

PERIYAR UNIVERSITY

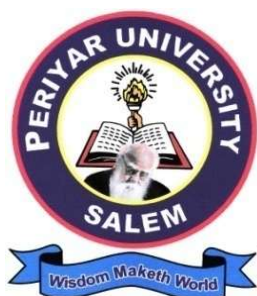
(NAAC 'A++' State University – NIRF Rank 94 – NIRF State Public University 25)

SALEM – 636 011

CENTRE FOR DISTANCE AND ONLINE EDUCATION

(CDOE)

Syllabus



M.Sc. MATHEMATICS

(admitted from January 2026 Onwards)

1.1 ABOUT THE PROGRAMME

This programme is designed with courses included from both pure, and applied mathematics. The curriculum has been designed to meet the current demands of applicable and industrial mathematics with the essence of basic mathematics courses. To make it more aligned with the latest education policy and give diverse opportunities to the students, variety of elective courses have been included.

1.2 SALIENT FEATURES

- (i) In-depth theoretical background and training for pursuing higher studies and research in both pure and applied mathematics.
- (ii) Create a platform for higher studies and research in mathematical computing and interdisciplinary areas.
- (iii) Prepare students to qualify various national and international level competitive examinations.

1.3 AIMS AND OBJECTIVES OF THE PROGRAMME

- i. Sound knowledge in the mathematics discipline that led to excellence in the art of teaching and research.
- ii. Nurtures a prospective student into research and makes them industry-ready.
- iii. Assist our students in securing positions or assignments at national and international institutions/ organizations.

1.4 DURATION OF THE PROGRAMME

The two-year postgraduate programme in Mathematics consists four semesters under Choice Based Credit System (CBCS).

1.5 ELIGIBILITY

Candidates who have passed the B.Sc. Degree Examination in Mathematics and Mathematics with Computer Applications (CA) of this university or an examination of some other university accepted by the syndicate as equivalent are eligible to apply for the M.Sc. Mathematics programme offered by the Centre for Distance and Online Education.

1.6 CURRICULAM HIGHLIGHTS

The curriculum aims to equip students with a comprehensive theoretical foundation in both pure and applied mathematics. In particular, the diverse spectrum of open electives enables a student to develop a career of his/her choice, either in academia or industry. Moreover, a student becomes competent enough to take up challenges in mathematics at the national and international institutions/organizations.

Curriculum has been restructured to suit the present needs with various courses under "**Outcome-Based Education with Problem Based, Project-Based, and Industry-aligned courses**".

1.7 COMMENCEMENT OF THIS REGULATION:

These regulations shall take with effect from the calendar year 2026, that is, for students who are admitted to the first year of the programme from January 2026.

2. REGULATIONS AND LEARNING OUTCOMES

<p>Programme Outcomes (POs)</p>	<p>At the time of graduation, students will be able to</p> <p>PO1 gain knowledge in the fundamental subjects of pure and applied mathematics</p> <p>PO2 explain the mathematical concepts with good understanding and clarity</p> <p>PO3 conduct research independently with strong mathematics background</p> <p>PO4 crack lectureship/fellowship exams like CSIR – NET/JRF, GATE, NBHM, SET, TRB etc.</p> <p>PO5 apply the acquired mathematical techniques to solve the industrial and real-world problems.</p> <p>PO6 obtain a career in the field of education/research/industry /administration</p>
<p>Programme Educational Outcomes (PEOs)</p>	<p>1. Core Competence in Mathematical Theories and Applications Graduates will demonstrate comprehensive knowledge of mathematical concepts, theories, and methodologies. They will be able to apply these principles effectively across diverse domains to analyze and solve industrial and real-world problems.</p> <p>2. Technical Knowledge and Computational Skills Graduates will attain proficiency in mathematical software, computational tools, and programming languages essential for modeling, simulation, data analysis, and solving complex mathematical problems in both industry and academic research.</p> <p>3. Preparation for Advanced Careers Graduates will be well-prepared to pursue advanced careers in academia, research institutions, industry, and government organizations that require high-level mathematical expertise and analytical competence.</p> <p>4. Research and Analytical Skills Graduates will develop strong analytical, critical thinking, and problem-solving abilities necessary for pursuing research. They will be capable of identifying, formulating, and rigorously solving complex mathematical problems.</p>
<p>Programme Specific Outcomes (PSOs)</p>	<p>PSO1 Acquire sound knowledge to solve specific theoretical & applied problems in different areas of mathematics & statistics.</p> <p>PSO2 Understand, formulate, develop mathematical arguments, logically and use quantitative models to address issues arising in social sciences, business and other related context/fields.</p> <p>PSO3 To prepare the students who will demonstrate respectful engagement with other’s ideas, behaviors, and beliefs and apply diverse frames of references to take decision and actions</p>

3. STRUCTURE OF THE PROGRAMME

S. No	COURSE CODE	CATEGORY	TITLE OF THE COURSE	CREDITS	MARKS (CIA = 25 + Ext =75)
SEMESTER I					
1.	26DPMA01	Core I	Algebraic Structures	5	100
2.	26DPMA02	Core II	Real Analysis I	5	100
3.	26DPMA03	Core III	Ordinary Differential Equations	5	100
4.		Elective-I	One from Group A	4	100
5.		Elective-II	One from Group B	3	100
SEMESTER II					
6.	26DPMA04	Core IV	Advanced Algebra	5	100
7.	26DPMA05	Core V	Real Analysis – II	5	100
8.	26DPMA06	Core VI	Topology	5	100
9.		Elective-III	One from Group C	4	100
10.		Elective-IV	One from Group D	3	100
SEMESTER III					
11.	26DPMA07	Core VII	Complex Analysis	5	100
12.	26DPMA08	Core VIII	Functional Analysis	5	100
13.	26DPMA09	Core IX	Partial Differential Equations	5	100
14.		Elective-V	One from Group E	4	100
15.		Elective-VI	One from Group F	3	100
SEMESTER IV					
16.	26DPMA10	Core X	Measure Theory & Integration	5	100
17.	26DPMA11	Core XI	Differential Geometry	5	100
18.	26DPMA12	Core XII	Probability Theory	5	100
19.	26CDOEMATD01 /26DPMA13	Project/ Core XIII	Project with viva voce/ Mathematical Programming	5	100
20.		Elective - VII	One from Group G	4	100
21.		Elective- VIII	One from Group H	3	100
TOTAL				93	2100

Note: In semester IV, a student can opt either a project with dissertation and viva-voce (26CDOEMAT01) or the core course (26DPMA13).

ELECTIVE COURSES OFFERED

Courses are grouped (Group A to Group H) so as to include topics from Pure Mathematics, Applied Mathematics, Industrial Components and IT Oriented courses for flexibility of choice by the stakeholders / institutions.

SEM	COURSE CODE	TITLE OF THE COURSE	CREDITS
I	GROUP - A		
	26DPMAE01	Number Theory and Cryptography	4
	26DPMAE02	Graph Theory and Applications	4
	GROUP - B		
	26DPMAE03	Discrete Mathematics	3
	26DPMAE04	Combinatorial Mathematics	3
II	GROUP - C		
	26DPMAE05	Nonlinear Differential Equations	4
	26DPMAE06	Mechanics	4
	GROUP - D		
	26DPMAE07	Mathematical Modeling	3
	26DPMAE08	Difference Equations	3
III	GROUP - E		
	26DPMAE09	Fluid Dynamics	4
	26DPMAE10	Methods of Applied Mathematics	4
	GROUP - F		
	26DPMAE11	Mathematical Python	3
	26DPMAE12	Data Analytics using Python	3
IV	GROUP - G		
	26DPMAE13	Numerical Analysis	4
	26DPMAE14	Financial Mathematics	4
	GROUP - H		
	26DPMAE15	Mathematical Documentation using LaTeX	3
	26DPMAE16	Industrial Mathematics	3

1. EXAMINATION

For the purpose of uniformity, there shall be a uniform pattern of examination to be adopted by all the teachers offering courses. There shall be three tests, one seminar and one assignment for internal evaluation and end semester examination during each semester.

The distribution of marks for internal evaluation and end semester examination shall be 25 and 75 marks, respectively. Further, distribution of internal marks shall be 10 marks for test, 5 marks for seminar, 5 marks for assignment and 5 marks for attendance, respectively. Best mark out of the

first two internal tests (5 marks) and one model examination (5 marks) shall be taken for Internal Assessment.

Courses	Marks			No. of Courses	Total Marks	Credits
	External	Internal	Total			
Core	75	25	100	12	1200	60
Elective	75	25	100	08	800	28
Dissertation + Viva Voce*	25+25	25+25	100	01	100	05
Core	75	25				
Grand Total				21	2100	93

2. QUESTION PAPER PATTERN:

Intended Learning Skills	Maximum: 75 Marks Passing Minimum: 50% (i.e. 38 marks) out of 75 marks Duration: 3 Hours	Mark Pattern	K Level
Concepts recall /Example/ Counter Example/ Knowledge about the Concepts/ Understanding	Question 1 to 10 Answer ALL questions (Two questions from each Unit)	10 x 2 = 20	K1-K2
Descriptions/ Application (Problems only)	Question 11 to 15 Answer any three questions out of five questions (One question from each Unit)	3 x 5 = 15	K2-K6
Analysis/ Synthesis/ Evaluation	Question 16(a) or 16(b) To 20(a) or 20(b) Answer ALL questions (Either or type one pair from each unit)	5 x 8 = 40	K2-K6

Each question should carry the course outcome and cognitive level. For instance,

1. Question [CO1: K2]
2. Question [CO3: K1]

3. PASSING MINIMUM

Passing Minimum in the end semester examination shall be 50% out of 75 marks (i.e., 38 marks).

There shall be no passing minimum for internal marks. A candidate who has secured a minimum of 50% marks in all the courses (including

practical) prescribed in the programme and earned 93 credits will be considered to qualify the Master's programme.

For the project work and viva-voce, a candidate should secure 50% of the marks for pass. The candidate should attend viva-voce examination to secure pass in the Project.

4. PROJECT WITH VIVA-VOCE

For M.Sc. Mathematics students, individual project is optional. To choose their topics/titles for the project, the students may visit the libraries at the University or any institutions.

Dissertation: The topic of the project shall be assigned to the candidate at the beginning of the third semester. Students shall prepare three copies of project report and submit the same to the office concerned with the last date decided by the office/university. After evaluation and completion of viva-voce examination, one copy shall be retained by the respective guide, one in the library and one with the student.

(a) Format for the preparation of the project:

- (a) Title page
- (b) Bonafide certificate
- (c) Acknowledgement
- (d) Table of contents

CONTENTS

Chapter No.	Title	Page No.
1.	Introduction	
2.	Review of Literature	
3.	Results	
4.	Summary/Conclusion	
5.	References	

Format of the Title Page

TITLE OF THE PROJECT

Dissertation submitted in partial fulfilment of the requirements for the award of the Degree of Master of Science in **MATHEMATICS**

Submitted to



Department of Mathematics

Periyar University, Salem – 636 011.

By

Students Name :
Register Number :
Subject :
Year :

Format of the Certificate

CERTIFICATE

This is to certify that the project entitled submitted in partial fulfillment of the requirements for 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 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

Signature of External Examiner

CORE COURSES – SYLLABUS

26DPMA01	ALGEBRAIC STRUCTURES	L	T	P	C
		4	1	0	5

OBJECTIVE: The objective of this course is to introduce the concepts and to develop working knowledge on class equation, finite abelian groups, linear transformations, real quadratic forms.

UNIT I: Sylow's theorems

Counting Principle - Class equation for finite groups and its applications - Sylow's theorems.

Chapter 2: Sections 2.11-2.12

(For theorem 2.12.1, First proof only & Omit lemma 2.12.5)

UNIT II: Finite abelian groups

Direct products - Finite abelian groups.

Chapter 2: Sections 2.13-2.14

UNIT III: Canonical forms

Linear Transformations: Canonical forms –Triangular form - Nilpotent transformations.

Chapter 6: Sections 6.4 – 6.5

UNIT IV: The Rational and Jordan forms

Jordan form - Rational canonical form.

Chapter 6: Sections 6.6 – 6.7

UNIT V: Hermitian, unitary, normal transformations

Trace and transpose - Hermitian, unitary, normal transformations, real quadratic form.

Chapter 6: Sections 6.8, 6.10 and 6.11

TEXT BOOK:

I.N. Herstein, Topics in Algebra, (II Edition) Wiley Eastern Limited, New Delhi, 1975.

