Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar

(Autonomous)

(Affiliated to Savitribai Phule Pune University, Pune)

Choice Based Credit System (CBCS)

Master of Science (M. Sc. - I)

Syllabus of

M. Sc. -I Mathematics

Implemented from

Academic year 2021 -22

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar (Autonomous)

Board of studies in Mathematics

Sr. No.	Name	Affiliation	Designation
1.	Dr. S. B. Gaikwad	Associate Professor, N.A.C.& Sc. College, Ahmednagar	Chairman
2.	Dr. S. V. Ingale	Assistant Professor, N.A.C.& Sc. College, Ahmednagar	Member
3.	Mr. S. A. Tarate	Assistant Professor N.A.C.& Sc. College, Ahmednagar	Member
4.	Dr. N. S. Darkunde	Assistant Professor School of Mathematical Sciences, Swami Ramanand Teerth Marathwada University, Nanded-43160 Hrs6	Member, Nominated by Academic council
5.	Dr. S. B. Bhalekar	Associate Professor, School of Mathematics and Statistics, University of Hyderabad, Central University Campus, Hyderabad- 500046	Member, Nominated by Academic council
6.	Dr. G. S. Kadu	Assistant Professor, Department of Mathematics, Savitribai Phule Pune University, Pune	Member, Nominated by Hon. Vice Chancellor, SPPU, Pune
7.	Mr. P. L. Pawar	Junior College Teacher, Ahmednagar College, Ahmednagar	Member, Alumina Nominated by Hon. Principal
8.	Mr. Shirish Padalkar	Principal Engineer, Medly Software System, LLP, Pune	Member, Industry/ Corporate Nominatedby Hon. Principal
9.	Dr. A. A. Kulkarni	Assistant Professor, Department of Statistics N.A.C.& Sc. College, Ahmednagar	Member (Coopted)
10.	Dr. A. V. Mancharkar	Professor and HOD Department of Physics N.A.C.& Sc. College, Ahmednagar	Member (Coopted)

1. Prologue/ Introduction of the program:

New Arts, Commerce and Science College has introduced to the syllabi of various faculties from June, 2021. Taking into consideration the rapid changes in science and technology and new approaches in different areas of mathematics and related subjects, Board of studies in Mathematics after a thorough discussion with the teachers of Mathematics from different colleges, Universities likes SPPU, SRTMU and Hyderabad University. Department of Mathematics, New Arts, Commerce and Science College, Ahmednagar has prepared the syllabus of M.Sc. Semester - I and Semester- II (w.e.f. 2021-22) Mathematics course under the Choice Based Credit System (CBCS). The model curriculum as developed by U. G. C. is used as a guideline for the present syllabus.

Rules and regulation

1. The M. Sc. Mathematics Program is for 2 academic years and 4 semesters. The minimum total number of credits requirements for each program is 88 credits and 12 additional credits for grades.
2. The M.Sc. The degree will be awarded to the students who complete a total of 88 credits in a minimum of two years by completing an average of 22 credits per semester and 12 additional grade-based credits
3. Each theory credit is equivalent to 15 clock hour of teaching and each practical credit is equivalent to 30 clock Lectures of teaching in a semester.
4. Semester GPA will be calculated based on 22 credits and Final CGPA will be calculated on the basis of 88 credits of all the four semesters.
5. The duration of each theory semester is 15-18 weeks in which at least 12-week classroom teaching and 03 weeks of continuous internal assessment is must.

6. The duration of each practical semester is 15 to 18 weeks in which at least 14-week laboratory session and one week of internal evaluation including viva and journal certification is must.
7. The student can complete the two-year degree program in maximum four years by completing less number of credits in each semester. This rule is not applicable to practical courses, as student need to opt practical courses in the two years of degree program.
8. Discipline Specific Core Courses (DSCC) are compulsory in nature.
9. Students are allowed to opt the Discipline specific elective and project credits from another department then where he/she is registered for M.Sc. Students are also allowed to take all the courses/credits from parent department.

It is believed that the proposed syllabus as part of the credit-based system will bring a qualitative change in the way M.Sc. Mathematics is taught, which will offer a more enriched learning experience. It aims to provide technology-oriented students with the knowledge and ability to develop creative solutions, and better understand the effects of future developments of Mathematical Sciences and technology on people and society. The syllabus is about developing skills to learn new technology, grasping the concepts and issues behind its use and the use of Mathematical Software.

This course includes courses Linear algebra, Real analysis, Group theory, Advanced calculus, Ordinary differential equations, Latex practical's, Complex analysis, General topology, Ring theory, Numerical analysis, Partial differential equations, Mathematical practical's. Vectors spaces, Linear transformations, Matrices, Determinants, Inner product are part of Linear algebra. Real-world applications of linear algebra include ranking in search engines, decision tree induction, testing

software code in software engineering, graphics, facial recognition, prediction. Theoretical as well as Hands on approach to mathematical software Mathematica and Latex. General topology includes basis, sub basis, open sets, interior and closure of a set, connectedness, compactness. It generalizes the concept of continuity to define topological spaces, in which limits of sequences can be considered. Sometimes distances can be defined in these spaces, in which case they are called metric spaces; sometimes no concept of distance makes sense.

Advanced Calculus refers to the applied side of the subject. This involves work around computing derivatives and integrals, evaluating series of sums and convergence, and so on. In advanced calculus students learn how to compute gradients and integrals in more than one dimension. Group theory studies algebraic objects called groups, which can be used to model and thus study the symmetries of a certain object. One of the very important applications of group theory is its application to geometry. Numerical analysis investigates and provides accurate solutions to real-life problems from the field of science, engineering, biology, astrophysics and finance. Partial differential equations are used to mathematically formulate, and thus aid the solution of, physical and other problems involving functions of several variables, such as the propagation of heat or sound, fluid flow, elasticity, electrostatics, electrodynamics, etc.

Eligibility:

A Bachelor Degree in Mathematical Science with minimum 50% marks or equivalent for student belonging to Unreserved Category and minimum 45% or equivalent for students belonging to the Reserved Category.

Admission:

Admissions will be offered as per the selection procedure / policies adopted by the college, in accordance with conditions laid down by the Savitribai Phule Pune University. Reservation and relaxation will be as per the government rules.

External Students: There shall be no external students.

2. Programme outcomes (Pos)

Students enrolled in the program complete a curriculum that exposes and trains students in afull range of essential skills and abilities. They will have the opportunity to master the following objectives.

