrization theorem and Tychonoff theorem.

COURSE OUTCOMES

After completion of the **TOPOLOGY**, the Learner will be able to:

- demonstrate an understanding of the concepts of metric spaces and topological spaces and their role in mathematics
- demonstrate familiarity with a range of examples of these structures
- prove basic results about completeness, compactness and connectedness within these structures
- demonstrate skills in communicating mathematics orally and in writing
- Apply knowledge of Mathematics to become successful in national level examinations like NET, SLET, GATEetc.

UNIT- I

TOPOLOGICAL SPACES

Topological spaces - Basis for a topology - Product topology on finite cartesian products – Subspace topology.

UNIT- II

CLOSED SETS AND CONTINUOUS FUNCTIONS

Closed sets and Limit points - Continuous functions - Homeomorphism - Metric Topology – Uniform limit theorem.

UNIT- III

CONNECTEDNESS AND COMPACTNESS

Connected spaces -Components -Path components - Compact spaces - Limit point compactness- Local compactness.

UNIT- IV

COUNTABILITY AND SEPARATION AXIOMS

Countabilityaxioms-T1-spaces-Hausdorffspaces-Completelyregularspaces-Normalspaces.

UNIT- V

URYSOHN LEMMA AND TYCHONOFF THEOREM

Urysohn lemma - Urysohn metrization theorem - Imbedding theorem - Tietze extension theorem - Tychonoff theorem.

REFERENCE BOOKS :

1. Munkres J.R., "Topology", Prentice-Hall of India, New Delhi, Second Edition, 2003.
2. Simmons G.F., "Introduction to Topology and Modern Analysis", International Student Edition, Tata McGraw Hill Kogakusha Ltd., 1983.
3. Murdeshwar M.G., "General Topology", Wiley Eastern, Second Edition, 1990.
4. Kelly J.L., "General Topology", Van Nostrand, 1955.
5. Dugundji J., "Topology", University Book Stall, New Delhi, 1990.
6. Joshi K. D., "Introduction to General Topology", New Age International, New Delhi, 2000.

SYLLABUS
M.Sc. Mathematics (Semester - III)

FUNCTIONAL ANALYSIS (MMT-302)

COURSE OBJECTIVES

While studying the **FUNCTIONAL ANALYSIS,** the Learner shall be able to:

- Highlight the interplay between algebraic structures and distance structures
- Introduce Operator theory and its application to finite dimensional Spectral Theory.

COURSE OUTCOMES

After completion of the **FUNCTIONAL ANALYSIS**, the Learner will be able to:

- understand an abstract approach to analysis
- understand the interplay between algebraic structures and distance structures
- understand Operator Theory and its application to finite dimensional Spectral Theory
- Apply knowledge of Mathematics to become successful in national level examinations like NET, SLET, GATEetc.

UNIT- I

BANACH SPACES

Banach Spaces - Definition and Examples - Continuous linear transformations

UNIT- II

FUNDAMENTAL THEOREMS IN NORMED LINEAR SPACES

The Hahn-Banach theorem - The natural imbedding of N in N** - The open mapping theorem -Closed graph theorem - The conjugate of an operator - Uniform boundedness theorem.

UNIT- III

HILBERT SPACES

Hilbert Spaces - Definition and Properties - Schwarz inequality - Orthogonal complements - Orthonormal sets - Bessel's inequality - Gram–Schmidt orthogonalization process - The conjugate space H*- Riesz - Representation theorem.

UNIT- IV

OPERATOR ON A HILBERT SPACE

The adjoint of an operator - Self-adjoint operators - Normal and unitary operators - Projections.

UNIT- V

SPECTRAL AND FIXED POINT THEOREMS

Matrices - Determinants and the spectrum of an operator - Spectral theorem - Fixed point theorems and some applications to analysis.

REFERENCE BOOKS :

1. Simmons G.F., "Introduction to Topology and Modern Analysis", Tata Mc-Graw Hill Pvt. Ltd., New Delhi, 2011.
2. Kreyszig E.," Introductory Functional Analysis with Applications, John Wiley G Sons, New York, 2007.
3. Limaye B. V.," Functional Analysis", New Age International Ltd., Publishers, Second Edition, New Delhi,1996.
4. Coffman C. and Pedrick G., "First Course in Functional Analysis", Prentice-Hall of India, New Delhi, 1995.
5. Conway J.B., "A Course in Functional Analysis", Springer-Verlag, New York, 2008.
6. Bollobas B.,"Linear Analysis", Cambridge University Press, Indian Edition, New York, 1999.