BOOKS FOR SUPPLEMENTARY READING AND REFERENCES:

1. M. Artin, Algebra, Prentice Hall of India, 1991.
2. P.B. Bhattacharya, S.K. Jain, and S.R. Nagpaul, Basic Abstract Algebra (II Edition) Cambridge University Press, 1997.
3. I.S. Luther and I.B.S. Passi, Algebra, Vol. I – Groups, Narosa Publishing House, New Delhi, 1999.
4. I.S. Luther and I.B.S. Passi, Algebra, Vol. II Rings, Narosa Publishing House, New Delhi, 1999.
5. D.S. Malik, J.N. Mordeson and M.K. Sen, Fundamental of Abstract Algebra, McGraw Hill (International Edition), New York. 1997.

26DPMA02	REAL ANALYSIS – I	L	T	P	C
		4	1	0	5

OBJECTIVE: This course aims to develop a strong conceptual understanding of Riemann–Stieltjes integration and sequences and series of real-valued functions.

UNIT I: Functions of Bounded Variation

Introduction - Properties of monotonic functions - Functions of bounded variation - Total variation - Additive property of total variation - Total variation on $[a, x]$ as a function of x - Functions of bounded variation expressed as the difference of two increasing functions - Continuous functions of bounded variation.

Infinite Series: Absolute and conditional convergence - Dirichlet's test and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series.

Chapters 6 & 8: Sections 6.1-6.8, 8.8, 8.15, 8.17, 8.18.

UNIT II: The Riemann-Stieltjes Integral

The definition of the Riemann-Stieltjes (RS) integral - Linear properties - Integration by parts- Change of variable in a RS integral – Step function as integrators - Reduction of a RS integral to a Riemann Integral – Euler's summation formula - Monotonically increasing integrators, Upper and lower integrals - Additive and linearity properties of upper, lower integrals - Riemann's condition - Comparison theorems.

Chapter 7: Sections 7.1-7.14

UNIT III: The Riemann-Stieltjes Integral

Integrators of bounded variation-Sufficient conditions for the existence of RS integrals-Necessary conditions for the existence of RS integrals- Mean value theorems -integrals as a function of the interval – Second fundamental theorem of integral calculus-Change of variable -Second Mean Value Theorem for Riemann integral- RS integrals depending on a parameter- Differentiation under integral sign - Lebesgue criterion for existence of Riemann integrals.

Chapter 7: Sections 7.15 - 7.24, 7.26

UNIT IV: Infinite Series and Infinite Products

Double sequences - Double series - Rearrangement theorem for double series - A sufficient condition for equality of iterated series - Multiplication of series – Cesaro summability - Infinite products.

Power series – Multiplication of power series - The Taylor's series generated by a function - Bernstein's theorem - Abel's limit theorem - Tauber's theorem.

Chapters 8 & 9: Sections 8.20-8.26, 9.14, 9.15, 9.19, 9.20, 9.22, 9.23

UNIT-V: Sequences of Functions

Pointwise convergence of sequences of functions - Examples of sequences of real - valued functions - Uniform convergence and continuity - Cauchy condition for uniform convergence - Uniform convergence of infinite series of functions - Riemann - Stieltjes integration – Non-uniform Convergence and Term-by-term Integration - Uniform convergence and differentiation - Sufficient condition for uniform convergence of a series.

Chapter 9: Sections 9.1-9.6, 9.8-9.11, 9.13

TEXT BOOK:

Tom M. Apostol, Mathematical Analysis, Second Edition, Addison-Wesley Publishing Company, New York, 1974.

BOOKS FOR SUPPLEMENTARY READING AND REFERENCES

1. Ajith Kumar and S. Kumeresan, Basic Course in Real Analysis, CRC Press, 2014.
2. R.G. Bartle and D.R.Sherbert, Introduction to Real Analysis, Fourth Edition, John Wiley and Sons Inc., 1976.
3. S.C. Malik and S. Arora. Mathematical Analysis, Wiley Eastern Limited, New Delhi, 1991.
4. B.R. Gelbaum and J. Olmsted, Counter Examples in Analysis, Holden day, San Francisco, 1964.
5. W. Rudin, Principles of Mathematical Analysis, 3rd Edition. McGraw Hill Company, New York, 1976.

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

CLO	Statements	Knowledge level
CLO1	Recall the concepts of derivatives and partial derivatives	K1, K2
CLO2	Identify functions of bounded variation and analyze the convergence of the series	K1, K4
CLO3	Classify Riemann-Stieltjes integrable functions and apply the fundamental theorem of calculus	K2, K3
CLO4	Explain the rearrangement of terms of a double series	K2, K3
CLO5	Examine the convergence of a double series and compute the Taylor series and power series for given functions.	K2, K3, K4

MAPPING WITH PROGRAMME OUTCOME(S):

CLO	POs						PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CLO1	3	3	3	3	2	3	3	2	1
CLO2	3	3	3	3	2	3	3	1	1
CLO3	3	3	3	3	2	3	3	1	1
CLO4	3	3	3	3	2	3	3	2	1
CLO5	3	3	3	3	2	3	3	2	1

26DPMA03	ORDINARY DIFFERENTIAL EQUATIONS	L	T	P	C
		4	1	0	5

OBJECTIVE: The objective of this course is to develop strong background on finding solutions to linear differential equations with constant and variable coefficients and also with singular points, to study existence and uniqueness of the solutions of first order differential equations

UNIT-I: Linear equations with constant coefficients

Second order homogeneous equations-Initial value problems-Linear dependence and independence-Wronskian and a formula for Wronskian-Non-homogeneous equation of order two.

Chapter 2: Sections 1-6

UNIT-II: Linear equations with constant coefficients

Homogeneous and non-homogeneous equation of order n –Initial value problems-Annihilator method to solve non-homogeneous equation.

Chapter 2: Sections 7,8,10,11

UNIT-III: Linear equation with variable coefficients

Initial value problems –Existence and uniqueness theorems – Solutions of the homogeneous equation – Wronskian and linear dependence – Reduction of the order of a homogeneous equation –The Legendre equation.

Chapter 3: Sections 1-5, 8

UNIT-IV: Linear equation with regular singular points

Euler equation – Second order equations with regular singular points – Bessel Function.

Chapter 4: Sections 1-3, 7, 8

UNIT-V: First order ordinary differential equations

Existence and uniqueness of solutions to first order equations: Equation with variable separated – Exact equation – method of successive approximations – the Lipschitz condition – convergence of the successive approximations and the existence theorem.

Chapter 5: Sections 1-6

TEXT BOOK:

E.A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall of India Ltd., New Delhi, 2011.

BOOKS FOR SUPPLEMENTARY READING AND REFERENCES

1. Williams E. Boyce, Richard C. Diprima and Douglas B. Meade, Elementary Differential Equations and Boundary Value Problems, John Wiley and sons, New York, 1967.
2. George F Simmons, Differential Equations with Applications and Historical Notes, Tata McGraw Hill, New Delhi, 1974.

3. W.T. Reid. Ordinary Differential Equations, John Wiley and Sons, New York, 1971
4. M.D. Raisinghania, Advanced Differential Equations, S. Chand & Company Ltd. New Delhi, 2001.
5. B. Raj, D.P.Choudary and H.I. Freedman, A Course in Ordinary Differential Equations, Narosa Publishing House, New Delhi, 2002.

CLO	Statements	Knowledge level
CLO 1	Establish the fundamental methodology to solve second order initial value problem and understand the nature of solutions of ordinary differential equations	K1, K2, K3
CLO 2	Develop several procedures to solve nth order homogeneous and non-homogeneous equations	K2, K3
CLO 3	Apply the gained knowledge to solve ODE with variable coefficients	K2, K3, K4
CLO 4	Enhancing the students to explore some of the basic theory of linear equations with regular singular points.	K3, K4, K5
CLO 5	Learn various methods of solving first order differential equations and to obtain approximate solutions.	K3, K4, K5

MAPPING WITH PROGRAMME OUTCOME(S):

CLO	POs						PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

26DPMA04	ADVANCED ALGEBRA	L	T	P	C
		4	1	0	5

OBJECTIVE: The objective of this course is to study field extension, roots of polynomials, Galois Theory, finite fields, division rings and to develop computational skill in abstract algebra.

UNIT-I: Algebraic Extension

Extension fields – Transcendence of e .
Chapter 5: Sections 5.1-5.2

UNIT-II: Splitting Field and Simple Extension

Roots of Polynomials - More about roots.
Chapter 5: Sections 5.3 & 5.5

UNIT-III: Galois Theory

Elements of Galois Theory.
Chapter 5: Section 5.6

UNIT-IV: Finite fields

Finite fields - Wedderburn's theorem on finite division rings.
Chapter 7: Sections 7.1-7.2 (Theorem 7.2.1 only)

UNIT-V: Frobenius and Four - Square theorems

A theorem of Frobenius - Integral Quaternions and the Four - Square theorem.
Chapter 7: Sections 7.3-7.4

TEXT BOOK:

I.N. Herstein, Topics in Algebra (II Edition) Wiley Eastern Limited, New Delhi, 1975.

BOOKS FOR SUPPLEMENTARY READING AND REFERENCES:

1. M. Artin, Algebra, Prentice Hall of India, 1991.
2. P.B. Bhattacharya, S.K. Jain, and S.R. Nagpaul, Basic Abstract Algebra (II Edition) Cambridge University Press, 1997. (Indian Edition)
3. I.S. Luther and I.B.S. Passi, Algebra, Vol. I –Groups(1996); Vol. II Rings, Narosa Publishing House , New Delhi, 1999.
4. D.S. Malik, J.N. Mordeson and M.K. Sen, Fundamental of Abstract Algebra, McGraw Hill (International Edition), New York. 1997.
5. N. Jacobson, Basic Algebra, Vol. I & II, Hindustan Publishing Company, New Delhi.

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

CLO	Statements	Knowledge level
CLO 1	Understand the concept of finite extension, algebraic element, algebraic extension, algebraic number, algebraic integer and transcendental number.	K1, K2, K3
CLO 2	Count a root of multiplicity m , find the splitting field of a given polynomial and to understand the concepts of simple extension & separable extension	K2, K3, K4
CLO 3	Find the fixed field by Galois group and to understand the concept of normal extension and the fundamental theorem of Galois theory.	K3, K4, K5
CLO 4	Determine the structure of finite multiplicative group and to find the primitive roots.	K3, K4, K5
CLO 5	Understand the concept of Frobenius and Four square theorems.	K3, K4, K5

MAPPING WITH PROGRAMME OUTCOME(S):

CLO	POs						PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CLO 1	3	3	3	3	1	3	3	2	1
CLO 2	3	3	3	3	1	3	3	2	1
CLO 3	3	3	3	3	1	3	3	2	1
CLO 4	3	3	3	3	1	3	3	2	1
CLO 5	3	3	3	3	1	3	3	2	1

26DPMA05	REAL ANALYSIS – II	L	T	P	C
		4	1	0	5

OBJECTIVE: This course primarily covers multivariable calculus including partial derivatives, multiple integrals, and vector calculus in two- and three-dimensional spaces. The course also includes line integrals and the integral theorems that generalize the Fundamental Theorem of Calculus, namely Green's theorem, Stokes' theorem, and Gauss's theorem.

UNIT-I: Multivariable Differential Calculus

Introduction - The Directional derivative - Directional derivative and continuity - The total derivative - The total derivative expressed in terms of partial derivatives - The matrix of linear function - The Jacobian matrix - The chain rule - Matrix form of chain rule - The mean - value theorem for differentiable functions - A sufficient condition for differentiability - A sufficient condition for equality of mixed partial derivatives - Taylor's theorem for functions of \mathbb{R}^n to \mathbb{R}^1 .

Chapter 12 [1]: Sections 12.1-12.5, 12.7-12.14

UNIT-II: Implicit Functions:

Functions with non-zero Jacobian determinants – The inverse function theorem - The Implicit function theorem.

Chapter 13 [1]: Sections 13.1-13.7

Unit-III: Line Integrals

Introduction – Paths and line integrals – Other notations of line integrals – Basic properties of line integrals – Line integrals with respect to the arc length – Open connected sets & Independence of the path – Second fundamental theorem of calculus for line integrals – The first fundamental theorem of calculus for line integrals.

