DEGREE OF MASTER OF SCIENCE
CHOICE BASED CREDIT SYSTEM

SYLLABUS FOR
M.SC. MATHEMATICS
(SEMESTER PATTERN)
(For Candidates admitted in the Colleges affiliated to Periyar University from 2021-2022 onwards)
REGULATIONS

1. OBJECTIVES OF THE COURSE

In recent days Mathematics is penetrating all fields of human endeavor and therefore it is necessary to prepare the students to cope with the advanced developments in various fields of Mathematics. The objectives of this course are the following:

(a) To impart knowledge in advanced concepts and applications in various fields of Mathematics.

(b) To provide wide choice of elective subjects with updated and new areas in various branches of Mathematics to meet the needs of all students.

2. COMMENCEMENT OF THIS REGULATION:

These regulations shall take effect from the academic year 2021-2022, that is, for students who are admitted to the first year of the course during the academic year 2021-2022 and thereafter.

3. DEFINITIONS:

Programme: Programme means a course of study leading to the award of the degree in a discipline.

Course: Course refers to the subject offered under the degree Programme.

4. ELIGIBILITY FOR ADMISSION:

A candidate who has passed B.Sc., Mathematics / B.Sc., Mathematics (Computer Applications) degree of this University or any of the above degree of any other University accepted by the Syndicate equivalent thereto, subject to such condition as may be prescribed therefore are eligible for admission to M.Sc., Degree Programme and shall be permitted to appear and qualify for the Master of Science (M.Sc.) Degree Examination in Mathematics of this University.

5. DURATION OF THE COURSE:

The course of study of Master of Science in Mathematics shall consist of two academic years divided into four semesters. Each Semester consists of 90 working days.
M.Sc. MATHEMATICS

6. SYLLABUS:
   The syllabus of the PG degree Programme has been divided into the following courses:
   i. Core Courses,
   ii. Elective Courses, and
   iii. Extra Disciplinary Course (EDC).
   iv. Add On Course

i. Core Courses:
   The core courses related to the programme concerned including practicals and project work offered under the programme.

ii. Elective Courses:
   There are FOUR Elective Courses offered under the programme related to the major or non-major but are to be selected by the students.

iii. Extra Disciplinary Course (EDC):
   There is an Extra Disciplinary Course offered under the programme related to the non-major but are to be selected by the students.

iv. Add On Course:
   This course offered in II semester, help students to attain special skills related to their subject.

7. CREDITS:
   Weightage given to each course of study is termed as credit.

8. CREDITSYSTEM:
   The weightage of credits are spread over to four different semester during the period of study and the cumulative credit point average shall be awarded based on the credits earned by the students. A total of 90 credits are prescribed for the Post Graduate programme.

9. COURSE OF STUDY:
   The course of study for the degree shall be in Branch I-Mathematics (under Choice Based Credit System) with internal assessment according to syllabi prescribed from time to time.
## COURSE OF STUDY AND SCHEME OF EXAMINATION

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Subject</th>
<th>Subject Title</th>
<th>Hours</th>
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### SEMESTER I

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<td>2</td>
<td>Core II</td>
<td>REAL ANALYSIS – I</td>
<td>6</td>
<td>25</td>
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<td>3</td>
<td>Core III</td>
<td>ORDINARY DIFFERENTIAL EQUATIONS</td>
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<td>4</td>
<td>Core IV</td>
<td>MECHANICS</td>
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<tbody>
<tr>
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<td>Core V</td>
<td>ABSTRACT ALGEBRA</td>
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<td>7</td>
<td>Core VI</td>
<td>REAL ANALYSIS – II</td>
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<td>Core VII</td>
<td>PARTIAL DIFFERENTIAL EQUATIONS</td>
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<td>9</td>
<td>Elective II</td>
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<td>CALCULUS OF VARIATION AND INTEGRAL CALCULATIONS</td>
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**SEMESTER III**

**SEMESTER IV**
(i) List of Elective Courses:

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<tr>
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<td>GROUP A</td>
</tr>
<tr>
<td>I</td>
<td>Paper I</td>
<td>Discrete Mathematics Combinatorial Mathematics</td>
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<tr>
<td>II</td>
<td>Paper I</td>
<td>Numerical Analysis Difference Equations</td>
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<td>GROUP C</td>
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<tr>
<td>III</td>
<td>Paper I</td>
<td>Differential Geometry Fluid Dynamics Programming with C++</td>
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<td>Paper III</td>
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<td>GROUP D</td>
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<td>IV</td>
<td>Paper I</td>
<td>Number Theory (T) Optimization techniques (T) C++ Programming Lab (P)</td>
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(ii) List of Extra Disciplinary Courses (EDC):

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<th>PAPER TITLE</th>
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<tbody>
<tr>
<td>1</td>
<td>Paper I</td>
<td>Numerical &amp; Statistical Methods</td>
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<tr>
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(iii) List of Add on Courses (AOC):

<table>
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<th>PAPER CODE</th>
<th>PAPER TITLE</th>
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<td>1</td>
<td>Paper I</td>
<td>Advanced LaTeX</td>
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<td>2</td>
<td>Paper II</td>
<td>Python Programming</td>
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<tr>
<td>3</td>
<td>Paper III</td>
<td>Artificial Intelligence</td>
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</table>
11. **EXAMINATIONS:**

The examination shall be of Three Hours duration for each paper at the end of each semester. The candidate failing in any subject(s) will be permitted to appear for each failed subject(s) in the subsequent examination. Practical examinations for PG course should be conducted at the end of the even semester only. At the end of fourth semester viva-voce will be conducted on the basis of the Dissertation/ Project report by one internal and one external examiner.

12. **QUESTION PAPER PATTERN AND MARKS DISTRIBUTION:**

(i) Question Paper Pattern and Marks Distribution for Theory Examination:

(ii) **TITLE OF THE PAPER**

Time: Three Hours  
Maximum Marks: 75

**Part – A (15 X 1 = 15 Marks)**

Answer ALL objective type Questions

(Three Questions from each unit)

**Part – B (5 X 2 = 10 Marks)**

Answer ANY TWO Questions (One Question from each unit )

**Part – C (5 X 10 = 50 Marks)**

Answer ALL questions

(Two questions from each unit with internal choice).
(i) Question Paper Pattern and Marks Distribution for C++ Programming Lab: Question

Paper Pattern:

There will be ONE question with or without subsections to be asked for the Practical examination. Every question should be chosen from the question bank prepared by the examiner(s). Every fourth student get a new question i.e. each question may be used for at most three students.

The answer should contain i) Algorithm (A), ii) Flow Chart (F), iii) Program (P), iv) Execution of the Program with correct output (E & OP), and v) viva-voce (V).