7.. Nair M.T., "Functional Analysis, A First course", Prentice Hall of India, New Delhi, 2010

SYLLABUS
M.Sc. Mathematics (Semester - III)

ORDINARY DIFFERENTIAL EQUATIONS (MMT-303)

COURSE OBJECTIVES

While studying the **ORDINARY DIFFERENTIAL EQUATIONS,** the Learner shall be able to:

- Inculcate the concept of the existence, uniqueness and continuous dependence of the solution of initial and boundary value problems
- Introduce mathematical techniques for solving higher order ordinary differential equations using special functions

COURSE OUTCOMES

After completion of the **ORDINARY DIFFERENTIAL EQUATIONS**, the Learner will be able to:

- Have in-depth knowledge of mathematical techniques for solving higher order ordinary differential equations
- Understand the conditions for the existence and uniqueness of solutions for Initial and Boundary value problems
- Demonstrate the ability to integrate knowledge and ideas of differential equations by analyzing their solution to explain the underlying physical processes.

UNIT- I

LINEAR EQUATIONS WITH CONSTANT COEFFICIENTS

Introduction - Second order homogenous equations - Initial value problem for second order equations - Linear dependence and independence - A formula for Wronskian

UNIT- II

LINEAR EQUATIONS WITH CONSTANT COEFFICIENTS

The Non- homogenous equations of order two-homogenous and Non - homogenous equations of order n - Initial value problems for n^{th} order equations- Annihilator method to solve non- Homogenous equation.

UNIT- III

LINEAR EQUATIONS WITH VARIABLE COEFFICIENTS

Initial value problem - Existence and uniqueness theorem - The Wronskian and linear independence - Reduction of the order of a homogenous equation - The non- Homogenous equation - Homogenous equations with analytic coefficients - The Legendre equations .

UNIT- IV

LINEAR EQUATIONS WITH REGULAR SINGULAR POINTS

The Euler equations - Second order equations with regular singular points - Exceptional cases - The Bessel equation – The Bessel equation contd.

UNIT- V

EXISTENCE AND UNIQUENESS OF SOLUTIONS TO FIRSTORDER EQUATIONS

Equations with variable separated - Exact equations - The method of successive approximation - The Lipschitz Condition - Convergence of the successive approximation - Non-local existence of solutions - Approximations to and uniqueness of solutions.

REFERENCE BOOKS :

1. Earl A. Coddington, An Introduction to Oridinary Differential Equations– Prentice – Hall of India Private Limited, New Delhi 2008

2. Williams E. Boyce and Richard C. Diprima Elementary Differential Equations and Boundary Value Problems, 10th edition John Wiley and Sons, New York 2012

3. M.D. Raisinghania, Advanced Differential Equations, S. Chand G CompanyLtd.,New Delhi 2012

4. George F. Simmons, Differential Equations with Application And HistoricalNotes, Tata McGraw Hill, New Delhi 1974

5. B. Rai, D.P. Choudhury and H.I. Freedman, A Course in Ordinary Differential Equations, Narosa Publishing House Pvt. Ltd, New Delhi 2012.

6. Ravi P. Agarwal and Ramesh C. Gupta, Essentials of Ordinary Differential Equations, McGraw Hill, New York, 1991.

SYLLABUS
M.Sc. Mathematics (Semester - III)

NUMERICAL ANALYSIS (MMT-304)

COURSE OBJECTIVES

While studying the **NUMERICAL ANALYSIS,** the Learner shall be able to:

- Understand the mathematical concepts of numerical methods, their implementation and analysis.