Chapter 10 [2]: Sections 10.1-10.5, 10.7, 10.10 – 10.11, 10.14

Unit-IV: Multiple integrals:

Introduction – Partitions of rectangle, 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 rectangles – Evaluation of a double integral by repeated one-dimensional integration – Geometric interpretation of the double integral as a volume – Integrability of continuous functions.

Chapter 11 [2]: Sections 11.1 to 11.11

Unit-V: Green's theorem and Surface integrals

Green's theorem in the plane – Change of variables in a double integral – Extensions to higher dimensions – Worked examples.

Surface Integrals: Definition of surface integral – Change of parametric representation – Stoke's theorem – The divergence theorem.

Chapter 11 [2]: Sections 11.19, 11.22, 11.26,

Chapter 12 [2]: Sections 12.7, 12.8, 12.11, 12.19

TEXT BOOK:

1. **Tom M. Apostol**, Mathematical Analysis, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974. (for Units I to II).
2. **T.M. Apostol**, "Calculus Vol.2, Multi-Variable Calculus and Linear Algebra with Applications to Differential Equations and Probability", Second Edition, John Wiley & Sons, 1969. (for Units III to V).

BOOKS FOR SUPPLEMENTARY READING AND REFERENCES:

1. L.H. Loomis and S. Sternberg, Advanced Calculus, Revised Edition, Jones and Bartlett Publisher, Inc. Boston, MA 02116, 1990.
2. R. Ghorpade and B.V. Limaye, A Course in Multivariable Calculus and Analysis, Undergraduate Texts in Mathematics, Springer-Verlag, New York, 2010.
3. J.R.C, Webb, Functions of Several Real Variables, Ellis Horwood, Chichester, 1991.
4. H. Rogers, Multivariable Calculus with Vectors, Prentice Hall, New Jersey, 1998.
5. James Stewart, Multivariable Calculus, Cengage Learning Publisher, 2016.

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

CLO	Statements	Knowledge level
CLO1	Analyze and evaluate functions of bounded variation and determine the convergence of the series with complex terms.	K1, K2, K3
CLO2	Study classes of Riemann-Stieltjes integrable functions and application of fundamental theorem of calculus.	K2, K3, K4
CLO3	Understand the Rearrangement of terms of a double series.	K2, K3, K4
CLO4	Compute the Taylor series and power series for given functions.	K3, K4, K5
CLO5	Illustrate the effect of uniform convergence on the limit function with respect to continuity, differentiability and integrability.	K2, K3, K5

MAPPING WITH PROGRAMME OUTCOME(S):

CLO	POs						PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CLO1	3	3	3	3	3	2	1	2	2
CLO2	3	3	2	3	3	2	1	2	2
CLO3	3	3	2	3	3	3	1	2	3
CLO4	3	3	2	3	3	2	1	2	2
CLO5	3	3	2	3	3	3	1	2	3

26DPMA06	TOPOLOGY	L	T	P	C
		4	1	0	5

OBJECTIVE: The objective of this course is to study topological spaces, continuous functions, connectedness, compactness, countability and separation axioms.

UNIT-I: Topological spaces

Topological spaces – Basis for a topology – The order topology – The product topology on $X \times Y$ – The subspace topology – Closed sets and limit points.

Chapter 2: Sections 12-17

UNIT-II: Continuous functions

Continuous functions – The product topology – The metric topology.

Chapter 2: Sections 18-21

UNIT-III: Connectedness

Connected spaces- Connected subspaces of the Real line.

Chapter 3: Sections 23-24

UNIT-IV: Compactness

Compact spaces – Compact subspaces of the Real line – Limit Point Compactness.

Chapter 3: Sections 26-28

UNIT-V: Countability and Separation Axiom

The Countability Axioms – The separation Axioms – Normal spaces – The Urysohn Lemma (Statement only) – The Urysohn metrization Theorem – The Tietz extension theorem.

Chapter 4: Sections 30-35 (Statement only for Theorem 33.1)

TEXT BOOK:

James R. Munkres, Topology (2nd Edition), Prentice Hall of India, New Delhi, 2011.

BOOKS FOR SUPPLEMENTARY READING AND REFERENCES:

1. J. Dugundji, Topology, Prentice Hall of India, New Delhi, 1975.
2. George F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Book Co., 1963
3. J.L. Kelly, General Topology, Van Nostrand, Reinhold Co., New York
4. L. Steen and J. Subhash, Counter Examples in Topology, Holt, Rinehart and Winston, New York, 1970.
5. S. Willard, General Topology, Addison - Wesley, Mass., 1970

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

CLO	Statements	Knowledge level
CLO 1	Define what a topological space is, and to identify the concepts like open sets, closed sets, limit points and continuous functions.	K1, K2, K4
CLO 2	Explain various properties of continuous functions and to examine the metrizable of various topological spaces.	K1, K2, K3, K4, K6
CLO 3	Form new connected spaces from given ones and understand the concepts of path connectedness and linear continuum.	K1, K2, K3, K6
CLO 4	Construct new compact spaces from existing ones, give compact subspaces of the real line and relate different versions of compactness.	K2, K3, K6
CLO 5	Classify the countability and separation axioms, and to determine the conditions under which a topological space is metrizable.	K1, K2, K3, K4

MAPPING WITH PROGRAMME OUTCOME(S):

CLO	POs						PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CLO 1	3	1	3	3	2	3	3	2	1
CLO 2	2	1	3	3	2	3	3	2	1
CLO 3	3	2	3	3	2	3	3	2	1
CLO 4	1	2	3	3	2	3	3	2	1
CLO 5	3	1	3	3	2	3	3	2	1

26DPMA07	COMPLEX ANALYSIS	L	T	P	C
		4	1	0	5

OBJECTIVE: The objective of this course is to study Cauchy integral formula, local properties of analytic functions, general form of Cauchy's theorem and evaluation of definite integral and harmonic functions.

UNIT-I: Cauchy's Integral Formula

The Index of a point with respect to a closed curve – The Integral formula – Higher derivatives. Local Properties of analytical Functions:

Removable Singularities-Taylor's Theorem – Zeros and poles – The local Mapping – The Maximum Principle.

Chapter 4: Sections 2.1-2.3, Sections 3.1-3.4

UNIT-II: The general form of Cauchy's Theorem

Chains and cycles- Simple Continuity - Homology - The General statement of Cauchy's Theorem - Proof of Cauchy's theorem - Locally exact differentials- Multiply connected regions - Residue theorem - The argument principle.

Chapter 4: Sections 4.1 - 4.7, Chapter 5: Sections 5.1 and 5.2

UNIT-III: Evaluation of Definite Integrals and Harmonic Functions

Evaluation of definite integrals - Definition of Harmonic function and basic properties - Mean value property - Poisson formula.

Chapter 4: Sections 5.3, Sections 6.1 - 6.3

UNIT-IV: Harmonic Functions and Power Series Expansions

Schwarz theorem - The reflection principle - Weierstrass theorem –Taylor's Series – Laurent series.

Chapter 4: Sections 6.4 and 6.5, Chapter 5: Sections 1.1 - 1.3

UNIT-V: Partial Fractions and Entire Functions

Partial fractions - Infinite products – Canonical products – Gamma Function- Jensen's formula – Hadamard's Theorem.

Chapter 5: Sections 2.1 - 2.4, Sections 3.1 and 3.2

TEXT BOOK:

Lars V. Ahlfors, Complex Analysis, (3rd edition) McGraw Hill Co., New York, 1979

BOOKS FOR SUPPLEMENTARY READING AND REFERENCES:

1. H.A. Presfly, Introduction to complex Analysis, Clarendon Press, oxford, 1990.
2. J.B. Conway, Functions of one complex variables Springer - Verlag, International student Edition, Naroser Publishing Co.1978
3. E. Hille, Analytic function Thorey(2 vols.), Gonm& Co, 1959.
4. M.Heins, Complex function Theory, Academic Press, New York, 1968.

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

CLO	Statements	Knowledge level
CLO 1	Analyze and evaluate local properties of analytical functions, definite integrals and apply Cauchy's integral formula, Taylor's theorem for solving the problems and finding zeros and poles of the given equation.	K1, K2, K3
CLO 2	Demonstrate the concept of the general form of Cauchy's theorem.	K1, K2, K3
CLO 3	Describe the concept of definite integral, harmonic functions, Mean value property and solve Poisson problem.	K2, K3, K4
CLO 4	Demonstrate the concepts of Schwarz theorem, The reflection principle, Weierstrass theorem and apply Taylor's Series, Laurent series to solve the given problems.	K2, K3, K4
CLO 5	Explain the partial fractions, infinite products, canonical products and Jensen's formula.	K3, K4, K5

MAPPING WITH PROGRAMME OUTCOME(S):

CLO	POs						PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CLO 1	3	2	3	3	1	1	3	2	2
CLO 2	2	2	2	2	2	1	3	2	2
CLO 3	3	2	3	3	1	1	3	2	1
CLO 4	2	2	1	2	2	1	3	2	1
CLO 5	3	2	2	3	1	1	2	1	2

26DPMA08	FUNCTIONAL ANALYSIS	L	T	P	C
		4	1	0	5

OBJECTIVE: The objective of this course is to provide students with a strong foundation in functional analysis, focusing on spaces, operators and fundamental theorems and to develop student's skills and confidence in mathematical analysis and proof techniques.

UNIT-I: Banach Spaces

The definition and some examples – Continuous linear transformations – The Hahn-Banach theorem – The natural imbedding of N in N^{**} - The open mapping theorem – The conjugate of an Operator.

Chapter 9: Sections 46-51

UNIT II: Hilbert Spaces

The definition and some simple properties–Orthogonal complements–Ortho normal sets–The conjugate space H^*

Chapter 10: Sections 52-55

UNIT III: Hilbert Spaces (Contd...)

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

Chapter 10: Sections 56-59

UNIT IV: Finite-Dimensional Spectral Theory

Matrices – Determinants and the spectrum of an operator –The spectral theorem.

Chapter 11: Sections 60-62

UNIT V: General Preliminaries on Banach Algebras

The definition and some examples – Regular and singular elements – Topological divisors of zero – The spectrum – The formula for the spectral radius – Radical and semi simplicity.

Chapter 12: Sections 64-69

TEXT BOOK:

G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Education (India)Private Limited, New Delhi, 1963.

BOOKS FOR SUPPLEMENTARY READING AND REFERENCES:

1. W. Rudin, Functional Analysis, McGraw Hill Education (India) Private Limited, New Delhi, 1973.
2. B.V. Limaye, Functional Analysis, New Age International, 1996.
3. C. Goffman and G. Pedrick, First course in Functional Analysis, Prentice Hall of India, NewDelhi, 1987.
4. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, New York, 1978.
5. M. Thamban Nair, Functional Analysis, A First course, Prentice Hall of India, New Delhi, 2002.

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

CLO	Statements	Knowledge level
CLO 1	Understand the Banach spaces and Transformations on Banach Spaces	K2, K3, K4
CLO 2	Prove Hahn Banach theorem and open mapping theorem.	K3, K4, K5
CLO 3	Describe operators and fundamental theorems	K3, K4, K5
CLO 4	Validate orthogonal and orthonormal sets	K3, K4
CLO 5	Analyze and establish the regular and singular elements and obtain a formula for spectral radius	K3, K4, K5

MAPPING WITH PROGRAMME OUTCOME(S):

CLO	POs						PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CLO1	3	1	3	3	3	3	3	2	1
CLO2	2	1	3	3	3	3	3	2	1
CLO3	3	2	3	3	3	3	3	2	1
CLO4	1	2	3	1	3	3	3	2	1
CLO5	3	1	3	1	3	3	3	2	1

26DPMA09	PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
		4	1	0	5

OBJECTIVE: The objective of this course is to classify the second order partial differential equations and to study Cauchy problem, method of separation of variables, boundary value problems.

UNIT I: Mathematical Models and Classification of second order equation

Classical equations-Vibrating string – Vibrating membrane – Waves in elastic medium – Conduction of heat in solids – Gravitational potential – Second order equations in two independent variables – Canonical forms – Equations with constant coefficients – General solution.

Chapters 3 & 4: Sections 3.1 – 3.6 & Sections 4.1 – 4.4

UNIT II: Cauchy Problem

The Cauchy problem – Cauchy-Kowalewsky theorem – Homogeneous wave equation – Initial Boundary value problem- Non-homogeneous boundary conditions – Finite string with fixed ends – Non-homogeneous wave equation – Riemann method – Goursat problem.

