Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
III	*CC*	***P24MMA301***	***Complex Analysis***	***90***	***5***	***25***	***75***	***100***

Objectives:

To Study Cauchy integral formula, local properties of analytic functions, general form of Cauchy's theorem and evaluation of definite integral and harmonic functions.

Course Outcomes (COs)

Cos	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Explain Cauchy integral formula and local properties of analytical functions.	**K2**
CO2	Analyze the general of form of Cauchy's theorem and calculate residues	**K4**
CO3	Evaluate certain types of definite integral and explain basic properties of Harmonic functions	**K5**
CO4	Develop the complex function into a Taylor or Laurent series.	**K6**
CO5	Explain the infinite products, canonical products and Jensen's formula.	**K2**

Cognitive Levels (K1-Remember**; K2-**Understand**; K3-**Apply**; K4-**Analyze**; K5-**Evaluate**; K6-**Create**)**

Syllabus:

Unit – I Cauchy's Integral Formula: (18 Hours)

The Index of a point with respect to a closed curve – The Integral formula – Higher derivatives.

Local Properties of analytical Functions:

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

Chapter 4: Section 2: 2.1 to 2.3, Section 3: 3.1 to 3.4

UNIT-II The general form of Cauchy's Theorem and the calculus of Residues: (18 hours)

Chains and cycles- Simple Connectivity - 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: Section 4: 4.1 to 4.7, Section 5: 5.1 and 5.2

UNIT-III The Calculus of Residues and Harmonic Functions: (18 Hours)

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

Chapter 4: Section 5: 5.3, Section 6: 6.1 to 6.3

UNIT-IV Harmonic Functions and Power Series Expansions: (18 Hours)

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

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

UNIT-V Partial Fractions and Entire Functions: (18 Hours)

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

Chapter 5: Sections 2.1 to 2.4 (Omit 2.5), Sections 3.1 and 3.2

Text Book:

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

Reference Books:

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.
5. S. Ponnusamy, Foundation of Complex Analysis, Second Edition (2005), Narosa Publising House.

E-Resources

1. https://archive.nptel.ac.in/courses/111/103/111103070/
2. https://onlinecourses.nptel.ac.in/noc23_ma51/preview
3. https://archive.nptel.ac.in/courses/111/106/111106084/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	-	2	-	-	2	2	2	3
CO2	2	3	2	-	2	-	-	2	3	2	2
CO3	2	2	2	-	2	-	-	2	2	2	2
CO4	2	2	2	-	2	-	-	2	2	2	2
CO5	2	2	2	-	2	-	-	2	2	2	2
Mean	2.2	2.4	2.2	-	2	-	-	2	2.2	2	2.2

Prepared by	Verified by
Mr. A.S. FAIZUR RAHMAN	HOD

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
III	*CC*	***P24MMA302***	***Topology***	***75***	***4***	***25***	***75***	***100***

Objectives: To study topological spaces, continuous functions, connectedness, compactness, countability and separation axioms.

Course Outcomes (COs) and Cognitive Level Mapping:

Cos	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Explain how the topology on a space is determined by the collection of open sets or by a basis.	**K2**
CO2	Prove various topological properties.	**K5**
CO3	Analyze various topological concepts and identify whether the given two topological spaces are equivalent (up to homeomorphic) or not.	**K4**
CO4	Assess whether a given point in a topological space is a limit point of a specified subset of that space.	**K5**
CO5	Apply separation axioms in the context of the Tietze extension theorem and Urysohn's lemma.	**K3**

Cognitive Levels (K1-Remember**; K2-**Understand**; K3-**Apply**; K4-**Analyze**; K5-**Evaluate**; K6-**Create**)**

Syllabus:

Unit – I Topological spaces: (15 Hours)

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 to 17

Unit – II Continuous functions: (15 Hours)

Continuous functions – the product topology – The metric topology.

Chapter 2: Sections 18 to 21

Unit – III Connectedness: (15 Hours)

Connected spaces- connected subspaces of the Real line – Components and local connectedness.

Chapter 3: Sections 23 to 25

Unit – IV Compactness: (15 Hours)

Compact spaces –Compact subspaces of the Real line – Limit point compactness– Local compactness.

Chapter 3: Sections 26 to 29

Unit – V Countability and Separation Axioms: (15 Hours)

The Countability Axioms – The separation Axioms – Normal spaces – The Urysohn Lemma – The Urysohn metrization Theorem – The Tietz extension theorem.