COURSE OUTCOMES

After completion of the **NUMERICAL ANALYSIS**, the Learner will be able to:

- undertake the study of advanced courses like Numerical solution of Partial Differential Equations, Functional Analysis and its applications to Partial Differential Equations.
- The students will be able to understand, analyze and solve various problems arising in Science and Engineering numerically.
- Apply knowledge of Mathematics to become successful in national level examinations like NET, SLET, GATEetc.
- Engage in research in the fieldof pure and applied Mathematicsand involve in lifelong learning

UNIT- I

SYSTEMS OF LINEAR EQUATIONS AND ALGEBRAIC IGENVALUE PROBLEMS

Direct Method: Gauss elimination method - Error Analysis - Iterative methods: Gauss-Jacobi and Gauss-Seidel - Convergence considerations - Eigenvalue Problem: Power method.

UNIT- II

INTERPOLATION, DIFFERENTIATION AND INTEGRATION

Interpolation: Lagrange's and Newton's interpolation - Errors in interpolation - Optimal points for interpolation - Numerical differentiation by finite differences - Numerical Integration: Trapezoidal, Simpson's and Gaussian quadratures - Error in quadratures.

UNIT- III

APPROXIMATION OF FUNCTIONS

Norms of functions - Best Approximations: Least squares polynomial approximation – Approximation with Chebyshev polynomials - Piecewise Linear G Cubic Spline approximation.

UNIT- IV

ORDINARY DIFFERENTIAL EQUATIONS

Single-Step methods: Euler's method - Taylor series method - Runge-Kutta method of fourth order - Multistep methods: Adams-Bashforth and Milne's methods – Stability considerations - Linear Two point BVPs: Finite Difference method.

UNIT- V:

PARTIAL DIFFERENTIAL EQUATIONS

Elliptic equations: Five point finite difference formula in rectangular region - Truncation error; One dimensional - Parabolic equation: Explicit and Crank-Nicholson schemes; Stability of the above schemes - One-dimensional Hyperbolic equation: Explicit scheme.

REFERENCE BOOKS :

1. Atkinson K.E., "An Introduction to Numerical Analysis", Wiley, 1989.
2. Conte S.D. and Carl de Boor, "Elementary Numerical Analysis", Tata McGraw-Hill Publishing Company, Third Edition, 2005.
3. Kincaid D. and Chenney W., "Numerical Analysis: Mathematics of Scientific Computing", AMS, University Press, Hyderabad, Third Edition, 2009.
4. Isaacson E. and Keller, H.B., "Analysis of Numerical Methods" , Dover Publication, 1994.
5. Philips G.M and Taylor P.J., "Theory and Applications of Numerical Analysis", Elsevier, New Delhi, Second Edition, 2006.
6. Jain M.K., Iyengar S.R.K. and Jain R.K., "Numerical Methods for Scientific and Engineering", New Age International Pub. Co., Third Edition, 1993.
7. Iserles, A., "A first course in the Numerical Analysis of Differential Equations", Cambridge University press, New Delhi, 2010.
8. Brian Bradie., "A Friendly Introduction to Numerical Analysis", Pearson Education, New Delhi, First edition, 2007
9. C. E. Froberg., "Introduction to Numerical Analysis", Addison-Wesley Publishing Company, Second Edition, 1969.

SYLLABUS
M.Sc. Mathematics (Semester - III)

GRAPH THEORY (MMT-305)

COURSE OBJECTIVES

While studying the **GRAPH THEORY,** the Learner shall be able to:

- Give a broader view of concepts in basic graph theory
- Emphasize on application aspect of graph theory
- Introduce interconnection networks and to study some networks and its topological properties

COURSE OUTCOMES

After completion of the **GRAPH THEORY**, the Learner will be able to:

- understand advances in graph theory
- have acquired fundamental knowledge of finding shortest paths in networks using algorithms
- have learnt a clear perspective of solving real life problems using advanced graph theory
- understand the concept of networking and select an appropriate and adequate topological structure of interconnection networks while applying it in network communication problems
- Apply knowledge of Mathematics to become successful in national level examinations like NET, SLET, GATEetc.

UNIT- I

INTRODUCTION

An Introduction to graphs: Definitions and basic concepts – Graph Models – Vertex degrees – Isomorphism and Automorphism – Special class of graphs – The pigeonhole principles and Turan's theorem – Walk, Path and Connectedness – Distance, Radius, Diameter and Girth – Subgraphs and Isometric subgraphs –Operations on Graphs The Adjacency, Incidence and Path matrices – Algorithms – Introduction to Algorithms – Breadth-first search Algorithm – Dijkstra's Algorithm – Ford's Algorithm.