Chapter 5: Sections 5.1 – 5.9

UNIT III: Method of separation of variables

Separation of variable- Vibrating string problem – Existence and uniqueness of solution of vibrating string problem - Heat conduction problem – Existence and uniqueness of solution of heat conduction problem – Laplace and beam equations.

Chapter 7: Sections 7.1 – 7.7

UNIT IV: Boundary Value Problems

Boundary value problems – Maximum and minimum principles – Uniqueness and continuity theorem – Dirichlet problem for a circle, circular annulus and rectangle – Dirichlet problem involving the Poisson equation - Neumann problem for a circle and rectangle.

Chapter 9: Sections 9.1 – 9.9

UNIT V: Green's Function

The Dirac delta function – Properties of Green's function – Method of Green's function – Dirichlet Problem for the Laplace Operator – Dirichlet Problem for the Helmholtz operators – Method of images – Method of Eigen functions .

Chapter 11: Sections 11.1 – 11.8

TEXT BOOK:

Tyn Myint – U and Lokenath Debnath, Partial Differential Equations for Scientists and Engineers (Third Edition), North Holland, New York, 1987.

BOOKS FOR SUPPLEMENTARY READING AND REFERENCES:

1. M. M. Smirnov, Second Order partial Differential Equations, Leningrad, 1964.
2. N. Sneddon, Elements of Partial Differential Equations, McGraw Hill, New Delhi, 1983.

3. R. Dennemeyer, Introduction to Partial Differential Equations and Boundary Value Problems, McGraw Hill, New York, 1968.
4. M. D. Raisinghania, Advanced Differential Equations, S. Chand & Company Ltd., New Delhi, 2001.
5. S. Sankar Rao, Partial Differential Equations, 2nd Edition, Prentice Hall of India, New Delhi, 2004.

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

CLO	Statements	Knowledge level
CLO1	To understand and classify second order equations and find general solutions	K2, K3, K4
CLO2	To analyze and solve wave equations in different polar Coordinates	K2, K3, K4
CLO3	To solve Vibrating string problem, Heat conduction problem, To identify and solve Laplace and beam equations	K2, K3, K4
CLO4	To apply maximum and minimum principle's and solve Dirichlet, Neumann problems for various boundary conditions	K3, K4, K5
CLO5	To apply Green's function and solve Dirichlet, Laplace problems, to apply Helmholtz operation and to solve Higher dimensional problem	K3, K4, K5

MAPPING WITH PROGRAMME OUTCOME(S):

CLO	POs						PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO 3
CLO1	3	1	3	3	2	3	3	2	1
CLO2	2	1	3	3	2	3	3	2	1
CLO3	3	2	3	3	2	3	3	2	1
CLO4	1	2	3	3	2	3	3	2	1
CLO5	3	1	3	3	2	3	3	2	1

26DPMA10	MEASURE THEORY AND INTEGRATION	L	T	P	C
		4	1	0	5

OBJECTIVES: The objectives of this course are

- To gain understanding of the abstract measure theory and main properties of the Lebesgue integral.
- To make the students acquire basic knowledge of measure theory needed to understand probability theory, statistics and functional analysis.
- To get ability to differentiate and integrate the Lebesgue integral.

UNIT I: Lebesgue Measure

Introduction – Outer measure - Measurable sets and Lebesgue measure – Measurable functions - Littlewood’s three principles.

Chapter 3: Sections 1 – 3, 5 & 6

UNIT II: Lebesgue integral

The Riemann integral - Lebesgue integral of bounded functions over a set of finite measure - The integral of a nonnegative function - The general Lebesgue integral.

Chapter 4: Sections 1 – 4

UNIT III: Differentiation and Integration

Differentiation of monotone functions - Functions of bounded variation - Differentiation of an integral - Absolute continuity.

Chapter 5: Sections 1 – 4

UNIT IV: General Measure and Integration

Measure spaces – Measurable functions – Integration - General convergence theorems – Signed Measures – The Radon - Nikodym theorem (Statement only).

Chapter 11: Sections 1 – 3, 5 & 6

UNIT V: Measure and Outer Measure

Outer measure and measurability – Product measures.

Chapter 12: Sections 1, 4

TEXT BOOK:

H.L. Royden, “Real Analysis”, 3rd Edition, Macmillan Publishing Company, New York, 1988.

BOOKS FOR SUPPLEMENTARY READING AND REFERENCES:

1. Robert G. Bartle, The Elements of Integration and Lebesgue Measure, 2nd Edition, Wiley-Blackwell, 1995.
2. G. De Barra, Measure Theory and Integration, 2nd Edition, Horwood, Publishing, 2003.
3. W. Rudin, Real and Complex Analysis, 3rd Edition, Tata McGraw-Hill Education, New Delhi, 2013.

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

CLO	Statements	Knowledge level
CLO 1	Know the meaning of outer and inner measures with their basic properties and know the meaning with examples of algebras, sigma-algebras, measurable sets, measurable space and measure space.	K1, K2
CLO 2	Understand the concept of Lebesgue integration both on the general measure space and the real line and know the basic theory of integration and convergence, with the application in evaluating integrals.	K2, K3
CLO 3	Develop the concepts of Differentiation of monotone functions, Functions of bounded variation, Differentiation of an integral, Absolute continuity	K4, K6
CLO 4	Study the Radon-Nikodym theorem and its applications. Understand the concepts of Convergence in Measure and Lebesgue Integrability	K4, K3
CLO 5	Demonstrate understanding of the statements of the main results on integration on product spaces and an ability to apply these in examples.	K2, K4

MAPPING WITH PROGRAMME OUTCOME(S):

CLO	POs						PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CLO 1	3	2	3	3	2	1	3	3	2
CLO 2	3	2	2	3	2	1	3	2	2
CLO 3	3	2	2	3	2	1	3	2	2
CLO 4	3	3	2	1	2	1	3	2	2
CLO 5	3	3	2	1	1	1	3	2	1

26DPMA11	DIFFERENTIAL GEOMETRY	L	T	P	C
		4	1	0	5

OBJECTIVE: The objective of this course is to introduce space curves and their intrinsic properties of a surface and geodesics. Further then on-intrinsic properties of surface and the differential geometry of surfaces are explored.

UNIT - I: Space curves

Definition of a space curve – Arc length – tangent – normal and binormal – curvature and torsion – contact between curves and surfaces- tangent surface- involutes and evolutes- Intrinsic equations – Fundamental Existence Theorem for space curves - Helices.

Chapter 1: 1 – 9

UNIT – II: Intrinsic properties of a surface

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

Chapter 2: 1 – 9

UNIT - III: Geodesics

Geodesics – Canonical geodesic equations – Normal property of geodesics- Existence Theorems – Geodesic parallels.

Chapter 2: 10 – 18

UNIT - IV:

Geodesics curvature - Gauss- Bonnet Theorem –Gaussian curvature- surface of constant curvature.

Chapter 3: 1 – 4

UNIT - V: Non Intrinsic properties of a surface

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

Chapter 3: 5 - 8

TEXT BOOK:

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

BOOKS FOR SUPPLEMENTARY READING AND REFERENCES:

1. Struik, D. T. Lectures on Classical Differential Geometry, Addison – Wesley, Mass. 1950.
2. Kobayashi. S. and Nomizu. K. Foundations of Differential Geometry, Inter science Publishers, 1963. WilhelmKlingenberg: A course in Differential Geometry, Graduate Texts in Mathematics, Springer - Verlag, 1978.
3. J. A. Thorpe, Elementary topics in Differential Geometry, Under – graduate Texts in Mathematics, Springer – Verlag, 1979.

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

CLO	Statements	Knowledge level
CLO 1	Explain space curves, Curves between surfaces, metrics on a surface, fundamental form of a surface and Geodesics.	K2, K3, K4
CLO 2	Compute the metric of a surface and determine direction coefficients and families of curves.	K2, K3, K4
CLO 3	Understand and explain the concept of geodesics on surfaces, canonical geodesic equations, normal property of geodesics and the existence and uniqueness of geodesics.	K3, K4, K5
CLO 4	Relate Gaussian curvature to geodesics and apply the Gauss – Bonnet Theorem to surfaces of constant curvature.	K3, K4, K5
CLO 5	Analyze non-intrinsic properties of surfaces by applying the second fundamental form to study principal curvatures, lines of curvature, developable surfaces.	K3, K4, K5

MAPPING WITH PROGRAMME OUTCOME(S):

CLO	POs						PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO 3
CLO1	3	3	2	1	1	2	3	2	1
CLO2	3	3	2	1	2	2	3	2	1
CLO3	3	2	2	1	2	2	3	2	1
CLO4	2	2	3	1	2	2	3	2	1
CLO5	3	2	3	1	2	2	3	2	1

26DPMA12	PROBABILITY THEORY	L	T	P	C
		4	1	0	5

OBJECTIVE: The objective of this course is to introduce axiomatic approach to probability theory and to study some statistical characteristics, discrete and continuous distribution functions and their properties, characteristic function and basic limit theorems of probability.

UNIT I: Random Events and Random Variables

Random events – Probability axioms – Combinatorial formulae – conditional probability – Bayes Theorem – Independent events – Random Variables – Distribution Function – Joint Distribution – Marginal Distribution – Conditional Distribution – Independent random variables – Functions of random variables.

Chapter 1& 2: Sections 1.1 – 1.7, 2.1 – 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 – 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 – 4.7

UNIT IV: Some Probability Distributions

One point, twopoint, Binomial – Polya – Hypergeometric – Poisson (discrete) distributions – Uniform – normal gamma – Beta – Cauchy and Laplace (continuous) distributions.

Chapter 5: Sections 5.1 – 5.10

UNIT V: Limit Theorems

Stochastic convergence – Bernoulli law of large numbers – Convergence of sequence of distribution functions – Levy-Cramer Theorems – de Moivre-Laplace Theorem – Poisson, Chebyshev, Khintchine Weak law of large numbers – Lindeberg Theorem – Lapunov Theroem – Borel-Cantelli Lemma - Kolmogorov Inequality and Kolmogorov Strong Law of large numbers.

Chapter 6: Sections 6.1 – 6.4, 6.6 – 6.9, 6.11 and 6.12

TEXT BOOK:

M. Fisz, Probability Theory and Mathematical Statistics, John Wiley and Sons, New York, 1963.

BOOKS FOR SUPPLEMENTARY READING AND REFERENCES:

1. R.B. Ash, Real Analysis and Probability, Academic Press, New York, 1972

2. K.L. Chung, A course in Probability, Academic Press, New York, 1974.
3. R. Durrett, Probability: Theory and Examples, (2nd Edition) Duxbury Press, New York, 1996.
4. V.K. Rohatgi, An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern Ltd., New Delhi, 1988(3rd Print).
5. S.I. Resnick, A Probability Path, Birhauser, Berlin,1999.
6. B.R.Bhat, Modern Probability Theory (3rd Edition), New Age International (P)Ltd, New Delhi, 1999.

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

CLO	Statements	Knowledge level
CLO 1	Calculate the expectation and moments of random variables	K1, K2, K3
CLO 2	Identify the applications of various moment inequalities	K2, K3, K4
CLO 3	Obtain the expressions for the characteristic function of a random variable and verify its properties	K2, K3, K4
CLO 4	Classify the probability distributions as discrete or continuous case	K2, K3, K4
CLO 5	Apply the various laws of large numbers to sequence of random variables	K3, K4, K5

MAPPING WITH PROGRAMME OUTCOME(S):

CLO	POs						PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CLO 1	3	1	3	3	3	3	3	2	1
CLO 2	2	1	3	3	3	3	3	2	1
CLO 3	3	2	3	3	3	3	3	2	1
CLO 4	1	2	3	3	3	3	3	2	1
CLO 5	3	1	3	3	3	3	3	2	1

ELETIVE COURSES

26DPMAE01	NUMBER THEORY AND CRYPTOGRAPHY	L	T	P	C
		4	1	0	4

OBJECTIVE: The objective of this course is to give elementary ideas from number theory which will have applications in cryptography.

UNIT I: Elementary Number theory

Time estimates for doing arithmetic – divisibility and the Euclidean algorithm.

Chapter 1: Sections 1 – 2

UNIT II: Elementary Number theory

Congruences – Some applications to factoring.

Chapter 1: Sections 3 – 4

UNIT III: Finite Fields and Quadratic Residues

Finite Fields – Quadratic residues and reciprocity.

Chapter 2: Sections 1-2

UNIT IV: Cryptography

Some simple crypto systems – Enciphering matrices.