Marks Distribution for C++ Programming Lab:

Maximum marks:100

   Internal (CIA): 40

   External Assessment (EA- Practical Examination): 60

(PRACTICAL WRITTEN EXAM.: 50 MARKS (THE SPLIT UP MARKS OF THIS TOTAL MARKS 50 IS, FOR A-05, F-05, P- 10, E -20 & OP-05 AND V-05) AND RECORD:10 MARKS).

13. Dissertation:

(a) Topic:

   The topic of the dissertation shall be assigned to the candidate before the beginning of third semester and a copy of the same should be submitted to the University for Approval.

(b) No. of copies project / dissertation:

   The students should prepare Three copies of dissertation and submit the same for the evaluation by Examiners. After evaluation one copy is to be retained in the college library and one copy is to be submitted to the university (COE) and the student can have the rest.

(c) Format to be followed:

   The format of the Project / Dissertation to be prepared and submitted by the students in Semester IV is given below:
Format for the preparation of Project work:
i) Title page:

TITLE OF THE PROJECT / DISSERTATION

Project / dissertation Submitted in partial fulfillment of the requirement for the award of the
Degree of Master of Science in MATHEMATICS (under Choice Base Credit
System) to the Periyar University, Periyar Palkalai Nagar, Salem -636 011.

By

(Student’s Name )

(Register Number)

Under the Guidance of

(Guide Name and Designation)

(College Logo)

(Name of the Department)

(College Address)

(Month and Year)
ii) **BONAFIDE CERTIFICATE:**

**CERTIFICATE**

This is to certify that the dissertation entitled ………………………… submitted in partial fulfillment of the requirement of the award of the Degree of Master of Science in MATHEMATICS (Under Choice Based Credit System) to the Periyar University, Salem is a record of bonafide research work carried out by……………………… under my supervision and guidance and that no part of the dissertation has been submitted for the award of any degree, diploma, fellowship or other similar titles or prizes and that the work has not been published in part or full in any scientific or popular journals or magazines.

Date:

Place:

Signature of the Guide

Signature of the Head of the Department.
M.Sc. MATHEMATICS

(iii) Acknowledgement:
( Drafted by the student )

(iv) Table of contents:

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<tbody>
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<td>1.</td>
<td>Introduction</td>
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<td>2.</td>
<td>Review of Literature</td>
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14. MINIMUM MARKS FOR PASSING:

a. Theory Papers: The candidate shall be declared to have passed the examination if the candidate secures not less than 50 marks in total (CIA mark + Theory Exam mark) with minimum of 38 marks in the Theory Exam conducted by the University. The Continuous Internal Assessment (CIA) Mark 25 is distributed to four components viz., Tests, Assignment, Seminar and Attendance as 10, 05, 05 and 05 marks, respectively.

b. Practical paper: A minimum of 50 marks out of 100 marks in the University examination and the record notebook taken together is necessary for a pass. There is no passing minimum for the record notebook. However submission of record notebook is a must.

c. Project Work/Dissertation and Viva-Voce: A candidate should secure 50% of the marks for pass. The candidate should attend viva-voce examination to secure a pass in that paper.

Candidate who does not obtain the required minimum marks for a pass in a Paper / Practical/ Project/Dissertation shall be declared Re-Appeal (RA) and he / she has to appear and pass the same at a subsequent appearance.

15. CLASSIFICATION OF SUCCESSFUL CANDIDATES:

Candidates who secure not less than 60% of the aggregate marks in the whole examination shall be declared to have passed the examination in First Class. All other successful candidate shall be declared to have passed in the Second Class. Candidates who obtain 75% of the marks in the aggregate shall be deemed to have passed the examination in the First Class with Distinction provided they pass all the
examinations prescribed for the course at the first appearance. Candidates who pass all the examinations prescribed for the course in the first instance and within a period of two academic years from the year of admission to the course only are eligible for University Ranking.

16. **MAXIMUM DURATION FOR THE COMPLETION OF THE PG PROGRAMME:**

The maximum duration for completion of the PG Programme shall not exceed Four Years from the year of admission.

17. **TRANSITORY PROVISION:**

Candidates who were admitted to the PG course of study before 2020-2021 shall be permitted to appear for the examinations under those regulations for a period of three years, that is, up to end inclusive of the examination of April / May 2023. Thereafter, they will be permitted to appear for the examination only under the regulations then in force.
OBJECTIVE:

The objective of this course is 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.

UNIT I : Linear Transformation

UNIT II : Algebra of Polynomials
The algebra of polynomials - Lagrange interpolation - Polynomial ideals - The prime factorization of a polynomial - Determinant functions. (Chapter 4: Sections: 4.1 - 4.5, Chapter 5: Sections: 5.1 & 5.2).

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. (Chapter 5: Sections: 5.3 & 5.4, Chapter 6: Sections : 6.1 - 6.3).

UNIT IV : Diagonalization
Invariant subspaces - Simultaneous triangulations - Simultaneous diagonalizations - Direct-sum decompositions - Invariant sums - Primary decomposition theorem. (Chapter 6: Sections: 6.4 -6.8).

UNIT V : The Rational and Jordan Forms
Cyclic subspaces and annihilators-Cyclic decompositions and rational form-The Jordan form-Computation of invariant factors. (Chapter 7: Sections 7.1 - 7.4).

TEXT BOOK:
REFERENCE BOOKS:


LEARNING OUTCOMES: At the end of the course, students will be able

➢ to describe a diagonalizable operator T in a language of invariant direct sum decompositions (projections which commute with T).
➢ to find the minimal polynomials, Jordan forms and the rational forms of real matrices.
OBJECTIVE:

The course will develop a deeper and more rigorous understanding of calculus including defining terms and proving theorems about functions, sequences, series, limits, continuity and derivatives. The course will develop specialized techniques in problem solving.

UNIT I: Basic Topology


Unit II: Numerical Sequences and Series

Convergent sequences – Subsequences – Cauchy sequences - Upper and lower limits
- Some special sequences – Series – Series of nonnegative terms - The number $e$ - The root and ratio tests. (Chapter 3 Pages 47 – 68).

Unit III: Rearrangements of Series


UNIT IV: Continuity

Limit of Functions – Continuous functions - Continuity and Compactness – Continuity and Connectedness – Discontinuities – Monotonic functions – Infinite limits and Limits at infinity. (Chapter 4 Pages 83 – 102).