Bipartite Graphs: Characterisations of bipartite graphs – Trees – cut edges and cut vertices – Spanning trees and isometric trees – Cayley's Formula – Binary trees – Algorithms – Spanning tree Algorithm – Kruskal's Algorithm – Prim's Algorithm.

UNIT- II

CONNECTIVITIY AND GRAPHICAL SEQUENCES

Connectivity: Connectivity and edge connectivity – 2-Connected graphs – Menger's Theorem – Separable graphs, 1-Isomorphism and 2-Isomorphism.

Graphic Sequences: Degree sequences – Graphic sequences – Wang and Kleitman's Theorem – Algorithms – Algorithm 1 – Algorithm 2.

UNIT- III

EULERIAN AND HAMILTONIAN GRAPHS

Charecterisations of Eulerian Graphs – Degree Sets – Randomly Eulerian Graphs – Application – Algorithm – Fleury's Algorithm – Further Readings – Enumeration – Hamiltonian Graphs – Hamilton Cycle in Power Graphs and Line Graphs – Hamiltonian Sequences – Application – Algorithms – Two Optimal Algorithm – The Closest Insertion Algorithm – Albertson's Algorithm – Related Parameters.

Matchings: Matching – System of Distinct Representatives and Marriage Problem – Covering – 1-Factor – Stable Matchings – Application – Algorithm – The Hungaria Algorithm – Algorithm for Maximum Matching.

UNIT- IV

INDEPENDENCE

Independent Sets – Edge colourings – Application – Vizing's Theorem – Vertex Colouring Uniquely Colourable Graphs – Brook's Bound and Improvements – Hajos Conjecture Mycielski's onstruction – Line-distinguishing Colourings – Chromatic Polynomials – Algorithm – Sequential Colouring Algorithm.

UNIT- V

PLANAR GRAPHS

Planar Embedding – Euler's Formula – Maximum Planar Graphs – Geometric dual – Characterisations of Planar Graphs – Algorithm – DMP Planarity Algorithm – Colouring in Planar Graphs – Face Colouring.

Reference Books

1. M.Murugan, Graph Theory and Algorithms, Muthali Publishing House, Annanagar, Chennai, 2003.
2. J.A. Bondy and U.S.R. Murthy, Graph Theory with applications, Macmillan Co., London, 1976.
3. D.B.West, Introduction to graph theory, Prentice Hall of India, 2001.
4. J. Clark and D.A. Holton, A First look at Graph Theory, Allied Publishers, New Delhi, 1995.

SYLLABUS
M.Sc. Mathematics (Semester - IV)

INTEGRAL TRANSFORMS AND CALCULUS OF VARIATIONS (MMT-401)

COURSE OBJECTIVES

While studying the **INTEGRAL TRANSFORMS AND CALCULUS OF VARIATIONS,** the Learner shall be able to:

- Familiarize the students in the field of differential and elliptic equations to solve boundary value problems associated with engineering applications.
- Expose the students to variational formulation and numerical integration techniques and their applications to obtain solutions for one and two dimensional conditions.
- Study different analytical techniques tocharacterize thesamples

COURSE OUTCOMES

After completion of the **INTEGRAL TRANSFORMS AND CALCULUS OF VARIATIONS**, the Learner will be able to:

- develop the mathematical methods of applied mathematics and mathematical physics with an emphasis on calculus of variation and integral transforms.

UNIT- I

LAPLACE TRANSFORMS

Transforms of elementary functions - Unit step and Dirac delta functions - Properties – Differentiation and integration of transforms - Periodic functions - Initial G final value theorems - Inverse Laplace transforms - Convolution theorem - Error function - Transforms involving Bessel functions.

UNIT- II

FOURIER TRANSFORMS

Fourier integral representation - Fourier transform pairs - Properties - Fourier sine and cosine transforms - Transforms and inverse transforms of elementary functions - Convolution theorem - Transforms of derivatives.

UNIT- III

APPLICATIONS OF TRANSFORMS

Application of Laplace Transforms - Evaluation of integrals - Solution of Linear ODE - Applications of Fourier Transforms – wave equation -Heat equation on infinite and semi- infinite line – Potential problems in half-plane.