1. To take care of fast development in the knowledge of mathematics.
2. To create and aptitude for Mathematics in those students who show a promise for higher studies and creative work in Mathematics.
3. To create confidence in others, for equipping themselves with that part of Mathematics which is needed for various branches of Sciences or Humanities in which they have aptitude for higher studies and original work.
4. To enhance the quality and standards of Mathematics Education.
5. To provide a broad common frame work, for exchange, mobility and free dialogue across the Indian Mathematical and associated community.

I. Programme Structure and Course Titles

Sr. No.	Class	Semester	CourseCode	Course Title	Credits
1.	M. Sc.	I	MSC-MT 111 T	Linear Algebra	04
2.	M. Sc.	I	MSC-MT 112 T	Real Analysis	04
3.	M. Sc.	I	MSC-MT 113 T	Group Theory	04
4.	M. Sc.	I	MSC-MT 114 T (A)	Advanced Calculus	04
5.	M. Sc.	I	MSC-MT 114 T (B)	Combinatorics	04
6.	M. Sc.	I	MSC-MT 115 T (A)	Ordinary Differential equations	04
7.	M. Sc.	I	MSC-MT 115 T (B)	Theory of Wavelets	04
8.	M. Sc.	I	MSC-MT 116 P	Practical: Advance LaTeX	02
9.	M. Sc.	II	MSC-MT 211 T	Complex Analysis	04
10.	M. Sc.	II	MSC-MT 212 T	General Topology	04
11.	M. Sc.	II	MSC-MT 213 T	Ring Theory	04
12.	M. Sc.	II	MSC-MT 214 T (A)	Numerical Analysis	04
13.	M. Sc.	II	MSC-MT 214 T (B)	Operations Research	04
14.	M. Sc.	II	MSC-MT 215 T (A)	Partial Differential Equations	04
15.	M. Sc.	II	MSC-MT 215 T (B)	Graph Theory	04
16.	M. Sc.	II	MSC-MT 216 T	Probability and Statistical Techniques	02

Semester -I	**Paper -I**
Course Code: MSC-MT 111 T	**Title of the Course: Linear Algebra**
Credits: 4	**Total Lectures: 60 Hrs.**

Course Outcomes(Cos):

1. Find basis & dimension of vector space
2. Find matrix of linear transformation
3. Reduce matrix to triangular form & Jordan canonical form
4. Find matrix of bilinear form.

Details of Syllabus:

Unit I: Vector Spaces [14 Lectures]

1.1 Definition & examples

1.2 Subspaces

1.3 Basis & Dimension

1.4 Row equivalence of matrices

1.5 Systems of linear equations

1.6 Systems of homogeneous equations

Unit II: Linear Transformation & Matrices [9 Lectures]

2.1 Linear Transformations

2.2 Addition & Multiplication of Matrices

2.3 Linear transformation & matrices

Unit III: Vector Spaces with an Inner Product [12 Lectures]

3.1 The concept of symmetry

3.2 Inner products

Unit IV: Determinants [6 Lectures]

4.1 Definition & examples

4.2 Existence & uniqueness of determinants

4.3 The multiplication theorem for determinants

4.4 Further properties of determinants

Unit V: The Theory of a Single Linear Transformation [13 Lectures]

5.1 Basic Properties

5.2 Invariant subspaces

5.3 The Triangular Form Theorem

5.4 The Rational & Jordan Canonical Form

Unit VI: Dual Vector Spaces [6 Lectures]

6.1 Quotient Spaces

6.2 Dual Vector Spaces

6.3 Bilinear Forms

Suggested Readings:

1. Charles W Curtis : Linear Algebra an Introductory Approach, Springer, 1963
   Unit:I: Chapter 2 : section 3,4,5,7,8,9 .
   Unit II: Chapter 3 : section 11[except theorem11.7, definition11.8,11.7, definition 11.10, theorem 11.11,Theorem 11.12], 12,13.
   Unit III: Chapter 4: section14,15.
   Unit IV: Chapter 5: section 16, 17, 18, 19.
   Unit V: Chapter 7: section 22, 23, 24, 25.
   Unit VI: Chapter 8: section 26, 27.
2. K .Hoffman, Ray Kunze - Linear Algebra, 2nd Ed, Prentice Hall Of India Private Ltd, 2000
3. P. B . Bhattacharya , S.R. Nagpaul , S.K. Jain – First course In Linear Algebra , Second Edition ,New Age International Publishers, 1983
4. S . Kumarsean – Linear Algebra a Geometric Approach, PHI Learning Private Ltd, 2000
5. Sahai, V. Bist , Linear Algebra , Second Edition, Narosa Publication Reprint 2019

e-resources:

1. https://libguides.ntu.edu.sg/linear-algebra/eresources
2. http://freebookcentre.net/Mathematics/Linear-Algebra-Books.html

Semester -I	**Paper -II**
Course Code: MSC-MT 112 T	**Title of the Course: Real Analysis**
Credits: 4	**Total Lectures: 60 Hrs.**

Course Outcomes(Cos):

1. Develop skills and to acquire knowledge on basic concepts of Lebesgue Measure.
2. Learn the Lebesgue Integral, Measurable Functions, Convergence and completeness.
3. Understand the concept of measure and properties of Lebesgue measure.
4. Learn the properties of Lebesgue integral and compare it with Riemann integral

Details of Syllabus:

Unit-I. Lebesgue Measure: [20 Lectures]

1.1 Lebesgue Outer Measure

1.2 σ- algebra of Lebesgue Measurable Sets

1.3 Outer and Inner Approximation of Lebesgue Measurable Sets

1.4 Countable Additivity

1.5 Continuity

1.6 Borel-Cantelli Lemma

1.7 Non-measurable Set, Cantor Set, Cantor-Lebesgue Function.

Unit-II. Lebesgue Measurable Functions: [18 Lectures]

2.1 Definition and algebra of Lebesgue Measurable Functions

2.2 Sequential Point wise Limits and Approximations by SimpleFunctions

2.3 Littlewood's Three Principles

2.4 Egoroff's Theorem

2.5 Lusin's Theorem.

Unit-III. Differentiation: [12 Lectures]

3.1 Continuity of Monotone Functions

3.2 Lebesgue's Differentiation Theorem

3.3 Functions of Bounded Variation

3.4 Jordan's Theorem,

3.5 Absolutely Continuous Functions

Unit-IV. Integration [10 Lectures]

4.1 Integration of Derivatives

4.2 Differentiation of Indefinite Integral

4.3 Fundamental Theorem of Calculus.

Suggested Readings:

1. H. L. Royden, Patrick Fitzpatrick, Real Analysis, Fourth Edition, Prentice Hall, 2010

   Unit- I: Chapter 2 - sections 2.1 to 2.7,

   Unit- II Chapter 3 - sections 3.1 to 3.3,

   Unit- III Chapter 6 - sections 6.1 to 6.3.