UNIT IV: Differentiation


TEXT BOOK:

BOOKS FOR REFERENCE:

LEARNING OUTCOMES:
On successful completion of this course, students will be able
- to give the definition of concepts related to metric spaces, such as continuity, compactness, completeness and connectedness that will help for further studies within topology and functional analysis.
- to demonstrate an understanding of limits and how they are used in sequences, series, continuity and differentiation.
- to construct rigorous mathematical proofs of basic results in real analysis.
M.Sc. MATHEMATICS

SEMESTER – I

CORE III - ORDINARY DIFFERENTIAL EQUATIONS

OBJECTIVE:

The objective of this course is to equip the students with knowledge of some advanced concepts related to ordinary differential equations and to understand the concepts related to the solution of ordinary differential equations.

UNIT I : Linear Equations with Constant Coefficients:
Introduction – Second order homogeneous equations – Initial value problem – Linear dependence and independence – A formula for the Wronskian. (Chapter 2: Section 1 to 5).

UNIT II : Linear Equations with Constant Coefficients (Contd.):
Non-homogeneous equations of order two – Homogenous and non-homogeneous equations of order n – Initial value problem – Annihilator method to solve a non-homogeneous equation. (Chapter 2: Section 6 to 11).

UNIT III : Linear Equations with Variable Coefficients:
Initial value problems for homogeneous equations – solutions of homogeneous equations- Wronskian and linear independence – Reduction of the order of homogeneous equation. (Chapter 3: Section 1 to 5).

UNIT IV : Linear Equations with Regular Singular Points:
Linear equation with regular singular points – Euler equation – second order equations with regular singular points – solutions and properties of Legendre and Bessel equation. (Chapter 3: Section 8 & Chapter 4: Section 1 to 4 and 7 and 8).

UNIT V : First Order Equation – Existence and Uniqueness:

TEXT BOOK:
BOOKS FOR REFERENCE:

LEARNING OUTCOMES: At the end of the course, students will be able
➢ to solve the differential equations by using various methods.
M.Sc. MATHEMATICS

M.Sc. MATHEMATICS SEMESTER – I
CORE IV – MECHANICS

OBJECTIVE:

The objective of this course is to understand the Lagrangian and Hamiltonian equations for dynamical systems.

UNIT I : Mechanical Systems:

The Mechanical System – Generalized co–ordinates – Constraints – Virtual work – Energy and Momentum. (Chapter 1 Sections 1.1 to 1.5).

UNIT II : Lagrange’s Equations:

Lagrange’s Equation – Derivation of Lagrange’s Equations – Examples – Integrals of motion. (Chapter 2 Sections 2.1 to 2.3).

UNIT III : Hamilton’s Equation:

Hamilton’s Equation – Hamiltons Principle – Hamilton’s Equation – Other Variational Principle. (Chapter 4 Sections 4.1 to 4.3).

UNIT IV : Hamilton – Jacobi Theory:


UNIT V : Canonical Transformation:


TEXT BOOK:

BOOKS FOR REFERENCE:


LEARNING OUTCOMES:

➢ At the end of the course, the students will understand the formation of differential equations which will help to study the dynamics of mechanical systems.
OBJECTIVE:

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.

UNIT I: Sylow’s Theorem
Another Counting Principle – 1st, 2nd and 3rd parts of Sylow’s Theorems – double coset – the normalizer of a group. (Chapter 2 Sections 2.11 to 2.12).

UNIT II: Finite Abelian Groups
External and Internal direct Products – structure theorem for finite abelian groups – non isomorphic abelian groups - polynomial rings. (Chapters 2 & 3 Sections 2.13, 2.14 & 3.9).

UNIT III: Splitting Field

UNIT IV: Galois Theory

UNIT V: Solvability by radicals
Solvable group – the commutator subgroup – Solvability by radicals - finite fields. (Chapters 5 & 7 Sections 5.7 & 7.1).

TEXT BOOK:
BOOKS FOR REFERENCE:


LEARNING OUTCOMES: At the end of the course, students 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.
OBJECTIVE:

The course will develop a deeper and more rigorous understanding of calculus including defining terms and proving theorems about sequence and series of functions, integration, special functions and multivariable calculus. The course will develop specialized techniques in problem solving.

UNIT I: Riemann – Stieltjes Integral

UNIT II: Sequences and Series of Functions
Discussion of main problem – Uniform Convergence - Uniform Convergence and Continuity - Uniform Convergence and Integration – Uniform Convergence and Differentiation. (Chapter 7 Pages 143 – 154).

Unit III: Sequences and Series of Functions (contd…)

Unit IV: Some special functions
Power series – The Exponential and Logarithmic functions – Trigonometric Functions – Fourier series - The Gamma functions (Algebraic completeness of the complex field - omitted). (Chapter 8 Pages 172 – 203 (Omitted Theorem 8.8)).

Unit V: Functions of several variables
Linear transformations – Differentiation – The contraction principle - The inverse function theorem – The implicit function theorem. (Chapter 9 Pages 204 – 228).

TEXT BOOK:
BOOKS FOR REFERENCE


LEARNING OUTCOMES:

On successful completion of this course, students will be able to
➢ find the integrals of a bounded function on a closed bounded interval
➢ understand sequences and series of functions and its convergence
➢ find the derivative of functions of several variables.
M.Sc. MATHEMATICS

SEMESTER -II

CORE VII - PARTIAL DIFFERENTIAL EQUATIONS

OBJECTIVE:

The objective of this course is to enable the students to understand the concepts related to the solution of partial differential equations arising in various fields.

UNIT I Second order Partial Differential Equations:

UNIT II Elliptic Differential Equations:

UNIT III Parabolic Differential Equations:
Parabolic differential equations – Occurrence of the diffusion equation – Boundary condition – Separation of variable method – Diffusion equation in cylindrical – Spherical co-ordinates. (Chapter 4: Sections 4.1 to 4.5).

UNIT IV Hyperbolic Differential Equations:

UNIT V Integral Transform:

TEXTBOOK
BOOKS FOR REFERENCE


LEARNING OUTCOMES: At the end of the course, students will

- be familiar with the modeling assumptions and derivations that lead to PDE’s.
- recognize the major classification of PDEs and the qualitative difference between the classes of equations.
- be competent in solving linear PDEs using classical methods.
M.Sc. MATHEMATICS SEMESTER -III
CORE VIII – COMPLEX ANALYSIS

OBJECTIVES

❖ To learn the various intrinsic concepts and the theory of Complex Analysis.
❖ To study the concept of Analyticity, Complex Integration and Infinite Products in depth.

UNIT I Complex Integration :
Complex Integration – Fundamental Theorems – Line integrals –Rectifiable Arcs-Line Integrals as Arcs – Cauchy’s Theorem for a Rectangle and in a disk – Cauchy’s Integral Formula – Index of point with respect to a closed curve– The Integral formula – Higher order derivatives – Local properties of analytic functions – Taylor’s Theorem – Zeros and Poles –Local mapping - Maximum Principle. (Chapter 4: Sections 1 to 3).