Chapter 3: Sections 1-2

UNIT V: Public Key Cryptography

Public key cryptography – RSA.

Chapter 4: Sections 1-2

TEXT BOOK:

NealKoblit, “A course in Number Theory and Cryptography”, Springer – Verlag, New York, 2nd edition, 2002.

BOOKS FOR SUPPLEMENTARY READING AND REFERENCES:

1. Niven and H. S. Zuckermann, “An Introduction to Theory of Numbers (Edition 3)”, Wiley Eastern Ltd, New Delhi, 1976.
2. D. M. Burton, “Elementary Number Theory”, Brown Publishers, Iowa, 1989.
3. K. Ireland and M. Rosen, “A classic Introduction to Modern Number Theory”, Springer – Verlag, 1972.
4. N. Koblit, “Algebraic Aspects of Cryptography”, Springer - Verlag, 1998.

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

CLO	Statements	Knowledge level
CLO1	Define a difference operator and to state the properties of difference operator.	K1, K2
CLO2	Solve the congruences and estimating the number of bit operations.	K1, K2, K3
CLO3	Estimate the multiplicative order of non-zero elements of a finite field. Find the number of irreducible polynomial solver	K2, K3, K4

	finite field of degree n . Find how many n^{th} roots of unity are there in F_q .	
CLO4	Invent a crypto system is to label all possible plaintext message units and all possible cipher text message units. Solve the systems of simultaneous congruence's. Find the Deciphering matrix and read the message.	K2, K3, K4
CLO5	Understand the concepts of enciphering and deciphering transformations. Describe how RSA works.	K3, K4, K5

MAPPING WITH PROGRAMME OUTCOME(S):

CLO	POs						PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CLO 1	3	3	1	1	1	1	2	2	1
CLO 2	3	3	1	1	1	1	2	2	1
CLO 3	2	2	2	1	2	1	2	2	1
CLO 4	2	3	2	1	2	2	2	2	1
CLO 5	2	3	2	1	1	2	2	2	1

26DPMAE02	GRAPH THEORY AND APPLICATIONS	L	T	P	C
		4	1	0	4

OBJECTIVE: The objective of the course is to introduce students with the fundamental concepts in graph theory, with a sense to know some of the new developments and its modern applications. They will be able to use these concepts/techniques in subsequent courses in the design and analysis of algorithms, software engineering and computer systems.

UNIT I: Graphs and Digraphs

Basic concepts – subgraphs – degrees of vertices – paths and connectedness – automorphism of a simple graph – line graphs – operations on graphs – applications to social psychology - basic concepts in digraphs – tournaments.

Chapter 1 & 2: Sections 1.1 – 1.8, 1.11, 2.1-2.3

UNIT II: Connectivity and trees

Vertex cuts and edge cuts – connectivity and edge connectivity – Cyclical edge connectivity of a graph - Definition, Characterization and simple properties of trees – centers and centroids - counting spanning trees – cayley’s formula – Applications: Connector Problem – Kruskal’s Algorithm.

Chapter 3 & 4: Sections 3.1 - 3.3, 3.5, 4.1 - 4.5, 4.7.1– 4.7.2

UNIT III: Independent sets, Matchings and Cycles

Independents sets and coverings (both vertex & edge) – matchings and factors – matchings in bipartite graphs – Eulerian graphs and Hamiltonian graphs – Introduction – Eulerian Graphs – Hamiltonian Graphs – 2-Factorable Graphs.

Chapter 5: Sections 5.1 – 5.5, 6.1 - 6.3, 6.6

UNIT IV: Graph colorings

Vertex colorings – applications of graph coloring - critical graphs – Brooks Theorem – other coloring parameters – b-colorings; Edge colorings – the time table problem – Vizings theorem – Kirkman’s Schoolgirl Problem – chromatic polynomials.

Chapter 7: Sections 7.1 - 7.3, 7.6, 7.8, 7.9

UNIT V: Planar Graphs

Planar and non-planar graphs – Euler formula and its consequences – K_5 and $K_{3,3}$ are non-planar 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, 8.9

TEXT BOOK:

R. Balakrishnan and K. Ranganathan, “A Textbook of Graph Theory” (2nd edition), Springer, New York, 2012.

BOOKS FOR SUPPLEMENTARY READING AND REFERENCES:

1. J. Clark and D.A. Holton, “A First look at Graph Theory”, Allied Publishers, New Delhi, 1995.
2. R.J. Wilson and J.J. Watkins, “Graphs: An Introductory Approach”, John Wiley and Sons, New York, 1989.
3. S.A. Choudum, “A First Course in Graph Theory”, MacMillan India Ltd. 1987.

4. J.A. Bondy and U.S.R. Murty, "Graph Theory and Applications", Macmillan, London, 1976

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

CLO	Statements	Knowledge level
CLO1	Understand the basic concepts on various types of graphs, trees/cycles/matchings/colorings, directed graphs and able to present a graph as a model to solve many real-life problems.	K1, K2, K3
CLO2	Understand the properties of bipartite graphs, Hamiltonian/Eularian graphs, maximum/maximal matchings, bounds for chromatic numbers, planarity and able to find a minimal spanning tree for a given weighted graph.	K1, K2, K3
CLO3	Understand necessary/sufficient conditions for bipartite graphs, connectedness, and relation with minimum/maximum degrees, connection between independent / matchings, Eulerian and Hamiltonian graphs which makes the model for optimal communication systems.	K2, K3, K4
CLO4	Apply Known properties to solve simple problems to enhance problem solving skill.	K3, K4
CLO5	Solve critical problems by applying more than one concepts / Properties which creates interest enhance confidence on basic research skill	K3, K4, K5

MAPPING WITH PROGRAMME OUTCOME(S):

CLO	POs						PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CLO 1	1	1	2	3	3	3	1	2	2
CLO 2	1	2	2	3	2	3	1	1	2
CLO 3	1	2	3	3	2	2	1	2	2
CLO 4	1	1	2	3	2	2	2	1	2
CLO 5	2	2	2	1	3	3	2	2	2

26DPMAE03	DISCRETE MATHEMATICS	L	T	P	C
		4	1	0	3

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 Foundation of Logic

Logic – Propositional equivalence – Predicates and quantifiers – Proof Methods and Strategy – The growth of functions.

Chapter 1 & 3: Sections 1.1–1.3,1.8, 3.2

UNIT II: Counting

Basics of counting – The pigeonhole principle – permutations and combinations – Generalized permutations and combinations – Generating permutations and combinations.

Chapter 5: Sections 5.1 – 5.6

UNIT III: Advanced counting techniques

Recurrence relation – Solving recurrence relations – Generating functions.

Chapter 6: Sections 6.1, 6.2, 6.4

UNIT IV: Boolean Algebra

Boolean functions – Representing Boolean functions – Logic Gates – Minimization of circuits.

Chapter 10: Sections 10.1-10.4

UNIT V: Modeling Computations

Finite – State machines with output, Finite – State machines with no output – Turing machines.

Chapter 12: Sections 12.2,12.3,12.5

TEXT BOOK:

Kenneth H. Rosen, “Discrete Mathematics and its Applications”, 7th Edition, WCB/ McGraw Hill Publications, New Delhi, 2011.

BOOKS FOR SUPPLEMENTARY READING AND REFERENCES:

1. Edward A. Bender and S. Gill Williamson, “A Short Course in Discrete Mathematics”, Dover Publications, 2006.
2. M.O. Albertson and J.P. Hutchinson, “Discrete Mathematics with Algorithms”, John Wiley & Sons, 2008.
3. Rajendra Akerkar and Rupali Akarkar, “Discrete Mathematics”, Pears on Education Pvt. Ltd, Singapore, 2004.
4. J.P. Trembley and R. Manohar, “Discrete Mathematical Structures”, Tata McGraw Hill, New Delhi, 1997.
5. Martin Aigner, “A Course in Enumeration”, Springer-Verlag, Heidelberg, 2007.

6. J.H. Van Lint and R.M. Wilson, "A Course in Combinatorics", 2nd Edition, Cambridge University Press, Cambridge, 2001.

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

CLO	Statements	Knowledge level
CLO 1	Express a logic sentence in terms of predicates, quantifiers and logical connectives.	K1, K2
CLO 2	Apply the rules of inference and methods of proof including direct and indirect proof forms, proof by contradiction and mathematical induction.	K2, K3
CLO 3	Solve discrete mathematics problems that involve permutations and combinations of set, fundamental enumeration principles.	K2, K3, K4
CLO 4	Evaluate Boolean functions and simplify Boolean expressions using the properties of Boolean algebra.	K3, K4, K5
CLO 5	Simplify Boolean function using circuits with different type of gates.	K3, K4, K5

MAPPING WITH PROGRAMME OUTCOME(S):

CLO	POs						PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CLO 1	1	2	2	2	2	3	1	2	2
CLO 2	1	1	2	2	3	3	1	1	2
CLO 3	1	1	1	2	2	2	1	1	2
CLO 4	1	2	2	2	3	3	2	2	2
CLO 5	2	2	2	2	3	3	2	2	3

26DPMAE04	COMBINATORIAL MATHEMATICS	L	T	P	C
		4	1	0	3

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 Combinatorics

The rules of sum and product – Permutations – Combinations – Distributions of distinct objects – Distribution of nondistinct objects.

Chapter 1: Sections 1.1 – 1.7

UNIT II: Generating Functions

Generating functions for combinations – Enumerators for permutations-Distributions of distinct objects into nondistinct cells – Partitions of integers – The Ferrers graph – Elementary relations.

Chapter 2: Sections 2.1 – 2.7

UNIT III: Recurrence relations

Linear recurrence relations with constant coefficients – Solution by the technique of generating functions – A special class of nonlinear difference equations – Recurrence relations with two indices.

Chapter 3: Sections 3.1 – 3.5

UNIT IV: The Principle of inclusion and exclusion

The Principle of inclusion and exclusion – The general formula – Derangements – Permutations with restrictions on relative positions – The rook polynomials – Permutations with forbidden positions.

Chapter 4: Sections 4.1 – 4.7

UNIT V: Polya's theory of counting

Sets, relations and groups – Equivalence classes under a permutation group – Equivalence classes of functions – Polya's fundamental theorem.

Chapter 5: Sections 5.1 – 5.7

TEXT BOOK

C.L. Liu, Introduction to Combinatorial Mathematics, McGraw Hill Book Company, New York, 1968.

BOOKS FOR SUPPLEMENTARY READING AND REFERENCES:

1. Murray Edelberg and C.L. Liu, "Solutions to Problems in Introduction to Combinatorial Mathematics", MC Grow-Hill Book & Co., New York, 1968.
2. R.P. Stanley, "Enumerative Combinatorics", Volume I, 2nd Edition, Cambridge Studies in Advanced Mathematics (Book 49)s, Cambridge University Press, 1997.
3. P.J. Cameron, "Combinatorics: Topics, Techniques, Algorithms", Cambridge University Press, Cambridge, 1998.

4. Miklos Bona, "A Walk-through Combinatorics", World Scientific Publishing Company, 2002.
5. M. Aigner, "A Course in Enumeration", Springer-Verlag, Heidelberg, 2007.
6. J.H. Van Lint and R.M. Wilson, "A Course in Combinatorics", 2nd Edition, Cambridge University Press, Cambridge, 2001.

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

CLO	Statements	Knowledge level
CLO 1	Use formulas for counting basic combinatorial outcomes to construct solutions to complete combinatorial enumeration problems: permutation with and without repetitions; combination with and without repetitions.	K1, K2
CLO 2	Apply counting strategies to solve discrete probability problems.	K1, K2, K3
CLO 3	Use specialized techniques to solve combinatorial enumeration problems like generating functions, recurrence relations Inclusion-exclusion principle.	K2, K3, K4
CLO 4	Understand the concepts of permutations with restrictions on relative positions and the rook polynomials.	K3, K4, K5
CLO 5	Enumerate configuration using Polya's theory.	K1, K2, K3, K4

MAPPING WITH PROGRAMME OUTCOME(S):

CLO	POs						PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CLO 1	1	1	1	3	2	1	1	1	2
CLO 2	1	1	2	3	2	2	1	2	2
CLO 3	2	2	2	3	2	2	2	2	2
CLO 4	1	2	2	3	3	2	1	2	2
CLO 5	2	1	1	1	2	2	1	1	2

26DPMAE05	NONLINEAR DIFFERENTIAL EQUATIONS	L	T	P	C
		4	1	0	4

OBJECTIVE: This course aims to

- ✓ to discuss nonlinear ordinary differential equations for their different behavior of the solutions.
- ✓ to study periodic solutions and averaging methods, perturbation methods and stability
- ✓ to analyze some applications of nonlinear ordinary differential equations studied in the present work to some concrete problem of the other areas of mathematics.