   Unit IV- Chapter 6 - sections 6.4 to 6.5.

2. Elias M. Stein, Rami Shakarchi, Real Analysis, Princeton University Press, 2005
3. Anthony W. Knapp, Basic Real Analysis, Springer Science & Business Media, 2005
4. Karen Saxe: Beginning Functional Analysis (Springer International Edition), 2001

e-resources:

1. https://realnotcomplex.com/analysis/real-analysis
2. https://mathcs.org/analysis/reals/

Semester -I	**Paper -III**
Course Code: MSC-MT 113 T	**Title of the Course: Group Theory**
Credits: 4	**Total Lectures: 60 Hrs.**

Course Outcomes(Cos):

1. Recognize the mathematical objects that are groups, and classify them as abelian, cyclic and permutation groups, etc;
2. Analyze consequences of Lagrange's theorem
3. Learn about structure preserving maps between groups and their consequences.
4. The significance of the notion of cosets, normal subgroups, and factor groups.
5. Use of Group Theory in solving problems of different of Mathematics such as Algebraic topology, how Group Theory explains symmetry and hence have application in Physics, chemistry and other subjects

Details of Syllabus:

Unit-I: Groups, Subgroups and Cyclic Groups [12 Lectures]

1.1 Definition and Examples of Groups; Properties of Groups; Order of a finite group; Order of an element in group; Subgroups; Subgroup Tests.

1.2 Cyclic Groups; Properties of Cyclic Groups; Classification of Subgroups of Cyclic Groups.

Unit-II: Permutation Groups- Isomorphism [12 Lectures]

2.1 Permutations Groups; Definition and notation; Cycles; Properties of Permutations; Even and odd permutations; Alternating Group of degree n.

2.2 Isomorphism of Group; Properties of Isomorphisms; Cayley's Theorem; Automorphisms.

Unit-III: Cosets, Lagrange's Theorem, External Direct Product [12 Lectures]

3.1 Cosets; Lagrange's Theorem and consequences; Stabilizer and orbit; Orbit stabilizer theorem.

3.2 External Direct Products; Properties of External Direct Products; Group of units modulo n as an external direct product.

Unit-IV: Normal Subgroups, Homomorphism's [12 Lectures]

4.1 Normal Subgroups; Factor Groups; Application of Factor Groups; Internal Direct Products.

4.2 Group Homomorphisms; Definition and examples; Properties of Homomorphisms; First Isomorphism Theorem

Unit-V: Sylow Theorems [12 Lectures]

5.1 Fundamental Theorem of Finite Abelian Groups; Isomorphism Classes of Abelian Groups; Proof of the Fundamental Theorem.

5.2 Conjugacy Classes; Class Equation; The Sylow Theorems; Applications of Sylow's Theorems.

5.3 Finite simple groups

Suggested Readings:

1. Joseph Gallian, Contemporary Abstract Algebra, 8th Edition, Cengage Learning India Pvt. Ltd. ISBN-10 9353502527

   Unit I- Chapters 2, 3, 4,

   Unit II- Chapter 5(except last article: A check Digit Scheme based on D5). Chapters 6

   Unit III- Chapter 7 (except: Rotations of a cube and Soccer Ball and subsequent Article).Chapter 8 (except: Applications).

   Unit IV-Chapters 9, 10.

   Unit V- Chapters 11,24,25.

2. M. Artin, Algebra, Prentice Hall, 2011
3. N. S. Gopalkrishnan, University Algebra, Wiley Eastern Ltd, 1986
4. J. B. Fraleigh, A First Course in Abstract Algebra, 7th Edition, Pearson Edition Ltd, 2002
5. S. Luthar, I. B. S. Passi, Algebra (Vol 1), Groups; Narosa Publication House, 2009
6. N. Herstein, Topics in Algebra, Wiley Eastern Ltd, 2nd Edition, 1975

e-resources :

1. https://www.tutorialspoint.com/discrete_mathematics/discrete_mathematics_group_theory.htm
2. https://realnotcomplex.com/algebra/group-theory
3. https://global.oup.com/uk/orc/chemistry/qchem2e/student/tables/

Semester -I	**Paper -IV**
Course Code: MSC-MT 114 T (A)	**Title of the Course: Advanced Calculus**
Credits: 4	**Total Lectures: 60 Hrs.**

Course Outcomes(Cos):

1. To apply basic concepts of calculus to solve Problems in Physics and other areas.
2. To understand conceptual variations while advancing from one variable to several variable in calculus.
3. Inter-relationship amongst the line integral, double and triple integral formulation.
4. Realize importance of Greens, Gauss and Stokes' theorem in other branches of mathematics.

Details of Syllabus:

Unit-I: Differential Calculus of Scalar and Vector Fields [20 Lectures]

1.1 Functions from Rn to Rm . Scalar and vector fields; Limits and continuity.

2.1 The derivative of a scalar field with respect to a vector; Directional derivatives and partial derivatives; Partial derivatives of higher order; Inverse function theorem and Implicit Function theorem. (Without proof)

3.1 Directional derivatives and continuity; The total derivatives; The gradient of a scalar field; A sufficient condition for differentiability.

4.1 A chain rule for derivatives of scalar fields; Applications to geometry. Level sets. Tangent planes; Derivatives of vector fields; Differentiability implies continuity; The chain rule for derivatives of vector fields; Matrix form of the chain rule.

Unit-II: Line Integrals [10 Lectures]

2.1 Paths and line integrals; Other notations for line integrals; Basic properties of line integrals.

2.2 The concept of work as a line integral; Line integrals with respect to arc length; Further applications of line integrals.

2.3 Open connected sets. Independence of the path; The first and second fundamental theorem of calculus for line integrals; Necessary and sufficient conditions for a vector field to be a gradient; Necessary conditions for a vector field to be a gradient.

Unit-III: Multiple Integrals [15 Lectures]

3.1 Partitions of rectangles. Step functions; The double integral of a step function; The

definition of the double integral of a function defined and bounded on a rectangle; Upper and lower double integrals; Evaluation of double integral by repeated one-dimensional integration; Geometric interpretation of the double integral as a volume; Worked examples.