UNIT II Complex Integration (Contd.):

UNIT III Harmonic Functions and Power Series Expansions:
Harmonic Functions – Definition and basic properties– Mean-Value Property– Poisson’s formula –Schwarz’s Theorem – Reflection Principle- Weierstrass’s theorem- Taylor’s series –Laurent series. (Chapter 4 : Sections 6 and Chapter 5 : Sections 1).

Unit IV Entire functions: Jenson’s formula – Hadamard’s theorem.

UNIT V Conformal Mapping:
The Riemann Mapping Theorem, Conformal Mapping of Polygons. A closure look at harmonic functions. (Chapter 6 : Sections 1,2 and 3).

TEXTBOOK
BOOKS FOR REFERENCE

LEARNING OUTCOMES: At the end of the course, students will

- be familiar with the modeling assumptions and derivations that lead to Complex Analysis
- recognize the major classification of analytic functions, harmonic functions, conformal mappings and the qualitative difference between the complex integration & Real integration.
OBJECTIVES:

❖ To study the concepts concerned with properties that are preserved under continuous deformations of objects.
❖ To train the students to develop analytical thinking and the study of continuity and connectivity.

UNIT I: Topological spaces:

Topological spaces - Basis for a topology – The Order Topology - The Product Topology on XxY – The Subspace Topology – Closed sets and Limit points. (Chapter 2: sections 12 to 17).

UNIT II: Continuous functions:


UNIT III: Connectedness:

Connected Spaces – Connected Subspaces of the Real line – Components and Local Connectedness. (Chapter 3: Sections 23 to 25)

UNIT IV: Compactness:

Compact spaces – Compact Subspace of the real line – Limit Point Compactness – Local Compactness. (Chapter 3: Sections 26 to 29).

UNIT V: Countability and Separation axioms:


TEXT BOOK:

BOOKS FOR REFERENCE:


LEARNING OUTCOMES: At the end of the course, students will be able

➢ to understand various concepts of Topology.
M.Sc. MATHEMATICS
SEMESTER -III
CORE X - MEASURE THEORY AND INTEGRATION

OBJECTIVES

❖ To generalize the concept of integration using measures.
❖ To develop the concept of analysis in abstract situations.

UNIT I : Lebesgue Measure:

UNIT II : Lebesgue integral:

UNIT III : Differentiation and Integration:
Differentiation and Integration – Differentiation of monotone functions – Functions of bounded variation – Differentiation of an integral – Absolute continuity. (Chapter 5: Sections 1 to 4).

UNIT IV : General Measure and Integration:

UNIT V : Measure and Outer Measure:
Measure and outer measure – outer measure and measurability – The Extension theorem – Product measures. (Chapter 12: Sections 1, 2 and 4).

TEXT BOOK:
BOOKS FOR REFERENCE:


LEARNING OUTCOMES:

➢ At the end of the course, the students will be able to get the knowledge of Measure and Outer measure, generalization of integrals with help of measures.
M.Sc. MATHEMATICS

SEMESTER – III

CORE XI - GRAPH THEORY

OBJECTIVES

❖ To give a rigorous study of the basic concepts of Graph Theory.
❖ To study the applications of Graph Theory in other disciplines.

UNIT I : Basic Results:

Introduction-Basic Concepts-Subgraphs-Degrees of Vertices - Paths and Connectedness - Automorphism of a Simple Graph. (Chapter 1: Sections 1.1 - 1.6).


UNIT II : Connectivity and Trees:

Connectivity: Introduction-Vertex cut and Edge Cut-Connectivity and Edge Connectivity.(Chapter 3: Sections 3.1 - 3.3). Trees: Introduction-Definition, Characterization and Simple Properties-Centers and Centroids- Cutting the Number of Spanning Trees-Cayley’s Formula. (Chapter 4: Sections 4.1 - 4.5).

UNIT III : Independent Sets, Matchings and Cycles:


UNIT IV: Graph Colorings:

Introduction-Vertex Colorings-Critical Graphs-Edge colorings of Graphs-Kirkman’s Schoolgirl- Problem-Chromatic Polynomials. (Chapter 7: Sections 7.1 ,7.2 ,7.3 (7.2.1 & 7.2.3 only) ,7.6, 7.8, and 7.9).

UNIT V: Planarity:

Introduction- Planar and Nonplanar Graphs –Euler Formula and its Consequences- K₅ and K₃,3 are Nonplanar Graphs – Dual of a Plane Graph- The Four-Color Theorem and the Heawood Five-Color Theorem-Hamiltonian Plane Graphs-Tait Coloring.(Chapter 8: Sections 8.1 - 8.6 ,8.8 and 8.9).
M.Sc. MATHEMATICS

TEXT BOOK:

BOOKS FOR REFERENCE:
2. Narasing Deo, Graph Theory with Application to Engineering and Computer Science, Prentice Hall of India, New Delhi, 2003.

LEARNING OUTCOMES: At the end of the course, students will be able
- to identify the graphs of connectivity and tree.
- to find the Independent set and cycle graph.
- to understand graph coloring.
- to check planarity.
M.Sc. MATHEMATICS

SEMESTER - IV

CORE XII - FUNCTIONAL ANALYSIS

OBJECTIVES

❖ To study the three structure theorems of Functional Analysis viz., Hahn- Banach theorem, Open mapping theorem and Uniform boundedness principle.
❖ To introduce Hilbert spaces and operator theory leading to the spectral theory of operators on a Hilbert space.

UNIT I : Banach Spaces:

Banach Spaces – Definition and examples – Continuous linear transformations – Hahn Banach theorem. (Chapter 9: Sections 46 to 48).

UNIT II : Banach Spaces and Hilbert Spaces:

The natural embedding of N in N** - Open mapping theorem – Conjugate of an operator – Hilbert space – Definition and properties. (Chapter 9: Sections 49 to 51, Chapter 10 : Sections 52).

UNIT III: Hilbert Spaces:

Orthogonal complements – Orthonormal sets – Conjugate space H* - Adjoint of an operator (Chapter 10 : Sections 53 to 56).

UNIT IV: Operations on Hilbert Spaces:

Self-adjoint operator – Normal and Unitary operators – Projections. (Chapter 10: Sections 57 to 59).

UNIT V: Banach Algebras:


TEXT BOOKS :

M.Sc. MATHEMATICS

BOOKS FOR REFERENCE:

LEARNING OUTCOMES:
On successful completion of this course, students will be able to
➢ Understand the relationship between metric space, normed space, inner product space
➢ understand properties of continuous linear functionals on Banach space
➢ understand various types of operators on Hilbert space.
➢ know Regular elements, singular elements, spectrum of Banach algebra & its ideals
M.Sc. MATHEMATICS

SEMESTER - IV

CORE XIII – PROBABILITY THEORY

OBJECTIVE:

The objective of this course is to enable the students
➢ to understand the concepts and results related to probability, random events,
➢ to understand various distributions and applications.
➢ To know the standard results related to probability &distribution.