UNIT I: Plane autonomous systems and linearization

The general phase plane - Some population models – Linear approximation at equilibrium points – Linear systems in matrix form.

Chapter 2: Sections 2.1 – 2.5

UNIT II: Periodic Solutions and Averaging Methods

An energy balance method for limit cycles – Amplitude and frequency estimates – Slowly varying amplitudes; Nearly periodic solutions - Periodic solutions: Harmonic balance – Equivalent linear equation by harmonic balance – Accuracy of a period estimate.

Chapter 4: Sections 4.1 – 4.5

UNIT III: Perturbation Methods

Outline of the direct method – Forced oscillations far from resonance- Forced oscillations near resonance with weak excitation – Amplitude equation for undamped pendulum – Amplitude perturbation for the pendulum equation – Lindstedt’s method – Forced oscillation of a self – excited equation – The Perturbation method and Fourier series.

Chapter 5: Sections 5.1 - 5.5 & 5.8 – 5.11

UNIT IV: Stability

Poincare stability – Paths and solution curves for general systems - Stability of time solutions: Lyapunov stability - Lyapunov stability of plane autonomous linear systems.

Chapter 8: Sections 8.1 - 8.4

UNIT V: Stability

Structure of the solutions of n - dimensional linear systems - Structure of n - dimensional inhomogeneous linear systems - Stability and boundedness for linear systems - Stability of linear systems with constant coefficients.

Chapter 8: Sections 8.5 – 8.8

TEXT BOOK:

D.W. Jordan and P. Smith, “Nonlinear Ordinary Differential Equations”, 4th Edition, Oxford University Press, New York, 2007.

BOOKS FOR SUPPLEMENTARY READING AND REFERENCES:

1. G.F. Simmons, "Differential Equations", Tata McGraw-Hill, New Delhi, 1995.
2. D.A. Sanchez, "Ordinary Differential Equations and Stability Theory", Dover, New York, 1979.
3. J.K. Aggarwal, "Notes on Nonlinear Systems", Van Nostrand, 1972.

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

CLO	Statements	Knowledge level
CLO1	Identify the concepts of population model with phase plane.	K1, K2
CLO 2	Derive the limit cycle via energy balance method.	K5
CLO 3	Use perturbation method and Fourier series to solve Forced oscillations and Amplitude equation for undamped pendulum.	K2
CLO 4	Understand the stability through Lyapunov function and Poincare stability.	K2
CLO 5	Apply stability theory to n-dimensional linear systems.	K3

MAPPING WITH PROGRAMME OUTCOME(S):

CLO	POs						PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CLO 1	2	2	1	3	2	2	3	2	1
CLO 2	2	2	2	1	2	2	3	2	1
CLO 3	2	2	1	1	1	2	3	1	1
CLO 4	2	2	3	1	2	2	3	2	1
CLO 5	2	2	2	1	1	2	3	2	1

26DPMAE06	MECHANICS	L	T	P	C
		4	1	0	4

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 coordinates – Constraints – Virtual work – Energy and Momentum.

Chapter 1: Section 1.1 – 1.5

UNIT II: Lagrange's Equations

Derivation of Lagrange's Equations – Examples – Integrals of the motion.

Chapter 2: Section 2.1 – 2.3

UNIT III: Hamilton's Equations

Hamilton's Principle – Hamilton's Equations – other variational principles.

Chapter 4: Section 4.1 – 4.3

UNIT IV: Hamilton – Jacobi Theory

Hamilton Principle Function – Hamilton-Jacobi Equation – Separability.

Chapter 5: Section 5.1 – 5.3

UNIT V: Canonical Transformation

Differential forms and Generating Functions – Special Transformations Lagrange and Poisson Brackets.

Chapter 6: Section 6.1 – 6.3

TEXT BOOK:

D.T. Greenwood, "Classical Dynamics", Prentice Hall of India, New Delhi, 1985.

BOOKS FOR SUPPLEMENTARY READING AND REFERENCES:

1. H. Goldstein, "Classical Mechanics", 2nd Edition, Narosa Publishing House, New Delhi.
2. R.D. Gregory, "Classical Mechanics", Cambridge University Press, 2006
3. J.L.Synge and B.A.Griffth, "Principles of Mechanics", 3rd Edition, McGraw Hill Book Co., New York, 1970.

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

CLO	Statements	Knowledge level
CLO 1	Define the mechanical system of generalized coordinates, virtual work , energy and momentum	K1, K2
CLO 2	Explain the Derivation of Lagrange's equation and the concept of the Integrals of the motion	K1, K2, K3
CLO 3	Classify the Hamilton's equations and Modified Hamilton's principle.	K2, K3

CLO 4	Determine the Hamilton form of the equation of motion and find the solutions of integral of equation by the Hamilton's Jacobi theory	K2, K3, K4
CLO 5	Analyze the Principle function of the generating function for canonical transformation, namely, Special Transformations, Lagrange and Poisson Brackets.	K3, K4, K5

MAPPING WITH PROGRAMME OUTCOME(S):

CLO	POs						PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CLO 1	1	2	2	3	3	3	1	1	2
CLO 2	1	2	2	2	3	3	1	1	2
CLO 3	1	2	2	3	3	3	1	1	2
CLO 4	1	2	2	3	3	3	1	1	2
CLO 5	2	2	2	3	3	3	1	1	2

26DPMAE07	MATHEMATICAL MODELING	L	T	P	C
		4	1	0	3

OBJECTIVE: This course aims to

- ✓ Provide rigorous instruction in fundamental mathematical concepts and skills presented in the context of real - world applications.
- ✓ Gain a working knowledge of core techniques behind mathematical modelling and develop a basic ability to quantify certain phenomena associated with the physical sciences.
- ✓ Represent real – world systems in a mathematical framework.

UNIT I: Mathematical Modelling through Ordinary Differential Equations of First order

Linear Growth and Decay Models – Non-Linear Growth and Decay Models – Compartment Models – Dynamics problems – Simple problems.

Chapter 2: Sections 2.1 – 2.6

UNIT II: Mathematical Modelling through Systems of Ordinary Differential Equations of First Order

Population Dynamics – Epidemics – Compartment Models – Economics – Medicine, Arms Race, Battles and International Trade – Simple problems.

Chapter 3: Sections 3.1 – 3.6

UNIT III: Mathematical Modelling through Ordinary Differential Equations of Second Order

Planetary Motions – Circular Motion and Motion of Satellites – Mathematical Modelling through Linear Differential Equations of Second Order – Miscellaneous Mathematical Models – Simple problems.

Chapter 4: Sections 4.1 - 4.4

UNIT IV: Mathematical Modelling through Difference Equations

Simple Models – Basic Theory of Linear Difference Equations with Constant Coefficients – Economics and Finance – Population Dynamics and Genetics – Probability Theory – Simple problems.

Chapter 5: Sections 5.1 - 5.6

UNIT V: Mathematical Modelling through Graphs

Solutions that can be modelled through Graphs – Mathematical Modelling in Terms of Directed Graphs, Signed Graphs, Weighted Digraphs – Simple problems.

Chapter 7: Sections 7.1 – 7.4

TEXT BOOK:

J. N. Kapur, “Mathematical Modelling”, Wiley Eastern Limited, New Delhi, 4th Reprint, May, 1994.

BOOKS FOR SUPPLEMENTARY READING AND REFERENCES:

1. M. Braun, C. S. Coleman and D. A. Drew, "Differential Equation Models", 1994.
2. C. Fowler, "Mathematical Models in Applied Sciences", Cambridge University Press, 1997.
3. Walter J. Meyer, "Concepts of Mathematical Modeling", New York : McGraw-Hill, 1984.
4. Edward A. Bender, "Introduction to Mathematical Modelling", Dover Publications, 1st edition, 2000.

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

CLO	Statements	Knowledge level
CLO 1	Create mathematical models of empirical or theoretical phenomena in domain such as the physical, natural, or social science.	K1, K2, K3
CLO 2	Draw inferences from models using mathematical techniques including problem solving, quantitative reasoning, and exploration using multiple representations such as equations, tables, and graphs.	K2, K3, K4
CLO 3	Design difference equation based mathematical model and resolve the problem of field population, pollution, Econometrics, and cooling systematic.	K2, K3, K4
CLO 4	Apply the difference equation based mathematical model to resolve the problems related to Epidemic model, compartment model, inflection model etc.	K2, K3, K4
CLO 5	Establish the connection of applicability of mathematical models to resolve the real problems arise in the fields of science and engineering.	K3, K4, K5

MAPPING WITH PROGRAMME OUTCOME(S):

CLO	POs						PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2
CLO 1	1	2	2	1	2	2	1	1
CLO 2	1	2	2	1	2	3	1	2
CLO 3	2	3	2	3	3	3	1	1
CLO 4	1	2	2	2	3	2	1	2
CLO 5	1	2	2	2	3	3	1	2

26DPMAE08	DIFFERENCE EQUATIONS	L	T	P	C
		4	1	0	3

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 functions and approximate summation.

Chapter 2: Section 2.1 -2.3

UNIT II: Linear Difference Equations

First order equations - General results for linear equations - Solving linear equations.

Chapter 3: Section 3.1 -3.3

UNIT III: Linear Difference Equations

Equations with variable coefficients – The z -transform.

Chapter 3: Section 3.5 & 3.7

UNIT IV: Stability Theory

Initial value problems for linear systems – Stability of linear systems.

Chapter 4: Section 4.1, 4.2

UNIT V: Asymptotic Methods

Introduction – Asymptotic analysis of sums – Linear equations.

Chapter 5: Section 5.1 -5.3

TEXT BOOK:

W.G. Kelley and A.C. Peterson, “Difference Equations”, 2nd Edition, Academic Press, New York, 2001.

BOOKS FOR SUPPLEMENTARY READING AND REFERENCES:

1. R.P. Agarwal, “Difference Equations and Inequalities”, 2nd Edition, Marcel Dekker, New York, 2000.
2. S.N. Elaydi, “An Introduction to Difference Equations”, 3rd Edition, Springer, India, 2008.
3. R. E. Mickens, “Difference Equations”, 3rd Edition, CRC Press, 2015.

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

CLO	Statements	Knowledge level
CLO 1	Define a difference operator and to state the properties of difference operator	K1, K2, K3
CLO 2	Explain the computation of sums, the concept of generating function and the important Euler summation formula	K1, K2, K3
CLO 3	Solve linear difference equations by applying different methods, namely, annihilator method, z-transform method, etc.	K1, K2, K3
CLO 4	Examine the stability of linear system of difference equations using eigen value criteria	K2, K3, K4
CLO 5	Analyze the asymptotic behavior of solutions to linear difference equations by the theorems of Poincare and Perron	K2, K3, K4

MAPPING WITH PROGRAMME OUTCOME(S):

CLO	POs						PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CLO 1	1	2	2	2	3	3	1	2	3
CLO 2	1	1	2	2	2	3	1	2	2
CLO 3	1	1	2	2	2	3	1	1	2
CLO 4	1	1	2	2	2	3	1	1	2
CLO 5	1	2	2	2	2	3	1	2	2

26DPMAE09	FLUID DYNAMICS	L	T	P	C
		4	1	0	4

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

Introductory Notions, velocity: Streamlines and paths of the particles-stream tubes and filaments-fluid body- Density – Pressure – Bernoulli’s theorem. Differentiation with respect to time- Equation of continuity- Boundary conditions: kinematical and physical – Rate of change of linear momentum – The equation of motion of an inviscid fluid.

Chapter I & III (TB1): Sections 1.0 – 1.4, 3.10 – 3.31, 3.40, 3.41

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.

Chapter III (TB1): Sections 3.42 – 3.45, 3.50 – 3.53

Unit III: Two Dimensional Motions

Two dimensional functions: Stream function – Velocity potential – Complex potential – Indirect approach – Inverse function. Basic singularities: Source – Doublet – Vortex – Mixed flow – Method of images: Circle theorem – Flow past circular cylinder with circulation. The aerofoil: Blasius’s theorem – Lift force.