UNIT- IV

VARIATIONAL PROBLEMS

Variation of a functional and its properties - Euler's equations - Functionals with several arguments - Higher order derivatives - Functionals dependent on functions of several independent variables - Variational Problems in Parametric form.

UNIT- V

MOVING BOUNDARIES AND DIRECT METHODS IN VARIATIONAL PROBLEMS

Variation problems with a movable boundary for functionals dependent on one and two functions - One-sided variations - Constraints - Isoperimetric Problems - Direct Methods in Variational Problems - Rayleigh-Ritz method and Kantorovich method.

REFERENCE BOOKS :

1. Andrews, L.C. and Shivamoggi, B.K., "Integral Transforms for Engineers", Prentice Hall of India Pvt. Ltd., New Delhi, 2003.
2. Gupta, A.S., "Calculus of Variations with Applications", Prentice Hall of India Pvt. Ltd., New Delhi, 1997.
3. Sneddon, I.N., "The use of integral Transforms", Tata Mc-Graw Hill, 1974.
4. Elsgolts,L., "Differential equations and the Calculus of Variations", MIR Publishers, 1980.
5. Churchill, R.V, " Operational Mathematics", Mc Graw Hill Company, 3rd Edition,1972, U.S.

SYLLABUS
M.Sc. Mathematics (Semester - IV)

PROBABILITY AND RANDOM PROCESSES (MMT-402)

COURSE OBJECTIVES

While studying the **PROBABILITY AND RANDOM PROCESSES,** the Learner shall be able to:

- Introduce essential concepts of probability, moment generating and characteristic functions
- Impart extended knowledge of Poisson processes, Markov Chains and Martingales

COURSE OUTCOMES

After completion of the **PROBABILITY AND RANDOM PROCESSES**, the Learner will be able to:

- identify and characterize the classes of states in Markov chains
- derive differential equations for time continuous Markov processes with a discrete state space.
- use martingales and related tools to study the behavior of stochastic processes

UNIT- I

PROBABILITY AND RANDOM VARIABLES

Probability Concepts - Random variables - Bernoulli, Binomial, Geometric, Poisson, Uniform, Exponential, Erlang, Weibull and Normal distributions - Functions of a Random variable - Moments, Moment generating function.

UNIT- II

TWO DIMENSIONAL RANDOM VARIABLES

Joint distributions - Transformation of random variables and their distributions – Conditional expectation - Computing probabilities and expectations by conditioning - Correlation and Regression.

UNIT- III

LIMIT THEOREMS

Modes of convergence - Markov, Chebyshev's and Jensen's inequalities - Weak law of large numbers - Strong law of large numbers - Central limit theorem (i.i.d case).

UNIT- IV

MARKOV CHAINS

Stochastic processes - Classification - Markov chain - Chapman Kolmogorov equations – Transition probability Matrix - Classification of states - First passage times – Stationary distribution - Mean time spent in a transient state.

UNIT- V

MARKOV PROCESSES

Markov process - Poisson process - Pure birth process - Pure death process - Birth and death process - Limiting probabilities - Non-homogeneous Poisson process - Compound Poisson process.

REFERENCE BOOKS :

1. Ross S.M., "Introduction to Probability Models", Academic Press Inc., Ninth Edition, 2007.
2. Rohatgi V.K. and A.K. Md. Ehsanes Saleh," An introduction to Probability and Statistics", John Wiley G Sons, Inc., Second Edition, 2001.
3. Karlin S and H.M.Taylor, "A First Course in Stochastic Processes", Academic Press, Second Edition,1975, (An imprint of Elsevier).
4. Medhi J, "Stochastic Processes", New Age International (P) Ltd., New Delhi, Second Edition, 2001.

M.Sc., Mathematics
Second Year - IV Semester (Distance Mode)

CONTINUUM MECHANICS (MMT-403)

COURSE OBJECTIVES

While studying the **CONTINUUM MECHANICS,** the Learner shall be able to:

- Continuum Mechanics is a branch of mechanics that deals with the analysis of the kinematics and the mechanical behaviour of materials modeled as a continuous mass rather than a discrete particle.