UNIT I
(Chapter 1: Sections 1.1 to 1.7, Chapter 2: Sections 2.1 to 2.9).

UNIT II:
Parameters of the Distribution - Expectation- Moments – The Chebyshev Inequality – Absolute moments – Order parameters – Moments of random vectors – Regression of the first and second types. (Chapter 3: Sections 3.1 to 3.8).

UNIT III:
Characteristic functions - Properties of characteristic functions – Characteristic functions and moments – semi-invariants – characteristic function of the sum of the independent random variables – Determination of distribution function by the Characteristic function – Characteristic function of multidimensional random vectors – Probability generating functions. (Chapter 4: Sections 4.1 to 4.7).

UNIT IV:
Some probability distributions - One point, two point, Binomial – Polya – Hypergeometric – Poisson (discrete) distributions – Uniform – normal gamma – Beta – Cauchy and Laplace (continuous) distributions. (Chapter 5: Section 5.1 to 5.10 (Omit Section 5.11).
UNIT V:


TEXT BOOK:

BOOKS FOR REFERENCE:

LEARNING OUTCOMES: At the end of the course, students will be able

➢ to get the knowledge of Random variables and Random events.
➢ to understand characteristic of function and Properties of characteristic function.
M.Sc. MATHEMATICS

SEMESTER - IV

CORE XIV - CALCULUS OF VARIATIONS AND INTEGRAL EQUATIONS

OBJECTIVES.
❖ To introduce the concept of calculus of variations and integral equations and their applications.
❖ To study solution of Fredholm & Volterra integral equations through different methods.

UNIT I: Variational Problems with Fixed Boundaries:
The concept of variation and its properties – Euler’s equation – Variational problems for Functionals – Functionals dependent on higher order derivatives – Functions of several independent variables – Some applications to problems of Mechanics. (Chapter 1: Sections 1.1 to 1.7 of [1]).

UNIT II: Variational Problems with Moving Boundaries:
Movable boundary for a functional dependent on two functions – one-side variations - Reflection and Refraction of extremals - Diffraction of light rays. (Chapter 2: Sections 2.1 to 2.5 of [1]).

UNIT III: Integral Equation:
Introduction – Types of Kernels – Eigen Values and Eigen functions – Connection with differential equation – Solution of an integral equation – Initial value problems – Boundary value problems. (Chapter 1: Section 1.1 to 1.3 and 1.5 to 1.8 of [2]).

UNIT IV: Solution of Fredholm Integral Equation:
Second kind with separable kernel – Orthogonality and reality eigen function – Fredholm Integral equation with separable kernel – Solution of Fredholm integral equation by successive substitution – Successive approximation – Volterra Integral equation – Solution by successive substitution. (Chapter 2: Sections 2.1 to 2.3 and Chapter 4 Sections 4.1 to 4.5 of [2]).

UNIT V: Hilbert – Schmidt Theory:
Complex Hilbert space – Orthogonal system of functions- Gram Schmidt orthogonalization process – Hilbert – Schmidt theorems – Solutions of Fredholm integral equation of first kind. (Chapter 3: Section 3.1 to 3.4 and 3.8 to 3.9 of [2]).
TEXT BOOKS:
1. A.S Gupta, Calculus of Variations with Application, Prentice Hall of India, New Delhi, 2005. (For Units I and II),

BOOKS FOR REFERENCE:

LEARNING OUTCOMES:
After the successful completion of the course, students will be able
➢ to know different types variational problems and finding their extremals.
➢ to find solution of Fredholm & Volterra integral equations through different methods.
M.Sc. MATHEMATICS

SEMESTER - I

ELECTIVE I - PAPER I - DISCRETE MATHEMATICS

OBJECTIVE:

The objective of this course is to understand the basic ideas of logic, proof methods and strategy, the growth of functions, counting techniques, pigeonhole principle, recurrence relations, solving recurrences using generating functions, Boolean functions, apply Boolean algebra to circuits and gating networks, use finite state-machines to model computer operations.

UNIT I : The Foundations: Logic and Proofs :


UNIT II : Counting:

The Basics of Counting- The Pigeonhole Principle -Permutations and Combinations - Generalized Permutations and Combinations - Generating Permutations and Combinations . (Chapter 5: Sections 5.1- 5.3, 5.5 and 5.6).

UNIT III : Advanced Counting Techniques:

Applications of Recurrence Relations - Solving Linear Recurrence Relations Generating Functions . (Chapter 6: Sections 6.1, 6.2 and 6.4).

UNIT IV : Boolean Algebra:


UNIT V : Modeling Computation:

Finite-State machines with Output- Finite-State machines with No Output-Turing Machines. (Chapter 12: Sections 12.2, 12.3 and 12.5).

TEXT BOOK:

M.Sc. MATHEMATICS

BOOKS FOR REFERENCE:


LEARNING OUTCOMES: Students completing this course will be able to

➢ express a logic sentence in terms of predicates, quantifiers and logical connectives.
➢ apply the rules of inference and methods of proof including direct and indirect proof forms, proof by contradiction and mathematical induction.
➢ solve mathematics problems that involve computing permutations and combinations of a set, fundamental enumeration principles.
➢ evaluate Boolean functions and simplify expressions using the properties of Boolean algebra.
OBJECTIVE:

Combinatorial mathematics is the study of the arrangements of objects, according to prescribed rules, to count the number of possible arrangements or patterns, to determine whether a pattern of a specified kind exists and to find methods of constructing arrangements of a given type. The objective of this course is to acquaint the students with the concepts of permutations and combinatorics, generating functions, recurrence relations, the principle of inclusion and exclusion and Polya’s theory of counting.

UNIT I: Permutations and Combinations. (Chapter 1 Section 1.1 to 1.7)

UNIT II: Generating functions. (Chapter 2 Section 2.1 to 2.7).

UNIT III: Recurrence relations. (Chapter 3 Section 3.1 to 3.5).

UNIT IV: Principle of inclusion and exclusion. (Chapter 4 Section 4.1 to 4.7)

UNIT V: Polya’s theory of counting. (Chapter 5 Section 5.1 to 5.7).

TEXT BOOK:


BOOKS FOR REFERENCE:


LEARNING OUTCOMES: After completing the course, students will be able to

➢ Use formulas for counting basic combinatorial outcomes to construct solutions to complete combinatorial enumeration problems:
  • permutation, with and without repetitions;
  • combinations, with and without repetitions;

➢ Apply counting strategies to solve discrete probability problems.