3.2 Integrability of continuous functions; Integrability of bounded functions with discontinuities; Double integrals extended over more general regions; Applications to area and volume; Worked examples.

3.3 Green's theorem in the plane; Some applications of green's theorem; A necessary and sufficient condition for a two-dimensional vector field to be a gradienof variables in a double integral; Special cases of the transformation formula with proof; General case of the transformation formula with proof; Extensions to higher dimensions; Change of variables in an n-fold integral; Worked examples.

Unit-IV: Surface Integrals [15 Lectures]

4.1 Parametric representation of a surface; The fundamental vector product; The fundamental vector product as a normal to the surface; Area of a parametric surface.

4.2 Surface integrals; Change of parametric representation; Other notations for surface integrals

4.3 The theorem of Stokes; Curl and divergence of a vector field; Properties of curl and divergence; the divergence theorem (Gauss' theorem) and applications of divergence theorem.

Suggested Readings

1. Tom M. Apostol, Calculus Volume II (Second Edition) Indian Reprint 2016 (John Wiley & Sons, Inc) ISBN:978-81-265-1520-2.
   Unit I: Chapter 8: 8.1 to 8.22.;
   Unit II: Chapter 10 : 10.1 to 10.11, 10.14 to 10.16.
   Unit III: Chapter 11: 11.1 to 11.15; 11.19 to 11.22, 11.26 to 11.34.;
   Unit IV: Chapter 12: 12.1 to 12.15, 12.19 and 12.21.
2. For "Inverse Function Theorem" and "Implicit Function Theorem", use Tom M. Apostol, Mathematical Analysis 2nd Edition Narosa Publication 20th Reprint 2002. ISBN 978-81-85015-66-8.
3. Gerald B. Folland, Advanced Calculus, Pearson Edn 2012. 2) A Devinatz, Advanced Calculus (Holt, Reinhart & Winston) 1968.

e-resources :

1. https://calculusresources.weebly.com/
2. https://algebra-and-calculus-resources-year12.weebly.com

Semester -I	**Paper -IV**
Course Code: MSC-MT 114 T (B)	**Title of the Course: Combinatorics**
Credits: 4	**Total Lectures: 60 Hrs.**

Course Outcomes (Cos):

1. Students are enable to solve the problems logically.
2. Students are enable with standard algebraic manipulations on generating functions, one can solve complicated counting problems.
3. Learn about the methods for solving recurrence relations appeared originally in the development of the theory of difference equations.
4. To understand how to apply Inclusion- Exclusion Formula to Various Counting Problems.

Details of Syllabus:

Unit 1: General Counting Methods [18 hours]

1.1 Counting principles,

1.2 Arrangements and selections,

1.3 Arrangements and selection with repetition,

1.4 Distributions,

1.5 Binomial identities

Unit 2: Generating Functions [15 Hours]

2.1 Generating function models,

2.2 Calculating coefficients of generating functions

2.3 Partition

2.4 Exponential generating functions

2.5 A summation method.

Unit 3: Recurrence Relations [15 Hours]

3.1 Recurrence relation models

3.2 Divide and conquer relations

3.3 Solution of linear recurrence relation

3.4 Solution of inhomogeneous recurrence relation

3.5 Solution with generating functions.

Unit 4: Inclusion-Exclusion [12 Hours]

4.1 Counting with Venn diagrams

4.2 Inclusion — exclusion formula

4.3 Restricted positions and Rook polynomials.

Suggested Readings:

1. Alan Tucker, Applied Combinatorics (sixth edition), John Wiley & sons, New York (1995)
   Unit 1: Chapter 5: 5.1-5.5,
   Unit 2: Chapter 6: 6.1-6.5,
   Unit 3: Chapter 7: 7.1-7.5,
   Unit 4: Chapter 8: 8.1-8.3.
2. l.V. Krishnamurthy, Combinatorial, Theory and Applications, East West Press, New Delhi (1989) Scientific, (1996)
3. K.D. Joshi: Foundations of discrete mathematics, Wiley
4. Marshall Hall: Combinatorial theory, Wiley.

e-resources

1. https://www.gatevidyalay.com/tag/recurrence-relations-calculator/
2. https://www.calculatorsoup.com/calculators/discretemathematics/combinations.php

Semester -I	**Paper -V**
Course Code: MSC-MT 115 T (A)	**Title of the Course: Ordinary Differential Equations**
Credits: 4	**Total Lectures: 60 Hrs.**

Course Outcomes (Cos):

1. Find general solutions of homogeneous and non-homogeneous differential equations
2. Find solutions of differential equations using power series
3. Find solutions using different methods
4. Understand applications of ODE in all sciences

Details of Syllabus:

Unit 1: Linear equations of the first order [06 Lectures]

1.1 Linear equations of the first order

2.1 The equation y'+ay=0

3.1 The equation y'+ay=b(x)

4.1 The general linear equations of first order

Unit 2: Second order linear equations [14 Lectures]

2.1 The general solution of the homogeneous equations

2.2 Use of a known solution to find another solution

2.3 Homogeneous equations with constant coefficients

2.4 The method of undetermined coefficient

2.5 The method of variation of parameters.

Unit 3: Power Series solutions [14 Lectures]

3.1 Review of power series

3.2 Series solutions of first order equations

3.3 Second order linear equations

3.4 Ordinary points, Regular singular points

3.5 Indicial equations

3.6 Gauss's Hypergeometric equation, The point at infinity.

Unit 4: Non-linear equations [12 Lectures]

4.1 Autonomous systems

4.2 Critical points, Stability

4.3 Liapunov's direct method

4.4 Nonlinear mechanics

4.5 Conservative systems.

Unit 5: Existence and uniqueness of solutions to first order equations [14 Lectures]

5.1 Equations with variables separated

5.2 Exact equations

5.3 Method of successive approximations

5.4 Lipschitz condition

5.5 Approximation to, and uniqueness of, solutions

Suggested Readings:

1. G.F. Simmons: Differential equations with applications and Historical Notes second edition (Mc-Graw Hill), 1991
   Unit I: 1.4 -1.7
   Unit II: 5.1 -5.8Unit II: Chapter 3- Section 15 to section 19
   Unit III: Chapter 5- Section 26 to section 32
   Unit IV: Chapter 11- Section 58 to section 63
2. A. Coddington, An introduction to Ordinary Differential Equations (Prentice- Hall), 1961
3. G. Birkhoff and G.C. Rota: Ordinary differential equations. (John Wiley and Sons) Fourth Edition, 1989
4. S. G. Deo, V. Lakshmikantham, V. Raghvendra. Text book of ordinary Differential Equations. Second edition. Tata Mc-Graw Hill, 2015.