Chapter 3 (TB2): Sections 3.2, 3.3, 3.5 - 3.5.1, 3.5.2, 3.7.4, 3.7.5

Chapter 8 (TB3): Sections 8.3 – a,b, 8.4 – a

Unit IV: Viscous Theory

The equations of motion for viscous flow: The stress tensor – The Navier-Stokes equations – Vorticity and circulation in a viscous fluid. Flow between parallel flat plates: Couette flow, Plane Poiseuille flow. Steady flow in pipes: Hagen-Poiseuille flow.

Chapter 5 (TB2): Sections 5.2.1- 5.2.3

Unit V: Boundary Layer Theory

Boundary layer concept- Boundary layer equations in two dimensional flow- Boundary layer along a flat plate: Blasius solution – Shearing stress and boundary layer thickness – Momentum integral theorem for the boundary layer: The von Karman integral relation – von Karman integral relation by momentum law.

Chapter 9 (TB3): Sections 9.1, 9.2, 9.3 – a,b, 9.5 – a,b

TEXT BOOKS:

1. L.M. Milne Thomson, "Theoretical Hydrodynamics", Dover, 1996.
2. N. Curle and H.J. Davies, "Modern Fluid Dynamics Vol-I" by, D Van Nostrand Company Ltd., London, 1968.
3. S.W. Yuan, "Foundations of Fluid Mechanics" by Prentice- Hall of India, New Delhi, 1988.

BOOKS FOR SUPPLEMENTARY READING AND REFERENCES:

1. R.K. Bansal, "An Introduction to Fluid Dynamics", Firewall Media, 2005.
2. G.K. Batchelor, "An Introduction to Fluid Dynamics", Cambridge University Press, 2000.
3. F. Chorlton, "Text Book of Fluid Dynamics", CBS Publications, Delhi, 1985.
4. D.E. Rutherford, "Fluid Dynamics", Oliver and Boyd, 1959.

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

CLO	Statements	Knowledge level
CLO 1	Apply laws of discrete mechanics to continuous systems	K3,K4
CLO 2	Apply basic principles of multi-variable calculus, differential equations and complex variables to fluid dynamic problems	K3,K4
CLO 3	Analyze fluid flow problems with the application of the momentum and energy	K4
CLO 4	Understand modeling approximations in finding exact solutions	K2
CLO 5	Derive boundary layer equations by logical reasoning	K3

MAPPING WITH PROGRAMME OUTCOME(S):

CLO	POs						PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CLO 1	3	3	3	-	3	3	3	3	2
CLO 2	3	3	3	-	2	3	3	3	3
CLO 3	2	3	3	-	3	2	3	3	3
CLO 4	3	2	3	-	3	3	2	3	3
CLO 5	2	3	3	-	2	2	3	3	3

26DPMAE10	METHODS OF APPLIED MATHEMATICS	L	T	P	C
		4	1	0	4

OBJECTIVE: This course treats the foundations of calculus of variations and gives example on some applications within physics and engineering science.

UNIT I: Calculus of variations

Maxima and Minima – The simplest case – Examples - Natural and transition boundary conditions – The variational notation – The more general case – Constraints and Lagranges multipliers – Variable end points – Sturm-Liouville problems.

Chapter 2: Sections 2.1 – 2.9

UNIT II: Applications of Calculus of variations

Hamilton’s principle – Lagrange’s equation – Generalized dynamical entities – Constraints in dynamical systems – Small vibrations about equilibrium – Variational problems for deformable bodies – Rayleigh – Ritz method.

Chapter 2: Sections 2.10 – 2.14, 2.16, 2.19

UNIT III: Integral Equations

Integral equations – Relations between differential and integral equations – The Green’s function – Fredholm equations with separable kernels – Example.

Chapter 2: Sections 3.1 – 3.3, 3.6, 3.7

UNIT IV: Integral Equations

Hilbert – Schmidt theory – Iterative method for solving equations of the second kind – The Neumann Series – Fredholm theory – Singular integral equations.

Chapter 3: Sections 3.8 – 3.12

UNIT V: Special Devices

Special devices – Iterative approximation to characteristic functions – Approximation of Fredholm equations by sets of algebraic equations.

Chapter 4: Sections 3.13 – 3.15

TEXT BOOK:

F.B. Hildebrand, “Methods of Applied Mathematics”, Prentice-Hall of India Pvt., New Delhi, 1968.

BOOKS FOR SUPPLEMENTARY READING AND REFERENCES:

1. A.S. Gupta, “Calculus of Variations with Application”, Prentice-Hall of India, New Delhi, 2005.
2. L. Elsgolts, “Differential Equations and Calculus of Variations”, University Press of the Pacific, 2003.
3. I.M. Gelfand and S.V. Fomin, “Calculus of Variations”, Prentice Hall, New Jersey, 1963.
4. R.P. Kanwal, “Linear integral equation: Theory and Techniques”, 2nd Edition, Birkhäuser, 1996.

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

CLO	Statements	Knowledge level
CLO1	Give an account of the foundations of calculus of variations and of its applications in Mathematics and Physics.	K1, K2
CLO2	Describe the brachistochrone problem mathematically and solve it.	K2, K3, K4
CLO3	Solve isoperimetric problems of standard type.	K2, K3, K4
CLO4	Solve simple initial and boundary value problems by using several variable.	K2, K3, K4
CLO5	Use the theory, methods and techniques of the course solve problems.	K4, K5, K6

MAPPING WITH PROGRAMME OUTCOME(S):

CLO	POs						PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CLO 1	1	1	1	2	2	2	1	1	2
CLO 2	1	2	1	2	2	2	1	2	2
CLO 3	1	1	1	2	2	3	1	2	3
CLO 4	1	1	1	2	2	2	1	1	2
CLO 5	1	2	1	2	2	3	1	1	2

26DPMAE11	MATHEMATICAL PYTHON	L	T	P	C
		4	1	0	3

OBJECTIVE: This course aims

- ✓ To introduce to students Python programming.
- ✓ To learn python coding to implement algorithms for Mathematical problems.

UNIT I: 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 II: 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 Jacobean. Python program for reduction formula with or without limits. Python program to find equation and plot sphere, cone, cylinder.

UNIT III: Roots of High-Degree Equations- Systems of Linear Equations

Introduction, Simple Iterations Method -Finite Differences Method, Gauss Elimination Method: Algorithm, Gauss Elimination Method, Jacobi's Method, Gauss-Seidel's Method.

UNIT IV: Numerical differentiation, Integration and Ordinary Differential Equations

Introduction & Euler's Method, Second Order Runge-Kutta's Method, Fourth Order Runge-Kutta's Method, Fourth Order Runge-Kutta's Method: Plot Numerical and Exact Solutions.

UNIT V: Two-Point Boundary Value Problems

Introduction to two-point boundary value Problems: second order differential equations - Higher order differential equations - solution of second order differential equation using Finite Difference Method.

TEXT BOOK:

1. www.python.org
2. <http://faculty.msmmary.edu/heinold/python.html>
3. J. Kiusalaas, "Numerical methods in engineering with Python 3", Cambridge University Press, 2013.
4. H. P. Langtangen, "Solving PDEs in Python: the FEniCS tutorial I", Springer Open, 2016

BOOKS FOR SUPPLEMENTARY READING AND REFERENCES:

1. Hans Fangohr, 'Introduction to Python for Computational Science and Engineering (A beginner's guide)', University of Southampton, 2015.
2. J. Crank, H. G. Martin, and D. M. Melluish, "Non-Linear Ordinary Differential Equations", Oxford University Press, 2015
3. Brain Heinold, "A practical Introduction to Python Programming", Department of Mathematics and Computer Science, Mount St. Maru's University, 2019.
4. H. P. Langtangen and Anders Logg, "Solving PDEs in Python", Springer Open, 2017.

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

CLO	Statements	Knowledge level
CLO1	Understand one of the most popular and robust general purpose programming language pythons.	K1, K2,K3
CLO2	Understand how scientific programming can be performed using python using various open-source mathematics libraries and tools available.	K2, K3, K4
CLO3	Visualize mathematics concepts and get the ability to demonstrate mathematical ideas through graphics.	K2, K3, K4
CLO4	Solve any concrete mathematics or general problem programmatically using numerical methods.	K2, K3, K4
CLO5	Develop, document and debug modular python programs to solve computational problems.	K2, K3, K4

MAPPING WITH PROGRAMME OUTCOME(S):

CLO	POs						PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CLO 1	1	2	2	2	2	3	1	2	3
CLO 2	1	2	2	2	2	2	1	2	2
CLO 3	1	2	2	2	2	3	1	2	3
CLO 4	1	1	1	2	2	2	1	1	2
CLO 5	1	1	2	2	2	3	1	2	3

26DPMAE12	DATA ANAYTICS USING PYTHON	L	T	P	C
		4	1	0	3

COURSE OBJECTIVE: The objective of this course is to provide students with a clear and practical understanding of data analytics using Python and Power BI. The course focuses on data handling, data preparation, basic database concepts, data modeling, and interactive data visualization, enabling students to analyze and present data effectively for decision-making.

UNIT I: PYTHON & DATA HANDLING

Python Basics for Analytics: Introduction to data analytics and its applications - Overview of Python for analytics - Python syntax, indentation, and coding standards - Variables and built-in data types - Input and output operations - Type casting and basic operators.

Control Structures & Data Structures: Conditional statements: if, if-else, elif - Looping statements: for and while - break, continue, and pass - Lists and list operations - Tuples and sets - Dictionaries - Built-in functions and methods

UNIT II: PANDAS FOR DATA ANALYSIS

Introduction to Pandas - Pandas Series and Data Frame - Importing data from CSV and Excel files - Exploring and understanding datasets - Selecting, filtering, and sorting data - Handling missing and duplicate values - Grouping and aggregation operations - Exporting processed data

UNIT III: DATA CLEANING & DATASET PREPARATION

Data quality issues in real-world datasets - Data type correction and formatting - Handling missing, incorrect, and inconsistent data - Date and time handling - Renaming and restructuring columns - Merging and joining datasets - Reshaping data using pivot and melt - Preparing datasets for analytics and visualization

UNIT IV: DATABASE FUNDAMENTALS

Introduction to databases and DBMS - Types of databases: relational and non-relational (overview) - Tables, records, and fields - Primary keys and foreign keys - Introduction to SQL for analytics - Basic SQL operations: SELECT, WHERE, ORDER BY, GROUP BY

UNIT V: DATA MODELING FOR ANALYTICS

Introduction to data modeling - OLTP vs OLAP systems - Fact tables and dimension tables - Measures and attributes - Star schema concepts and examples - Relationships and cardinality - Best practices in analytics data modeling.

TEXT BOOKS

Wes McKinney, *Python for Data Analysis*, O'Reilly Media.

REFERENCE BOOKS

1. Cole Nussbaumer Knaflic, *Storytelling with Data*
2. Microsoft Learn – Power BI Guided Learning

COURSE LEARNING OUTCOMES (COs): After successful completion of this course, students will be able to:

CLO	Statements	Knowledge level
CLO1	Apply Python programming concepts for data handling and analysis	K1, K2, K3, K4
CLO2	Use Pandas for data analysis and data cleaning	K1, K2, K3
CLO3	Understand database fundamentals and retrieve data for analytics	K2, K3, K4
CLO4	Design basic data models suitable for reporting and dashboards	K2, K3, K4
CLO5	Interpret analytical results for research and industry applications	K2, K3, K4, K5

MAPPING WITH PROGRAMME OUTCOME(S):

CLO	POs						PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CLO1	1	2	3	-	3	3	3	2	1
CLO2	1	2	3	-	3	3	3	2	1
CLO3	1	2	3	-	3	3	3	2	1
CLO4	1	2	3	-	3	3	3	2	1
CLO5	1	2	3	-	3	3	3	2	1

26DPMAE13	NUMERICAL ANALYSIS	L	T	P	C
		4	1	0	4

OBJECTIVE: The objective of this course is

- ✓ 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: Solutions of Equations in One Variable

Newton's Method and its Extensions – Error Analysis for Iterative Methods – interpolation and Polynomial Approximation - Interpolation and the Lagrange Polynomial – Cubic Spline Interpolation.

Chapter 2 & 3: Sections 2.3, 2.4, 3.1, 3.4, 3.5

UNIT II: Numerical Differentiation and Integration

Numerical Differentiation – Elements of Numerical Integration – Romberg Integration.

Chapter 4: Sections 4.1,4.3,4.5

UNIT III: Initial Value Problems for Ordinary Differential Equations

Elementary Theory of Initial Value Problems – Euler's Method – Taylor Method – Runge- Kutta Methods.