➢ Use specialized techniques to solve combinatorial enumeration problems:
  • generating functions;
  • recurrence relations;
  • Inclusion-exclusion principle.
OBJECTIVES:
The objectives of this course are
❖ to make the students familiarize with the ways of solving complicated mathematical problems numerically.
❖ To provide numerical methods for solving the non-linear equations, interpolation, differentiation, integration, ordinary and partial differential equations.
❖ Describing and understanding error analysis in numerical methods.

UNIT I: Numerical solutions to ordinary differential equation:

UNIT II: Picard and Euler Methods:

UNIT III: Runge – Kutta Method:

UNIT IV: Numerical Solutions to Partial Differential Equations:
UNIT V : Numerical Solutions to Partial Differential Equations (Contd.):


TEXT BOOK:


BOOKS FOR REFERENCE:


LEARNING OUTCOMES: At the end of the course, students will

➢ learn the principles for designing numerical schemes for differential equations.
➢ be able to analyze the consistency, stability and convergence of a numerical scheme.
➢ be able to know, for each type of differential equations, what kind of numerical methods are best suited for and the reasons behind these choices?
➢ be able to make a connection between the mathematical equations or properties and the corresponding physical meanings.
➢ be able to use a programming language or mathematical software to implement and test the numerical schemes.
OBJECTIVE:

Difference equations usually describe the evolution of certain phenomena over the course of time. The aim of studying this course is
❖ to introduce the difference calculus.
❖ to study linear difference equations and to know how to solve them.
❖ to know the stability theory for homogeneous linear system of difference equations.
❖ to study the asymptotic behavior of solutions of homogeneous linear difference equations.

UNIT I: Difference Calculus:

Difference operator – Summation – Generating function – Approximate summation. (Chapter 2 Sections 2.1 to 2.3).

UNIT II: Linear Difference Equations:

First order equations – General results for linear equations. (Chapter 3 Sections 3.1 to 3.2).

UNIT III: Linear Difference Equations (Contd.):

Equations with constant coefficients – Equations with variable coefficients – $z$ – transform. (Chapter 3 Sections 3.3, 3.5 and 3.7).

UNIT IV: Stability Theory

Initial value problems for linear systems – Stability of linear systems. (Chapter 4 Sections 4.1 to 4.3).

UNIT V: Asymptotic Methods

Asymptotic analysis of sums – Linear equations. (Chapter 5 Sections 5.1 to 5.3).

TEXT BOOK:

M.Sc. MATHEMATICS

BOOKS FOR REFERENCE:

LEARNING OUTCOMES:
After the successful completion of the course, students will be able
- to know the fundamentals of difference calculus, like, the difference operator, the computation of sums, the concept of generating function and the important Euler summation formula.
- to solve linear difference equations using different methods, namely, annihilator method, z-transform method, etc.
- to find the stability results for the linear system using eigen value criteria.
- to find asymptotic analysis of sums, and asymptotic behavior of solutions to linear difference equations by the theorems of Poincare and Perron.
OBJECTIVE:
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.

UNIT I: Theory of Space Curves:
Theory of space curves – Representation of space curves – Unique parametric representation of a space curve – Arc-length – Tangent and osculating plane – Principle normal and binormal – Curvature and torsion – Behaviour of a curve near one of its points – The curvature and torsion of a curve as the intersection of two surfaces. (Chapter 1: Sections 1.1 to 1.9).

UNIT II: Theory of Space Curves (Contd.):
Contact between curves and surfaces – Osculating circle and osculating sphere – Locus of centre of spherical curvature – Tangent surfaces – Involutes and Evolutes – Intrinsic equations of space curves – Fundamental Existence Theorem – Helices. (Chapter 1: Sections 1.10 to 1.13 and 1.16 to 1.18).

UNIT III: Local Intrinsic properties of surface:

UNIT IV: Local Intrinsic properties of surface and geodesic on a surface:

UNIT V: Geodesic on a surface:
M.Sc. MATHEMATICS

TEXT BOOK:

BOOKS FOR REFERENCE:

LEARNING OUTCOMES: After successful completion of the course, students 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.
M.Sc. MATHEMATICS
SEMESTER – III
ELECTIVE III - PAPER II – FLUID DYNAMICS

OBJECTIVE: The objective of this course is
❖ To give fundamental knowledge of fluid, its properties and behavior under various conditions of internal and external flows.
❖ To understand basic laws and equations used for analysis of static and dynamic fluids.
❖ To develop an appreciation for the properties of Newtonian fluids.
❖ To understand the dynamics of fluid flows and the governing non-dimensional parameters

Unit I: Inviscid Theory

Unit II: Inviscid Theory (contd...)
Euler’s momentum theorem- conservative forces – Lagrangian form of the equation of motion – Steady motion – The energy equation – Rate of change of circulation – Vortex motion – Permanence of vorticity.

Unit III: Two-Dimensional Motion

Unit IV: Viscous Theory

Unit V: Boundary Layer Theory
M.Sc. MATHEMATICS

TEXT BOOKS:

BOOKS FOR REFERENCES:

LEARNING OUTCOMES: On successful completion of the course, the student will be able to,

➢ Recognize and find the values of fluid properties and relationship between them and understand the principles of continuity, momentum, and energy as applied to fluid motions.
➢ Identify these principles written in form of mathematical equations.
➢ Apply dimensional analysis to predict physical parameters that influence the flow in fluid mechanics.
M.Sc. MATHEMATICS
SEMESTER – III

ELECTIVE III - PAPER III - PROGRAMMING WITH C++

OBJECTIVE:
The objective of this course is to introduce the basic knowledge of one of the programming language of C++.

UNIT I:

UNIT II:

UNIT III: Function in C++:

UNIT IV: Constructors and Destructors:
M.Sc. MATHEMATICS

UNIT V : Files:


TEXT BOOK:


BOOKS FOR REFERENCE:


LEARNING OUTCOMES: At the end of the course, students will be able

➢ To acquire the knowledge of getting solution to mathematical problems with the help of C++.
ELECTIVE IV - PAPER I - NUMBER THEORY

OBJECTIVE:

The aim of this course is to teach the students about the basics of elementary number theory starting with primes, congruences, quadratic residues, primitive roots, arithmetic functions and some Diophantine equations.

UNIT I : Divisibility and Congruence:

Divisibility – Primes - Congruences – Solutions of Congruences – Congruences of Degree one. (Chapter 1: Sections 1.1 to 1.3 and Chapter 2: Sections: 2.1 to 2.3).

UNIT II : Congruence:

The function φ(n) – Congruence of higher degree – Prime power moduli – Prime modulus – Congruence’s of degree two, prime modulus – power Residues. (Chapter 2: Sections 2.4 to 2.9).