COURSE OUTCOMES

After completion of the **CONTINUUM MECHANICS**, the Learner will be able to:

- familier with vector analysis, including the laws of Gauss and Stokes and should have some understanding of matrix operations. The key mathematical concept in continuum mechanics is the tensor and it convects the mathematical notion of a tensor to the physics of continuous media.

UNIT- I

TENSORS

Summation Convention - Components of a tensor - Transpose of a tensor - Symmetric G antisymmetric tensor - Principal values and directions - Scalar invariants.

UNIT- II

KINEMATICS OF A CONTINUUM

Material and Spatial descriptions - Material derivative - Deformation - Principal Strain - Rate of deformation - Conservation of mass - Compatibility conditions.

UNIT- III

STRESS

Stress vector and tensor - Components of a stress tensor - Symmetry - Principal Stresses – Equations of motion - Boundary conditions.

UNIT- IV

LINEAR ELASTIC SOLID

Isotropic solid - Equations of infinitesimal theory - Examples of elastodynamics and elastostatics.

UNIT- V

NEWTONIAN VISCOUS FLUID

Equations of hydrostatics - Newtonian fluid - Boundary conditions - Stream lines – Examples of laminar flows - Vorticity vector - Irrotational flow.

REFERENCE BOOKS :

1. Lai W.M., Rubin D. and Krempel E., "Introduction to Continuum Mechanics", Pergamon Unified Engineering Series, 1974.
2. Hunter S.C., "Mechanics of Continuous Media", Ellis Harwood Series, 1983.
3. Chandrasekaraiah D.S. and Loknath Debnath, "Continuum Mechanics", Prism Books Private Limited, 1994.
3. Chung T.J., "Continuum Mechanics", Prentice Hall, 1988.

SYLLABUS
M.Sc. Mathematics (Semester - IV)

MATHEMATICAL METHODS (MMT-404)
COURSE OBJECTIVES

While studying the **MATHEMATICAL METHODS,** the Learner shall be able to:

- Understand about Fourier Transforms, Fourier Sine Transforms, Fourier Cosine Transforms, Hankel Transforms, Integral Equations, Fredholm Integral Equations, Volterra Integral Equations, Singular Integral Equations and Calculus of variations

COURSE OUTCOMES

After completion of the **MATHEMATICAL METHODS**, the Learner will be able to:

- Acquire knowledge about integral equations and approximation method
- Ability to solve the problems using Fourier transformation
- Apply the skills in application of Intergal equation to ordinary integral equation

UNIT- I

INTEGRAL EQUATIONS

Types of Integral equations – Integral Fredholm Alternative - Approximate method – Equation with separable Kernel - Volterra integral equations – Fredholm's theory.

UNIT- II

APPLICATION OF INTEGRAL EQUATIONS TO ORDINARY INTEGRAL EQUATIONS AND SINGULAR INTEGRAL EQUATIONS

Initial value problems Boundary value problems – singular integral equations – Abel Integral equation.

UNIT- III

FOURIER TRANSFORMS

Fourier Transforms, Fourier sine and cosine transforms – Fourier transforms of derivatives - convolution integral – Parseval's Theorem - Solution of Laplace Equations by Fourier transform.

UNIT- IV

HANKEL TRANSFORMS

Properties of Hankel Transforms – Hankel transformation of derivatives of functions - The Parseval's relation – relation between Fourier and Hankel transforms - Axisymmetric Dirichlet problem for a half space - Axisymmetric Dirichlet problem for a thick plate.

UNIT- V

CALCULUS OF VARIATIONS

Variation and its properties – Euler's(Euler Lagrange's) equation – functionals dependent on the functions of several independent variables – variational problems in parametric form –applications.

REFERENCE BOOKS :

1. Linear Integral Equations Theory and Technique by R.P.Kanwal, Academic Press, New York, 1971.

2. The Use of Integral Transforms by I.N.Sneddon, McGraw-Hill, NewYork, 1972.

3. Differential Equations and Calculus of Variations by L.Elsgolts, Mir Publishers, Moscow, 1970.

4. Integral Equations by Shanti Swarup, Krishna Prakashan Media Ltd, Meerut,1982.

5. Integral Transforms and their Applications by Lokenath Debnath, Dambaru Bhatta, Taylor G Francis Group, London, 2007.

SYLLABUS
M.Sc. Mathematics (Semester - IV)

OPTIMIZATION TECHNIQUES (MMT-405)

COURSE OBJECTIVES

While studying the **OPTIMIZATION TECHNIQUES,** the Learner shall be able to:

- Use integer programming problem to solve system of linear equations.
- Provide the depth knowledge about inventory control theory and make students to solve the inventory problems.
- Introduce the concept of non–linear programming problems.
- Using optimization techniques to solve many practical problems.