Chapter 5: Sections 5.1,5.2,5.4

UNIT IV: Initial Value Problems for Ordinary Differential Equations (Continued)

Multistep Methods – Higher-Order Equations and Systems of Differential Equations – Stability.

Chapter 5: Sections 5.6,5.9,5.10

UNIT V: Numerical Solutions to Partial Differential Equations

Elliptic Partial Differential Equations – Parabolic Partial Differential Equations - Hyperbolic Partial Differential Equations.

Chapter 12: Sections 12.1-12.3

TEXT BOOK:

R. L. Burden and J.D. Faires, "Numerical Analysis", 9th Edition, Thomson Learning. Inc., Stanford, Connecticut, 2011.

BOOKS FOR SUPPLEMENTARY READING AND REFERENCES:

1. C.F. Gerald and P.O. Wheatley, "Applied Numerical Analysis" Sixth Edition, Addison- Wesley, Reading, 1998.
2. M.K. Jain, "Numerical Methods for Scientific and Engineering Computation" New Age International, 2003.

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

CLO	Statements	Knowledge level
CLO1	Apply numerical methods to obtain approximate solutions to mathematical problems.	K1, K2, K3
CLO2	Understand how to approximate the functions using interpolating polynomials	K1, K2, K3
CLO3	Perform error analysis for various methods	K2, K3, K4
CLO4	Learn numerical solution of ordinary and partial differential equations with an understanding of convergence, stability and consistency.	K2, K3, K4
CLO5	Analyze and evaluate the accuracy of common numerical methods	K3, K4, K5

MAPPING WITH PROGRAMME OUTCOME(S):

CLO	POs						PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CLO 1	1	2	2	3	3	3	1	2	3
CLO 2	1	2	2	3	2	3	1	2	2
CLO 3	1	2	2	3	3	3	1	2	3
CLO 4	1	2	3	3	3	3	1	3	3
CLO 5	1	2	2	2	3	3	1	2	3

26DPMAE14	FINANCIAL MATHEMATICS	L	T	P	C
		4	1	0	4

OBJECTIVE: In this course, the students will understand the concept of issue of risk management in a portfolio of asserts, derivative pricing models, arbitrage, finite probability spaces, discrete time pricing models, The Cox-Ross-Rubinstein model, The Blook-Schdes option pricing formula, the problem of pricing non attainable alternatives in an incomplete discrete model.

UNIT I: Portfolio Management and the Capital Asset Pricing Model

Portfolios, returns and risk – two-asset portfolios – Multi asset portfolios – stock options – the purpose of options – profit and Payoff curves – selling short.

Chapter 2 & 3: Sections 2.1 – 2.3 & 3.1 - 3.4

UNIT II: An Aperitif on Arbitage and more Discrete Probability

Background on forward contacts – the pricing of forward contracts – the put-call option parity formula – option prices – conditional probability – partitions and measurability – algebras – conditional expectation stochastic – processes – filtrations and martingales.

Chapter 4 & 5: Sections 4.1 – 4.4 & 5.1 - 5.6

UNIT III: Discrete – Time Pricing Models

Assumptions – positive random variables – the basic model by example – the basic model – portfolios and trading strategies – the pricing problem – arbitrage trading strategies – admissible – characterizing arbitrage – computing Martingale measures – the model – Martingale measures in the CRR model – pricing in the CRR model.

Chapter 6 & 7: Sections 6.1 - 6.10 & 7.1 - 7.4

UNIT IV: Continuous Probability

General probability spaces – probability measures on \mathbb{R} - distribution functions – density functions – types of probability measures on \mathbb{R} - random variables – the normal distribution – convergence in distribution – the central limit theorem – stock prices and Brownian motion – the CRR model in the limit – taking the limit as $\Delta t \rightarrow 0$.

Chapter 8 & 9: Sections 8.1 – 8.9 & 9.1 – 9.3

UNIT V: The Black – Scholes Option Pricing Formula and Optional Stopping

The natural CRR Model – the Martingale measure CRR model – more on the model from a different perspective – the Black – Scholes option pricing formula – how dividends affect the use of black – schools – the model – the payoffs – stopping times – stopping the payoff process – optimal stopping times and the Snell envelope – existence of optimal stopping times – optimal stopping times and the Doob decomposition – the smallest and the largest optimal stopping time.

Chapter 9 & 10: Sections 9.4 – 9.10 & 10.1 10.16

TEXT BOOK:

Steven Roman, "Introduction to the Mathematics of Finance from Risk Management to Options Pricing", Springer International edition, India, 2010.

BOOKS FOR SUPPLEMENTARY READING AND REFERENCES:

1. A. Etheridge, "A Course in Financial Calculus", Cambridge university press, Cambridge, 2002.
2. H. Föllmer, "Stochastic Finance: An Introduction to Discrete Time", Walter de Gruyter, 2002.
3. G. Kallianpur and R. Karamdikar, "Introduction to Option pricing Theory", Birkhouser, 1997.
4. S. Ross, "An Introduction to Mathematical Finance: Options and Other Topics", Cambridge University Press, 1999.
5. S. Ross, "An Elementary Introduction to Mathematical Finance", Cambridge University press, 2002.

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

CLO	Statements	Knowledge level
CLO1	Describe the main investment and risk characteristics of the standard asset classes available for investment purpose.	K1, K2, K3
CLO2	Calculate the discounted mean term or volatility of an asset or liability and analyse whether an asset-liability position is matched or immunized.	K1, K2, K3
CLO3	Demonstrate an understanding of the nature and use of simple stochastic interest rate models.	K2, K3, K4
CLO4	Calculate the forward price and value of a forwarded contract using no-arbitrage pricing.	K2, K3, K4
CLO5	Know about basic probability, random walks, central limit theorem, Brownian motion, Black schools' theory of options.	K2, K3, K4

MAPPING WITH PROGRAMME OUTCOME(S):

CLO	POs						PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CLO 1	2	2	1	2	2	3	1	3	3
CLO 2	1	2	2	2	2	3	2	2	2
CLO 3	1	2	1	2	2	3	1	2	3
CLO 4	1	1	1	2	2	3	1	1	3
CLO 5	1	1	1	2	2	3	1	2	3

26DPMAE15	MATHEMATICAL DOCUMENTATION USING LaTeX	L	T	P	C
		4	1	0	3

OBJECTIVE: The objective of this course is

- ✓ 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: 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, 2 & 3: Sections 1, 2 & 4, 1, 5, 8 (8.3 only)

UNIT II: 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 3: Sections 8 (8.2, 8.5, 8.6 and 8.9)

UNIT III: 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)

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 2: Sections 8, 9 & 12

UNIT V: Structuring Your Document

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.

Chapter 5: Sections 5 (5.1 – 5.7)

TEXT BOOK:

1. Advanced LATEX by Tim Love, 2006.
2. http://www.h.eng.cam.ac.uk/help/documentation/docsource/latex_advanced.pdf
3. LaTeX for Administrative Work by Nicola L. C. Talbot, Dickimaw Books, 2015, <http://www.dickimaw-books.com/latex/admin/>

4. The LaTeX Companion by Frank Mittelbach and Michel Goossens, Addison-Wesley, Library of Congress Cataloging-in-Publication Data (Second Edition)
5. Nicola L. C. Talbot, LATEX for Complete Novices Version 1.4, Dickimaw Books <http://www.dickimaw-books.com/2012>.

BOOKS FOR SUPPLEMENTARY READING AND REFERENCES:

1. Bindner, Donald & Erickson, Martin. (2011). "A Student's Guide to the Study, Practice, and Tools of Modern Mathematics", CRC Press, Taylor & Francis Group, LLC.
2. Lammport, Leslie (1994). LaTeX: A Document Preparation System, User's Guide and Reference Manual (2nd ed.). Pearson Education. Indian Reprint.
3. George Gratzer, More Math into LATEX, 4th Edition, 2007 Springer Science.
4. Frank Mittelbach, Michel Goossens, The LaTeX Companion, Second Edition, Addison-Wesley, 2004
5. A Primer, Latex, Tutorials, IndianTEX users' group, Trivandrum, India. www.tug.org.in

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

CLO	Statements	Knowledge level
CLO1	Create and typeset a LaTeX document	K1, K2, K3
CLO2	Typeset a mathematical document	K1, K2, K3
CLO3	Draw pictures in LaTeX	K1, K2, K3
CLO4	Create beamer presentations	K2, K3, K4
CLO5	Prepare the projects or dissertations in LaTeX	K2, K3, K4

MAPPING WITH PROGRAMME OUTCOME(S):

CLO	POs						PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CLO 1	1	1	1	2	2	2	1	2	2
CLO 2	1	1	1	1	2	2	1	1	2
CLO 3	1	1	1	1	2	2	1	1	2
CLO 4	1	1	1	1	2	2	1	1	2
CLO 5	1	1	1	1	2	2	1	1	2

26DPMAE16	INDUSTRIAL MATHEMATICS	L	T	P	C
		4	1	0	3

OBJECTIVE: The objectives of this course are

- ✓ to provide good mathematical modeling skills based on fundamental skills.
- ✓ to understand that the key factors can be expressible in terms of dimension less parameters.
- ✓ to understand methods for constant coefficient ordinary differential equations, systems of linear algebraic equations, graphical solutions of nonlinear transcendental equations.
- ✓ to introduce the method of regular perturbations.
- ✓ to introduce a case study about fires in a chipboard factory.

UNIT I: Dimensional Analysis

Mathematical Industry – Overview of the case studies – Unit and dimensions – Diffusion equations – Heat conduction equations – Boundary conditions – Solving the heat/diffusion equation – Scaling equations – Dimensional analysis

Chapter 1: Sections 1.1 – 1.10

UNIT II: Continuous Casting

Introduction to the case study problem – The Boltzmann similarity solution – A moving boundary problem – The pseudo-steady-state approximate solution – Solving the continuous casting case study.

Chapter 2: Sections 2.1-2.5

UNIT III: Water Filtration

Introduction to the case study problem – Stretching transformations – Diffusion from a point source – Solving the water filtration case study.

Chapter 3: Sections 3.1-3.4

UNIT IV: Laser Drilling

Introduction to the case study problem – Method of perturbations – Boundary perturbations – Solving the laser drilling case study.

Chapter 4: Sections 4.1-4.4

UNIT V: Factory Fires

Bifurcations and spontaneous ignition – ignition with conduction – Solving the factor fire case study.

Chapter 5: Sections 5.1-5.4

TEXT BOOK:

Glenn R. Fulford and Philip Broadbridge, “Industrial Mathematics: Case studies in the Diffusion of Heat and Matter”, Cambridge University Press, Cambridge, UK, 2002.

BOOKS FOR SUPPLEMENTARY READING AND REFERENCES:

1. Aziz and T.Y. Na, "Perturbation Methods in Heat Transfer", Springer-Verlag, Berlin, 1984, G.L. Barenblatt, Dimensional Analysis, Gordon and Breach, 1984.
2. G.L. Barenblatt, "Dimensional Analysis", Gordon and Breach, 1987.
3. N.D. Fowkeys and J.J. Mahony, "An Introduction to Mathematical Modelling," Wiley Publishers, UK, 1994.
4. Edward L. Cussler, "Diffusion-Mass Transfer in Fluid Systems", Cambridge University Press, 3rd Edition, 2009.

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

CLO	Statements	Knowledge level
CLO1	Understand the physical concepts for diffusion and heat conduction, and show how to formulate the main partial differential equations that describe these physical processes.	K1, K2, K3
CLO2	Find the puddle length in a continuous casting operation and calculate how fast molten steel solidifies and determine.	K2, K3, K4
CLO3	Understand the stretching symmetries of the PDE's and boundary conditions which allow the construction of variable combination which reduces the PDE to ODE.	K3, K4, K5
CLO4	Develop a mathematical model to calculate the drilling speed of a laser through a thick sheet of metal.	K3, K4, K5
CLO5	Obtain a criterion for safe storage of mildly combustible materials.	K4, K5, K6

MAPPING WITH PROGRAMME OUTCOME(S):

CLO	POs						PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CLO 1	1	1	1	2	2	2	1	1	2
CLO 2	2	2	2	2	2	3	2	2	3
CLO 3	1	1	1	2	2	2	1	1	2
CLO 4	1	1	1	2	2	2	1	1	2
CLO 5	1	1	1	2	2	3	1	2	3