UNIT III : Quadratic Reciprocity:

Quadratic residues – Quadratic reciprocity – The Jacobi symbol – Greatest Integer function. (Chapter 3: Sections 3.1 to 3.3 and Chapter 4: Section 4.1)

UNIT IV : Some Functions of Number Theory:

Arithmetic functions –The Mobius inverse formula – The multiplication of arithmetic functions. (Chapter 4: Sections 4.2 to 4.4).

UNIT V : Some Diaphantine Equations:

The equation ax + by= c- Positive solutions-Other linear equations-The equation $x^2 + y^2 = z^2$ - The equation $x^4 + y^4 = z^2$ Sums of four and five squares – Waring’s problem – Sum of fourth powers – Sum of Two squares. (Chapter 5: Sections 5.1 to 5.10).

TEXT BOOK:


BOOKS FOR REFERENCE:

M.Sc. MATHMATICS

SEMESTER - IV

LEARNING OUTCOMES: At the end of the course, student will be able to
➢ apply the Law of Quadratic Reciprocity and other methods to classify numbers as
   primitive roots, quadratic residues and quadratic non-residues.
➢ formulate and prove conjectures about numeric patterns and
➢ produce rigorous arguments centered on the material of number theory, most notably
   in the use of Mathematical induction and the Well-Ordered principle in the proof of
   theorems.
ELECTIVE IV - PAPER II - OPTIMIZATION TECHNIQUES

OBJECTIVES:

❖ To introduce the methods of optimization techniques.
❖ To understand the theory of optimization techniques for solving various types of optimization problems.
❖ To provide with basic skills and knowledge of optimization techniques and their applications.
❖ To make the students familiar in solving techniques, analyzing the results and propose recommendations to the decision-making processes.

UNIT I : Integer linear programming:

Introduction – Illustrative applications integer programming solution algorithms: Branch and Bound (B & B) algorithm – zero – One implicit enumeration algorithm – Cutting plane Algorithm. (Sections 9.1, 9.2, 9.3.1, 9.3.2, 9.3.3).

UNIT II : Deterministic dynamic programming:

Introduction – Recursive nature of computations in DP – Forward and backward recursion – Selected DP applications cargo – Loading model – Work force size model – Equipment replacement model – Investment model – Inventory models. (Sections 10.1, 10.2, 10.3, 10.4.1, 10.4.2, 10.4.3, 10.4.4, 10.4.5).

UNIT III : Decision analysis and games:


UNIT IV : Simulation modeling:

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SEMESTER - IV

UNIT V : Nonlinear programming algorithms:
   Unconstrained nonlinear algorithms – Direct search method – Gradient method
   Constrained algorithms: Separable programming – Quadratic programming – Geometric programming –

TEXT BOOK:

BOOKS FOR REFERENCE:

LEARNING OUTCOMES: At the end of the course, students will be able to
   □ Formulate a real-world problem as linear programming and queuing models.
   □ Assess the existence and uniqueness of solutions and derive necessary and sufficient optimality conditions for a given optimization problem.
   □ Understand the mathematical tools that are needed to solve optimization problems.
   □ Identify and develop decision making and inventory models from the verbal description of the real system.
M.Sc. MATHEMATICS SEMESTER - IV
ELECTIVE IV - PRACTICAL - C++ PROGRAMMING LAB

LIST OF PRACTICALS

1. Create two classes DM and DB, which store the value of distances. DM stores distances in meters and centimeters in DB in feet and inches. Write a program that can create the values for the class objects and add object DM with another object DB.

2. Create a class FLOAT that contains on float data member overload all the four arithmetic operators so that operates on the objects of FLOAT.

3. Design a class polar, which describes a part in a plane using polar coordinates radius and angle. A point in polar coordinates is as shown below. Use the overloads +operator to add two objects of polar. Note that we cannot add polar values of two points directly. The requires first the conversion points into rectangular coordinates and finally creating the result into polar coordinates.

   [Where rectangle co-ordinates: x = r*cos(a); y = r* sin(a); Polar co-ordinates: a = atan (x/y)
   r = Sqrt (x*x + y*y)]

4. Create a class MAT of size m*m. Define all possible matrix operations for MAT type objects verify the identity. (A-B)^2+B^2-2*A*B.

5. Area computation using derived class.

6. Define a class for vector containing scalar values. Apply overloading concepts for vector additions, multiplication of a vector by a scalar quantity, replace the values in a position vector.

7. Integrate a function using Simson’s 1/3 rule.

8. Solve the system of equations using Gauss Seidel method.

OBJECTIVE:

The objective of this course is to provide the foundation for numerical methods and statistics.

UNIT I:


UNIT II:


UNIT III:


UNIT IV:

Correlation Coefficient – Rank correlation coefficient of determination – Linear regression – Method of least squares – Fitting of the curve of the form $ax+b$, $ax^2+bx+c$, $ab^x$ and $ax^b$ – Multiple and partial correlation (3-variable only).

UNIT V:


TEXT BOOKS:


BOOKS FOR REFERENCE:
2. Dr.Kandasamy, Numerical Methods, Sultan Chand, New Delhi.

LEARNING OUTCOMES:
➢ After successful completion of the course, the students will be able to apply these concepts to solve algebraic and transcendental equations, system of linear equations, evaluate derivatives and integrals using numerical techniques. Further, students will be able to analyze the given data with the help of the above statistical tools.
M.Sc. MATHEMATICS SEMESTER – II

EXTRA DISCIPLINARY COURSE (EDC) EDC - PAPER II - STATISTICS
(Theorems and proof are not expected)

OBJECTIVE:

The aim of this course is to teach the students about the basics of measuring ideas and calculations methods.

UNIT I:

Collection, classification and tabulation of data, graphical and diagrammatic representation – Bar diagrams, Pie diagram, Histogram, Frequency polygon, frequency curve and Ogives.

UNIT II:

Measures of central tendency – Mean, Median and Mode in series of individual observations, Discrete series, Continuous series (inclusive), More than frequency, Less than frequency, Mid-value and open-end class.

UNIT III:

Measures of dispersion – Range, Quartile deviation, Mean deviation about an average, Standard deviation and co-efficient of variation for individual, discrete and continuous type data.

UNIT IV:

Correlation – Different types of correlation – Positive, Negative, Simple, Partial Multiple, Linear and non-Linear correlation. Methods of correlation – Karl-Pearson’s coefficient of correlation-Spearman’s rank correlations and Concurrent deviation.

UNIT V:

Regression types and method of analysis, Regression line, Regression equations, Deviation taken from arithmetic mean of X and Y, Deviation taken from assumed mean, Partial and multiple regression coefficients – Applications.