COURSE OUTCOMES

After completion of the **OPTIMIZATION TECHNIQUES**, the Learner will be able to:

- fall skill ful in decision making, markov process, integer programming, enumeration algorithm, dynamic programming, stage coach and cargo leading problem, EOQ, inventory, queuing theory and acquire essential concepts in non linear programming.

UNIT- I

LINEAR PROGRAMMING – NETWORK PROBLEMS

Preliminary ideas – Network linear programme- ensuring total supply equals total demand – transportation problem – assignment problem – shortest route problem – maximum flow problem cuts in a network.

UNIT- II:

INTEGER PROGRAMMING

Introduction – Integer Programming Formulations – Gomory's construction–Fractional cut method(all integer)–The Cutting – Plane Algorithm – Branch–and–Bound Technique – Zero– One Implicit Enumeration Algorithm.

UNIT- III

DYNAMIC PROGRAMMING

Introduction – Application of Dynamic Programming: Capital Budgeting Problem – Reliability Improvement Problem – Stage–coach Problem – Cargo Leading Problem – Minimizing Total Tardiness in Single Machine Scheduling Problem – Optimal Subdividing Problem – Solution of Linear Programming Problem through Dynamic Programming.

UNIT- IV

INVENTORY AND QUEUING THEOR INVENTORY

Introduction–Inventory Decisions–Cost Associated– with Inventories –Factors Affecting inventory– Economic Order Quantity–Deterministic Inventory Problems with No Shortages– Deterministic inventory Models with shortages–EOQ with Price Breaks–Multi Item Deterministic problems– Inventory Problems with Uncertain Demand.

QUEUING THEORY

Introduction–Queuing System–Elements Of Queuing System–Operating Characteristics of Queuing System–Classification of Queuing Models–Model–I(M/M/1):(∞/FIFO),Model– II(M/M/1) : (N/FIFO), Model–III(M/M/C):(∞/FIFO), Model–IV(M/M/C):(N/FIFO).Problems in above four models.

UNIT- V

NON LINEAR PROGRAMMING

Introduction – Lagrangean Method –Jacobi Method– Kuhn–Tucker Method – Quadratic Programming – Separable Programming – Chance–Constrained Programming or Stochastic Programming.

REFERENCE BOOKS :

1. Hamdy A. Taha, Operations Research,(sixth edition)Prentice–Hall of India private Limited ,New Delhi,1997.
2. Kanti Swarup, P.K. Gupta, Man Mohan, Operations Research, Sultan Chand G Sons, Educational Publishers, New Delhi.
3. Panneerselvam.R, Operations Research, 2nd Edition, PHI LearningPrivate Limited, Delhi, 2015
4. Hiller.F.S G Lieberman.J Introduction to Operation Research ,7th Edition, Tata–MCGraw Hill Publishing Company, NewDelhi, 2001.
5. Prem Kumar Gupta.Er, Hira.D.S. Operations Research,7th Edition,S.Chand G Company Pvt.Ltd.2014.

5. Procedure for Admission, Curriculum Transaction and Evaluation

The proposed program in ODL mode will be conducted by CDOE-SGVU with the support of various departments of the University. Eligibility criteria, course structure, detailed curriculum, duration of program and evaluation criteria shall be approved by Board of Studies and Academic Council, SGVU, Jaipur which are based on UGC guidelines for the program which comes under the purview of ODL and mode for award of Degree.

Details of Procedure for admission in which eligibility criteria for admission and fee structure of the course, Curriculum includes Program delivery, norms for delivery of courses in ODL mode, use of IT services to academic support services, course design academic calendar and Evaluation which includes Distribution of Marks in Continuous internal assessments, Minimum Passing criteria and system of

Grading formats are given in detail as under.