e-resources :

1. https://www.math.tamu.edu/~don.allen/ODE_resources.html
2. https://ximera.osu.edu/ode

Semester -I	**Paper -V**
Course Code: MSC-MT 115 T (B)	**Title of the Course: Theory of Wavelets**
Credits: 4	**Total Lectures: 60 Hrs.**

Course Outcomes (Cos):

1. Know basic concepts of signals and systems.
2. Learn Fourier transform and wavelets transform of digital signals
3. Learn applications of wavelets to the real –world problems.
4. Apply wavelets in signal processing and image processing

Details of Syllabus:

Unit I Background Complex Numbers and Linear Algebra [20 Hours]

1.1 Real Numbers and Complex Numbers,

1.2 Complex Series, Euler's Formula, and the Roots of Unity.

1.3 Vector Spaces and Bases

1.4 Linear Transformations, Matrices, and Change of Basis

1.5 Diagonalization of Linear Transformations and Matrices

1.6 Inner Products, Orthonormal Bases, and Unitary Matrices

Unit II The Discrete Fourier Transform

2.1 Basic Properties of the Discrete Fourier Transform.

2.2 Translation-Invariant Linear Transformations

2.3 The Fast Fourier Transform

Unit III: Wavelets on Z N [15 Hours]

3.1 Wavelets on ZN the First Stage.

3.2 Construction of Wavelets on Z_N : The Iteration Step,

3.3 Examples and Applications - Shamon, Daubiehie and Haar

Unit IV: Wavelets On Z [25 Hours]

4.1 L^2 (Z),

4.2 Complete Orthonormal sets in Hilbert Space,

4.3 L^2 ([-π,π))[-π,π] and Fourier Series.

4.4 Fourier Transforms and convolution on l^2 (Z),

4.5 First -Stage Wavelet on Z.

4.6 The iteration step for wavelets on Z

4.7 Examples Shamon Haar and Daubiehie

Suggested Readings:

1. Michael Frazier, An Introduction to Wavelets through Linear Algebra, Springer

Unit I: Chapter 1

Unit II: Chapter 2

Unit III: Chapter 3

Unit IV: Chapter 4

2. Mayor (1993), Wavelets and Operators, Cambridge University Press
3. Chui. C(1992), An Introduction to Wavelets, Academic Press, Boston

e-resources

1. https://cnx.org/contents/EQurkhlI@6.9:6ZtSGUDP@3/Calculation-of-the-Discrete-Wavelet-Transform
2. https://www.unf.edu/~ddreibel/camp/wave8.html

Semester -I	**Paper -VI**
Course Code: MSC-MT 116 P	**Title of the Course: Practical: Advanced LaTeX**
Credits: 2	**Total Lectures: 60 Hrs.**

Course Outcomes (Cos):

1. To understanding of the LaTeX- document typesetting software.
2. To Preparing the Research article, books, Thesis, presentation in beamer, letters and notes.
3. To inserting the minimal effort method of including Mathematical symbols, equations, graphics, tables and code in your documents.
4. To understand matrix operations.

Details of Syllabus:

Unit I [10 Lectures]

1.1 Introduction to MikTex
1.2 Installation -MikTex and Editor (TexStudio, Texmaker)

1.3 Preparing an input file
1.4 Sentences and paragraphs
1.5 Quotation marks
1.6 Special symbols
1.7 Emphasizing text
1.8 Preventing line breaks
1.9 Footnotes.

Unit II [10 Lectures]

2.1 Document class
2.2 Page style
2.3 Page numbering
2.4 Creating lists
2.5 Formatting lengths
2.6 Parts of the document
2.7 Title
2.8 Abstract
2.9 Dividing the document.

Unit III [20 Lectures]

3.1 Rows and columns
3.2 Keeping tabs
3.3 Pushing and poping
3.4 Simple tables
3.5 Superscripts and subscripts
3.6 Roots

3.7 Mathematical symbols
3.8 Fraction
3.9 Single equations
3.10 Numbered equations
3.11 Matrices.
3.12 Group of equations
3.13 The array environment
3.14 Typesetting theorems
3.15 Theorems in LATEX
3.16 The 'amsmath' package

Unit IV

[20 Lectures]

4.1 The picture environment
4.2 Boxes
4.3 Straight lines, Arrows, Circles, Ovals and rounded corners
4.4 Framing curves
4.5 Grids
4.6 Color
4.7 Preparing research articles
4.8 Books
4.9 Thesis
4.10 Preparing slides using beamer
4.11 Inserting pictures
4.12 Letters, Certificates and notes.

Suggested Readings:

1. LATEX Tutorials A Premier, Indian TEX users group, Tirvandram, India, 2003, September,
2. LATEX- A document preparation system - User's guide and reference manual, Second edition, Leslie Lamport, Published by Dorling Kindersely (India) Pvt. Ltd., licensees of Pearson Education in South Asia

e-resources:

1. https://miktex.org/docs
2. https://www.latex-project.org/help/documentation/
3. https://www.dickimaw-books.com/latex/

Semester -II	**Paper -I**
Course Code: MSC-MT 211 T	**Title of the Course: Complex Analysis**
Credits: 4	**Total Lectures: 60 Hrs.**

Course Outcomes (Cos):

1. Visualize Complex numbers as a points of R2 , stereographic projection of complex plane on the Riemann sphere
2. Understand the significance of differentiability and analyticity of complex function leading to the Cauchy's-Riemann equations
3. Apply Lowville's theorem in fundamental theorem of algebra
4. Learn Taylor's and Laurent series expansions of analytic functions, classify the nature of Singularities

Details of Syllabus:

Unit I : The Extended Plane & its Spherical Representation [8 Lectures]

1.1 Introduction to complex number

1.2 Extended plane & it's spherical representation

1.3 Stereographic projection

Unit II: Analytic Functions [15 Lectures]

2.1 Elementary properties

2.2 Analytic function definition & its Examples

2.3 Power Series

2.4 Harmonic Function & Harmonic Conjugate

2.5 Analytic functions as mapping

2.6 Mobius transformation

Unit III: Complex Integration [24 Lectures]

3.1 Bounded variations & theorems

3.2 Line integral

3.3 Definition & theorem of primitive

3.4 The index of a closed curve

3.5 Lowville's Theorem

3.6 Theorem & integral formula

3.7 The homotopic version of cauchy's theorem & simple connectivity

3.8 Morera's theorem Counting Zero's

3.9 The open mapping theorem,Goursat's theorem

Unit IV: Singularities [9 Lectures]