TEXT BOOK:

BOOKS FOR REFERENCE:


LEARNING OUTCOMES: After successful completion of the course, students will be able to

- calculate Mean, Median and Mode in series of individual observations.
- find Discrete series, Continuous series.
- calculate the first and the second fundamental forms of surface.
- calculate the Range, Quartile deviation, Mean deviation about an average, Standard deviation and co-efficient of variation for individual, discrete and continuous type data.
M.Sc. MATHEMATICS SEMESTER – II

ADD ON COURSE (AOC) - PAPER I – ADVANCED LATEX

Objectives: The course aims
➢ To create understanding of the LaTeX
➢ To typeset typical mathematical papers using the article style and figure out LaTeX errors, download and use packages, create simple diagrams.
➢ To prepare a short presentation using the beamer class.

Unit – I:  No. of Hours : 12
Introduction and the Structure of a LaTeX Document
Installation of the software LaTeX - Environments and commands - Classes and packages – Errors - Files created - How to use LAEX at CUED - Document Classes - Arara- Counters and Length parameters - Document and page organization – Page breaks, footnotes. Environments , Matrix-like environments . Chapter - 1 and 2 in I & Chapter - 1 in II ; Chapter – 4 in I & Chapter – 5 in II; Chapter -8 (Section 8.3) in III

Unit – II:  No. of Hours : 12
Display and alignment structures
Display and alignment structures for equations Comparison with standard LaTeX - A single equation on one line - A single equation on several lines: no alignment - A Single equation on several lines: with alignment - Equation groups without alignment - Equation groups with simple alignment- Multiple alignments: align and flalign - Display environments as mini-pages- Interrupting displays, Variable symbol commands - Symbols in formulas Chapter – 8 (Section 8.2, 8.5, 8.6 and 8.9) in III

Unit – III:  No. of Hours : 12
Figures Directly in LaTeX
Inserting Images, Positioning Images, List of Figures, Drawing diagrams directly in LaTeX, TikZ package, Graphics and PSTricks Pictures and graphics in LaTeX, simple pictures using PSTricks, Plotting of functions.

Unit – IV: Presentations (The beamer Class)  No. of Hours : 12
Overlays -Themes Assignments and Examinations The exam Class - The exsheets Package - The probsoln Package - Using the data tool Package for Exams or Assignment Sheets - Random Numbers. Charts Flow Charts - Pie Charts - The datapie Package - The pgf-pie Package - Bar Charts - The bchart Package - The databar Package - Gantt Charts - Plots . Chapter – 8, 9 and 12 in II

Unit – V: Structuring Your Document  No. of Hours : 12
Author and Title Information, Abstract, Chapters, Sections, Subsections, Creating a Table of Contents, Cross-Referencing, Creating a Bibliography, Page Styles and Page Numbering, Multi-Lingual Support: using the babel package. (5.1-5.7; in V)

Books for Study:
I. Advanced LATEX by Tim Love, 2006,
II. http://www.h.eng.cam.ac.uk/help/documentation/docsource/latex_advanced.pdf


References:
5) A Primer, Latex, Tutorials, Indian TEX users group, Trivandrum, India.www.tug.org.in

Learning Outcomes:
This course will enable the students to:
➢ Create and typeset a LaTeX document
➢ Typeset a mathematical document
➢ Draw pictures in LaTeX
➢ Create beamer presentations
➢ Prepare the projects or dissertations in LaTeX
Objectives: This course aims
➢ To introduce to students Python programming.
➢ To learn python coding to implement algorithms for Mathematical problems.

Unit-1 Introduction to Python

Basic syntax, variable types, basic operators, numbers, strings, lists, tuples, functions and input/output statements. Some simple programs to understand the relational, conditional and logical operators. Compare two numbers (less than, greater than) using if statement. Sum of natural numbers using while loop; Finding the factors of a number using for loop; To check the given number is prime or not (use if...else statement); Find the factorial of a number (use if...if...else...); Simple programs to illustrate logical operators (and, or, not).

Unit-2 Matrices, Differential Calculus & Analytical Geometry of Three Dimensions

Python commands to reduce given matrix to echelon form and normal form with examples. Python program/command to establish the consistency or otherwise and solving system of linear equations. Python command to find the nth derivatives. Python program to find nth derivative with and without Leibnitz rule. Obtaining partial derivative of some standard functions Verification of Euler’s theorem, its extension and Jacobian. Python program for reduction formula with or without limits. Python program to find equation and plot sphere, cone, cylinder.

Unit-3 Roots of High-Degree Equations- Systems of Linear Equations

Unit-4 Numerical differentiation, Integration and Ordinary Differential Equations

Unit-5 Two-Point Boundary Value Problems

Text Books:
1. www.python.org
2. www.rosettacode.org
Reference Books:

Learning outcomes:
This course enable the students to
➢ Get solution to their various mathematical problems quickly through Phyton programming.
➢ Implement the skill to find out the solution to dynamical systems given as differential equations.
➢ Do computational Mathematics easily.
M.Sc. MATHEMATICS SEMESTER – II
ADD ON COURSE (AOC) - PAPER III
ARTIFICIAL INTELLIGENCE

Course Objectives: The course aims to
1. Describe the role of Mathematics and Statistics in Machine Learning
2. Introduce the associated frameworks in large scale computation

Unit - I
No. of Hours : 12
When Models Meet Data- Data, Models, and Learning - Empirical Risk Minimization - Parameter Estimation - Probabilistic Modeling and Inference - Directed Graphical Models – Model selection
Chapter-8-sec: 8.1 to 8.6 (Page No: 251 - 283)

Unit - II
No. of Hours : 12
Linear Regression - Problem Formulation - Parameter Estimation - Bayesian Linear Regression - Maximum Likelihood as Orthogonal Projection
Chapter-9-sec: 9.1 to 9.4 (Page No: 289 - 315)

Unit - III
No. of Hours : 12
Dimensionality Reduction with Principal Component Analysis - Problem Setting - Maximum Variance Perspective - Projection Perspective - Eigenvector Computation and Low-Rank Approximations - PCA in High Dimensions - Key Steps of PCA in Practice - Latent Variable Perspective
Chapter-10-sec: 10.1 to 10.7 (Page No: 317 - 342)

Unit - IV
No. of Hours : 12
Density Estimation with Gaussian Mixture Models- Gaussian Mixture Models - Parameter Learning via Maximum Likelihood - EM Algorithm - Latent-Variable Perspective
Chapter-11-sec: 11.1 to 11.4 (Page No: 348 - 367)

Unit - V
No. of Hours : 12
Chapter-12-sec: 12.1 to 12.5 (Page No: 370 - 392)

Text Book:

Course Outcomes: This course enable the students to

➢ understand the role of Mathematics and Statistics in Machine Learning
➢ understand the associated frameworks in large scale computation