Procedure for Admission

Students who will seek admission in M.Sc Mathematics program to apply through its website www.sgvu.edu.in

Minimum Eligibility Criteria for Admission

The minimum eligibility criteria for admission in ODL M.Sc Mathematics program is a pass in Bachelor of Science in mathematics from any recognized University.

Program Fee and Financial Assistance Policy

Program fees for students for proposed M.Sc Mathematics in various streams offered by CDOE-SGVU Jaipur is Rs. 21,000 Per year tuition fees and 3000 per year examination fees.

Curriculum Transactions

Program Delivery

The curriculum will be delivered through the Self Learning Materials (SLMs) supported by various learning resources including audio-video aids.

Academic Calendar

Sr no	**Name of the Activity**	**Tentative months schedule(specify months) during Year**			
		From (Month)	**To (Month)**	**From (Month)**	**To (Month)**
1	Admission	Jul	Sep	Jan	Feb
2	Assignment Submission (if any)	Oct	Nov	April	May
3	Evaluation of Assignment	Nov	Dec	May	June
4	Examination	Dec	Jan	June	Jul
5	Declaration of Result	Feb	Mar	Aug	Sep
6	Re–registration	Jan	Feb	Jul	Sep
7	Distribution of SLM	Jul	Sep	Jan	Feb
8	Contact Program (Counselling, Practical's, etc.)	Nov	Dec	May	June

Evaluation

The evaluation shall include two types of assessments-

1. Continuous Assessment in the form of assignments (30% Weightage)
2. End Semester Examination, which will be held at the SGVU campus (70% Weightage).

Minimum Passing percentage

The students are considered as passed in a course if they score 40% marks in the Continuous Evaluation (Internal Assessment) and end-semester Examinations (External Assessment).

Marks and Grades

Grades & Grade Points

a. At the end of the Semester / Year every student is assigned a 'Letter Grade' based on his/her performance over the semester in all courses for which he/she had registered.

b. The letter grade and grade point indicate the results of quantitative and qualitative assessment of the student's performance in a course.

c. There are seven letter grades: **A+, A, B+, B, C+, C, E (E1 for internal back and E2 for external back), F** that have grade points with values distributed on a 10-point scale.

6. Requirement of the Laboratory Support and Library Resources

Library Resources

CDOE-SGVU has excellent library with all the books required for the course learning and reference books for the course of M.Sc Mathematics. Adequate online learning links and e-learning materials will also be provided to students which will be support students in their learning cycle.

7. Cost Estimate of the Program and the Provisions

The Estimate of Cost & Budget could be as follows (all figures on Annual basis):

1. Salaries: Rs. 9,60,00,00/- (Approx)
2. Travel: Rs. 30,000/- (Approx)
3. Seminars: Rs. 40,000/- (Approx)
4. SLM Preparation, Printing, Distribution: Rs. 3,00,000/- (Approx)
5. Library: 1,25,000/- (Approx)
6. Courier/Transportation: Rs. 50,000/- (Approx)
7. Infrastructure: Rs. 1,50,000/- (Approx)
8. Computer Labs & Leased Line: Rs. 1,00,000/- (Approx)

8. Quality assurance mechanism and expected Program Outcomes

The quality of the program depends on the course curriculum and syllabus which meets the requirement of the industry and creates the skillful learning in the students. The ultimate aim of M.Sc Mathematics program in ODL Mode is to enhance skills of the learners as managers, entrepreneurs and seeing them excel in their profession and meeting global standards too by upgrading their career opportunities.

The CDOE, SGVU, Jaipur has constituted Centre for Internal Quality Assurance (CIQA) . The CIQA will do periodic assessment of the ODL learning course material and audio video tutorials and will assure that the quality of learning is maintained and time to time changes are made as per the requirement of the course. The CIQA will also access the quality of assignments, quizzes and end term assessment time to time and required changes will be assured by them to maintain the quality of the learning program. CIQA will assure that the learning is made a truly global experience for the learner along with inculcation of required skills in the learner as expected program outcome with CDOE, SGVU, Jaipur.

The university will work continuously for the betterment of processes, assessments, teaching methodology, e-learning material improvisation as per four quadrant approach and implementation of the same as per New Education Policy. The University is committed to deliver the best education in all the learning modes with adherence to NEP, UGC and other regulatory guidelines in truly Global sense. To monitor quality of Student Support Services provided to the learners.