4.1 Definition & classification of singularities

4.2 Laurent Series

4.3 Casorati -Weierstrass theorem

4.4 Definition of Residues & it's theorem

4.5 The Argument Principle

Unit V : The Maximum Modulus theorem [4 Lectures]

5.1 The maximum principle

5.2 Schwarz's Lemma

Suggested Readings:

1. John B. Conway : Functions of One Complex Variable (Second Edition), 1978

   Unit I: Chapter 1: Section 6,

   Unit II: Chapter 3: Section 1 to 3,

   Unit III: Chapter 4: Section 1 to 8,

   Unit IV: Chapter 5: Section 1 to 3,

   Unit V: Chapter 6: Section 1 & 2

2. J.W. Brown and R. V. Churchill – Complex Variables & Applications (Eighth Edition)
3. L.V. Alfors, Complex Analysis, Mc Graw Hill ,1979
4. S. Ponnusamy – Foundation of Complex Analysis, Narosa Publications (Second Edition)

e-resources:

1. http://www.math.brown.edu/jk17/complex-resources.html
2. https://realnotcomplex.com/analysis/complex-analysis

Semester -II	**Paper -II**
Course Code: MSC-MT 212 T	**Title of the Course: General Topology**
Credits: 4	**Total Lectures: 60 Hrs.**

Course Outcomes (Cos):

1. Demonstrate an understanding of the concepts of metric spaces and topological spaces, and their role in mathematics.
2. Demonstrate familiarity with a range of examples of these structures.
3. Prove basic results about completeness, compactness, connectedness and convergence within these structures.
4. Understand the Tychonoff's Theorem, Tietze Extension Theorem

Details of Syllabus:

Unit I. Prerequisites [10 Lectures]

1.1 Cartesian Products

1.2 Finite Sets

1.3 Countable and Uncountable Sets

1.4 Infinite Sets and Axiom of Choice

1.5 Well Ordered Sets

Unit II. Topological Spaces and Continuous Functions [20 Lectures]

2.1 Topological Spaces

2.2 Basis for a Topology

2.3 Order Topology

2.4 Product Topology on X× Y

2.5 Subspace Topology

2.6 Closed Sets and Limit Points

2.7 Continuous Functions

2.8 The Product Topology, Metric Topology

2.9 Quotient Topology

Unit 3. Connected and Compact Spaces [15 Lectures]

3.1 Connected spaces

3.2 Connected Subspaces of Real Line

3.3 Components and Local Connectedness

3.4 Compact spaces

3.5 Compact Subspaces of the Real Line

3.6 Limit point compactness

3.7 Local Compactness

Unit 4. Countability and Separation Axioms [15 Lectures]

4.1 The Countability Axioms

4.2 The Separation axioms and Normal Spaces

4.3 Urysohn Lemma (State Only)

4.4 The Urysohn Metrization Theorem (State Only)

4.5 Tietze Extension Theorem

4.6 Tychonoff's Theorem.

Suggested Readings:

1. J. R. Munkres, Topology: A First Course, (Prentice Hall, Second Edition), 2000.

   Unit- I Chapter 1 : Sec. 5 to 7, Sec. 9 to 10.
   Unit -II Chapter 2: Sec.12 to 22.
   Unit- III Chapter 3 : Sec. 23 to 29.
   Unit- IV Chapter 4 : Sec. 30 to 35 ; Chapter 5 : Sec. 37.

2. K J¨anich. Topology. Springer, 1984.

3. M A Armstrong. Basic Topology. Springer, 1983.

4. Viro, O Ivanov, V Kharlamov, and N Netsvetaev. Elementary Topology: Problem Textbook, AMS Publication, 2008.

5. K. D. Joshi, Introduction to General Topology, John Wiley & Sons .

e-resources:

1. https://math-atlas.org/index/54-XX.html
2. https://archive.org/details/springer_10.1007-978-3-642-77030-2

Semester -II	**Paper -III**
Course Code: MSC-MT 213 T	**Title of the Course: Ring Theory**
Credits: 4	**Total Lectures: 60 Hrs.**

Course Outcomes (Cos):

1. Learn about basic terminology of Ring and Rings of continuous functions
2. Understand Ideals, Prime ideal and maximal ideals
3. Learn various examples of Homomorphism of rings
4. Understand the factorization domain and Eisenstein's Criterion.

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Details of Syllabus:

Unit I: Rings [20 Lectures]

1.1 Basic Terminologies

1.2 Rings of Continuous functions

1.3 Matrix Rings, Polynomial Rings, Power Series Rings, Laurent Rings, Boolean Rings, Some Special Rings,

1.4 Direct Products

1.5 Several Variables

1.6 Opposite Rings

1.7 Characteristic of a Ring.

Unit II: Ideals [14 Lectures]

2.1 Definitions

2.2 Maximal Ideals

2.3 Generators

2.4 Basic Properties of Ideals

2.5 Algebra of Ideals

2.6 Quotient Rings

2.7 Ideals in Quotient Rings

2.8 Local Rings.

Unit III : Homomorphisms of Rings [12 Lectures]

3.1 Definitions and Basic Properties

3.2 Fundamental theorems

3.3 Endomorphism Rings

3.4 Field of Fractions, Prime fields.

Unit IV : Factorisation Domains [14 Lectures]

4.1 Division in Domains

4.2 Euclidean Domains

4.3 Principal Ideal Domains

4.4 Factorisation Domains

4.5 Unique Factorisation Domains

4.6 Eisenstein's Criterion.

Suggested Readings:

1. C. Musili, Rings and Modules, 2nd Revised Edition, Narosa Publishing House, 1994

   Unit I: Chapter 1,

   Unit II: Chapter 2,

   Unit III: Chapter 3,

   Unit IV: Chapter 4

2. Dummit and Foote, Abstract Algebra, Third edition (Wiley India), 2011
3. Luther and Passi, Algebra II, Narosa Publishing House, 1999
4. Jain and Bhattacharya, Basic Abstract Algebra, 2nd Edition, Cambridge University Press, 1994
5. Joseph Gallian, Contemporary Algebra, 7th Edition, Narosa Publishing House, 2010

e-resources :

1. https://ringtheory.herokuapp.com/
2. https://ringtheory.herokuapp.com/resources/

Semester -II	**Paper -IV**
Course Code: MSC-MT 214 T (A)	**Title of the Course: Numerical Analysis**
Credits: 4	**Total Lectures: 60 Hrs.**

Course Outcomes (Cos):

1. Obtain numerical solution of algebraic and transcendental equations
2. Find the convergence of roots finding methods
3. Find the solution of system of equations by iterative techniques
4. Solve initial value problems in differential equations by using numerical methods
5. Apply various numerical methods in real life problems

Details of Syllabus:

Unit-I: Root Finding Methods [10 Lectures]

1.1 Convergence; Floating Point Number Systems; Floating Point Arithmetic.

1.2 The Bisection Method; The Method of False Position; Fixed Point Interaction Schemes; Newton's Method; Secant Method; Accelerating Convergence.

Unit-II: System of Equations [14 Lectures]

2.1 Gaussian Elimination; Pivoting Strategies.

2.2 Error Estimates and Condition Number; LU decomposition; Direct Factorization.

2.3 Iterative Techniques for Linear Systems: Basic Concepts and Methods.

2.4 Nonlinear Systems of Equations.

Unit-III: Eigenvalues and Eigenvectors [10 Lectures]

3.1 The Power Method.

3.2 The Inverse Power Method.

3.3 Reduction to Symmetric Tridiagonal Form.

3.4 Eigenvalues of Symmetric Tridiagonal Matrices.

Unit-IV: Differentiation and Integration [14 Lectures]

4.1 Numerical Differentiation, Part II.

4.2 Numerical Integration – The Basics and Newton-Cotes Quadrature; Composite Newton Cotes Quadrature.

Unit-V: Initial Value Problems of Ordinary Differential Equations [12 Lectures]

5.1 Euler's Method; Higher-Order One-Step Methods: Taylor Methods.

5.2 Runge-Kutta Methods.

5.3 Multistep Methods.

5.4 Convergence and Stability Analysis.

Suggested Readings:

1. Brian Bradie, A Friendly Introduction to Numerical Analysis, Pearson Prentice Hall 2007, ISBN 978-81-317-0942-9.

   Unit I: Sections: 1.2 – 1.4,

   Unit II: Sections: 2.3 – 2.6,

   Unit III: Sections: 3.1, 3.2, 3.4 -3.6, 3.8, 3.10,

   Unit IV: Sections: 4.1, 4.2, 4.4, 4.5,

   Unit V: Sections: 6.2, 6.4, 6.5, 7.2- 7.6

2. John H. Mathews, Kurtis D. Fink, Numerical Methods Using Matlab, 4th Edition, Pearson Education (Singapore) Pte. Ltd., Indian Branch, Delhi 2005.
3. (SciLab commands similar to MatLab commands can be used for problems)
4. K.E. Atkinson, An Introduction to Numerical Analysis, Second Edition, John Wiley & Sons, 1989.
5. J. L. Buchaman, P. R. Turner, Numerical Methods and Analysis, McGraw Hill, 1992 cop.
6. M.K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical Methods for Scientific & Engineering Computation, 1986
7. Richard L.Burden and J.Dougas Faires, Numerical Analysis, Edition 9th, Cengage Learning, 2010.

E-resources :

1. http://www.scholarpedia.org/article/Numerical_analysis
2. http://mathforcollege.com/nm/mtl/index.html

Semester -II	**Paper -IV**
Course Code: MSC-MT 214 T (B)	**Title of the Course: Operations Research**
Credits: 4	**Total Lectures: 60 Hrs.**

Course Outcomes (Cos):

1. Analyze and solve Network models of real-life situations.
2. The theory of Advanced Linear Programming is developed.
3. To develop linear programming (LP) models for shortest path
4. To solve the problems using special solution algorithms

Details of Syllabus:

Unit I. Network Models [10 Lectures]

1.1 Scope and definition of Network model

2.1 Minimal Spanning tree algorithm

3.1 Shortest Route Problem

4.1 Maximum Flow model

5.1 CPM and PERT

Unit II. Advanced Linear Programming [13 Lectures]

2.1 Simplex Method Fundamentals

2.2 Revised Simplex method

2.3 Bounded Variables Algorithm

2.4 Duality

2.5 Parametric Linear programming

Unit III. Integer Linear Programming [12 Lectures]

3.1 Illustrative Application

3.2 Integer Programming Algorithms

3.3 Traveling Salesperson Problem

Unit IV. Markov Chains [15 Lectures]

4.1 Definition of Markov Chain

4.2 Absolute and n step transition probabilities

4.3 Classification of states

4.4 Steady state probabilities and MRT

4.5 First Passage time

4.6 Analysis of Absorbing States

Unit IV.Nonlinear Programming Algorithms [10 Lectures]

5.1 Unconstrained Algorithms

5.2 Constrained Algorithms

Suggested Readings:

1. Hamdy A. Taha, Operation Research (Eighth Edition, 2009), Prentice Hall of India Pvt. Ltd, New Delhi.

   Unit I. Chapter 6 – 6.1,6.2,6.3,6.4,6.5

   Unit II. Chapter 7– 7.1,7.2,7.3,7.4,7.5

   Unit III. Chapter 9 – 8.1,8.2

   Unit IV. Chapter 17– 17.1,17.2,17.3,17.4,17.5,17.6

   Unit V. Chapter 19 – 19.1,19.2

2. Frederick S. Hillier, Gerald J. Lieberman, Introduction to Operation Research (Eighth Edition) Tata McGraw Hill.
3. J K Sharma, Operations Research (Theory and Applications, second edition, 2006), Macmillan India Ltd.

e-resources:

1. https://www.mathcelebrity.com/markov_chain.php
2. https://cbom.atozmath.com/CBOM/Simplex.aspx?q=01

Semester -II	**Paper -V**
Course Code: MSC-MT 215 T (A)	**Title of the Course: Partial Differential Equations**
Credits: 4	**Total Lectures: 60 Hrs.**

Course Outcomes (Cos):

1. Solve first order and second order partial differential equations
2. Solve Boundary value problems
3. Understand different canonical forms of partial differential equations
4. To understand the solution of one-dimensional wave equations

Details of Syllabus:

Unit I. Introduction To Partial Differential Equations of First Order [14 Lectures]

1.1 Genesis of first order P.D.E.

1.2 Compatible systems

1.3 Charpit's method

1.4 Jacobi's method

1.5 Quasi-linear equations

1.6 Non Linear first order P.D.E

Unit II. Fundamental Concepts [12 Lectures]

2.1 First order partial differential equations

2.2 Classification of Second Order PDE

2.3 Canonical Forms, Canonical Form for Hyperbolic Equation , Canonical Form for Parabolic Equation , Canonical Form for Elliptic Equation

2.4 Linear Partial Differential Equations with constant coefficients, General Method for Finding CF of Reducible Non-homogeneous Linear PDE, General method to Find CF of Irreducible Non-homogeneous Linear PDE

Unit III. Elliptic And Parabolic Differential Equations [20 Lectures]

3.1 Occurrence of the Laplace and Poisson Equations, Derivation of Laplace Equation, Derivation of Poisson Equation

3.2 Boundary Value Problems (BVPs)

3.3 Green's first and second identities

3.4 Dirichlet Problem for a Rectangle

3.5 Occurrence of the Diffusion Equation

3.6 Boundary Conditions

3.7 Elementary solutions of the Diffusion Equation

3.8 Separation of Variables Method (with examples)

Unit IV. Hyperbolic Differential Equations [14 Lectures]

4.1 Occurrence of the Wave Equation

4.2 Derivation of One-dimensional Wave Equation

4.3 Solution of One-dimensional Wave Equation by Canonical Reduction

4.4 Vibrating string- Variable separable solution(examples)

Suggested Readings:

1. An Elementary Course in Partial Differential Equations, T. Amarnath, Narosa Publication, Second Edition, 2009.
   Unit 1: Chapter 1
2. Introduction to Partial Differential Equations, K. Sankara Rao PHI Learning Private Limited, Third Edition, 2010.

   Unit 2: Chapter 1- 1.1 to 1.3(1.3.1, 1.3.2, 1.3.3), 1.6(1.6.1, 1.6.2)

   Unit 3: Chapter 2- 2.1(2.1.1, 2.1.2), 2.2, 2.6, Chapter 3- 3.1, 3.2, 3.3, 3.5

   Unit 4: Chapter 4- 4.1, 4.2, 4.3, 4.5
3. Elements of Partial Differential Equations, Ian Sneddon, Dover Publication 2013
4. An Introduction to Partial Differential Equations, Yehud Pinchor and Jaco Rubinstein, Cambridge University Press, 2018.

e-resources :

https://people.math.harvard.edu/~knill/pedagogy/pde/index.html

Semester -II	**Paper -V**
Course Code: MSC-MT 215 T (B)	**Title of the Course: Graph Theory**
Credits: 4	**Total Lectures: 60 Hrs.**

Course Outcomes (Cos):

1. Learn fundamentals of Graph Theory
2. Able to define the basic concept of Graphs, directed graphs, weighted graphs.
3. Students will be able to apply principles and concepts of graph theory

Unit I: Fundamental Concepts [15 Lectures]

1.1 Graphs

1.2 Matrices and isomorphism decomposition

1.3 connection in Graphs

1.4 bipartite graphs

1.5 Eulerian circuits

1.6 vertex degrees

1.7 Graphic sequences.

Unit II: Trees and Distance [15 Lectures]

2.1 Trees

2.2 Distance in trees and Graphs

2.3 Enumeration of trees Caycley's formula

2.4 Spanning trees in graphs

2.5 minimum spanning trees

2.6 Kruskal's algorithm

2.7 shortest paths Dijkstra's Algorithm.

Unit III: Matchings [15 Lectures]

3.1 Maximum Matchings

3.2 Hall's matching condition

3.3 Min-Max Theorems

3.4 Maximum bipartite Matching

3.5 weighted bipartite matching.

Unit IV: Connectivity and Paths [15 Lectures]

4.1 Connectivity

4.2 edge-connectivity

4.3 blocks

4.4 2-connected graphs

4.5 k-connected and k-edge connected graphs

4.6 Menger's Theorem

4.7 Maximum Network flow

4.8 Max-flow min-cut Theorem.

Suggested reading:

1. West D.B. Introduction to Graph Theory (Second edition), Prentice Hall of India, New Delhi (2009).

   Unit I: Chapters 1, Unit II: Chapters 2, Unit III: Chapters 3.1, 3.2, Unit IV: Chapters 4.
2. R. J. Wilson, Introduction to Graph Theory, (Fourth Edition), Pearson Education, Singapore (2003).

e-resources :

1. https://neo4j.com/blog/top-13-resources-graph-theory-algorithms/
2. https://deeplearning.lipingyang.org/graph-theory-resources/

Semester -II	**Paper -VI**
Course Code: MSC-MT 216 T	**Title of the Course: Probability and Statistical Techniques**
Credits: 2	**Total Lectures: 30 Hrs.**

Course Outcomes (Cos):

1. To define the principal concepts about probability**.**
2. To formulate theorems about the concept of probability.
3. Calculate probabilities using Conditional probability, Rule of total probability and Bayes' theorem.
4. To explain the concept of a random variable and the probability distributions.

Details of Syllabus:

Unit I. Introduction to Discrete Probability [03 Lectures]

1.1 Intuitive concepts: probability of an event as a measure between 0 and 1.

2.1 random variable; probability distribution; frequency interpretation of probability; random numbers; coins, dice, and other games;

Unit II. Formal concepts: [03 Lectures]

2.1 Sample space, outcomes, and events; random variable; discrete distribution functions and axioms of probability; unions, intersections, and complements.

2.2 properties of probabilities, principle of inclusion and exclusion;

Unit II. Conditional Probability: [04 Lectures]

3.1 Intuitive concept of conditional probability;

3.2 formal definition of conditional probability; Bayes' formula for inverting conditional probabilities; independent events; joint distribution functions; independent random variables; independent trials

Unit III Distributions: **[**10 Lectures]

4.1 Uniform continuous distributions.

4.2 Geometric distribution; Poisson distribution; exponential and gamma distributions;Chisquared distribution.

4.3 Introduction to Normal Distribution.

Unit IV. Expected Value and Variance : [10 Lectures]

5.1 Expected value for discrete random variables, expectation; linearity of expectation; expectation of independent random variables; conditional expectation; variance and standard deviation; variance of various distributions.

5.2 Expectation and variance for continuous random variables.

Suggested Readings

1. Charles M. Grinstead and J. Laurie Snell's textbook Introduction to Probability, published by the American Mathematical Society, 1997

   Unit I: Chapter 1 and 2

   Unit II: Chapter 3

   Unit III: Chapter 4

   Unit IV: Chapter 6

2. Agarwal, B. L. (2003). Programmed Statistics, Second Edition, New Age International Publishers, New Delhi.

e-resources:

1. **https://www.calculator.net/probability-calculator.html**
2. **https://homepage.divms.uiowa.edu/~mbognar/applets/normal.html**