Chapter 4: Sections 30 to 35

Text Book:

James R. Munkres, Topology (2nd Edition), Prentice-Hall of India, Private Ltd., New Delhi-2007 (Third Indian Reprint).

Reference Books:

1. J. Dugundji, Topology, Prentice Hall of India, New Delhi, 1975.
2. G. F. Simmons, Introduction to Topology and Modern Analysis, Tata McGraw Hill Edition, 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

e-Resources:

https://onlinecourses.nptel.ac.in/noc25_ma10/

https://ocw.mit.edu/courses/18-901-introduction-to-topology-fall-2004/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	2	2	-	2	-	-	2	2	2	2
CO2	3	2	2	-	2	-	-	2	3	2	2
CO3	2	2	2	-	2	-	-	2	2	2	2
CO4	2	2	2	-	2	-	-	2	2	2	2
CO5	2	2	2	-	2	-	-	2	2	2	2
Mean	2.2	2	2	-	2	-	-	2	2.2	2	2

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
Dr. S.SURESH KUMAR	HOD

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
III	*CC*	***P24MMA303***	***Probability Theory***	***75***	***4***	***25***	***75***	***100***

Objectives: To introduce axiomatic approach to probability theory, to study some statistical characteristics, discrete and continuous distribution functions and their properties, characteristic function and basic limit theorems of probability.

Course Outcomes (COs)

Cos	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Apply the concepts of Random events and Random variables with examples.	**K3**
CO2	Evaluate expectation, moments and analyze regression of the first and second types.	**K5**
CO3	Explain the properties and functionalities of characteristic functions.	**K2**
CO4	Analyze the various special probability distributions.	**K4**
CO5	Examine the solutions for real time applications using limits theorem.	**K4**

Cognitive Levels (K1-Remember**; K2-**Understand**; K3-**Apply**; K4-**Analyze**; K5-**Evaluate**; K6-**Create**)**

UNIT-I: Random Events: (15 Hours)

Preliminary remarks - Random events and operations performed on them – The system of axioms of the theory of probability – Application of Combinatorial formulas for computing probabilities - Conditional probability – Bayes Theorem - Independent events.

Random Variables:

The concept of a random variable – The Distribution Function – Random variables of the Discrete type and Continuous type - Functions of Random Variables – Multidimensional random variables - Marginal Distributions - Conditional Distributions - Independent random variables - Functions of Multidimensional random variables.

Chapter 1: Sections 1.1 to 1.7 Chapter 2: Sections 2.1 to 2.9 (Omit sec:2.10)

UNIT-II: Parameters of the distribution of a random variable (15 Hours)

Expected values - Moments - The Chebyshev Inequality - Absolute moments - Order parameters - Moments of random vectors - Regression of the first type – Regression of the second type.

Chapter 3: Sections 3.1 to 3.8

UNIT-III: Characteristic Functions (15 Hours)

Properties of characteristic functions - The characteristic function and moments - Semi-invariants – The characteristic function of the sum of independent random variables - Determination of the distribution function by the Characteristic function – The characteristic function of multidimensional random vectors - Probability generating functions.

Chapter 4: Sections 4.1 to 4.7

UNIT-IV: Some Probability Distributions (15 Hours)

One-point and two-point distributions – The Bernoulli scheme - The Poisson scheme-The Polya and Hypergeometric distributions – The Poisson Distribution - The Uniform Distribution - The Normal Distribution – The Gamma Distribution - The Beta Distribution.

Chapter 5: Section 5.1 to 5.9 (Omit Sections 5.10 – 5.13)

UNIT-V: Limit Theorems (15 Hours)

Stochastic convergence – Bernoulli's law of large numbers – The convergence of a sequence of distribution functions – The Levy-Cramer Theorem – The de Moivre Laplace Theorem – Lindeberg-Levy Theorem – The Lapunov Theorem.

Chapter 6: Sections 6.2 to 6.4, 6.6 to 6.9.

(Omit Sections 6.1, 6.5, 6.10 - 6.15)

Text Book:

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

Reference Books:

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, Moden Probability Theory (3rd Edition), New Age International (P)Ltd, New Delhi, 1999.

E-Resources

1. https://archive.nptel.ac.in/courses/111/102/111102111/
2. https://archive.nptel.ac.in/courses/111/104/111104079/
3. https://onlinecourses.nptel.ac.in/noc20_ma18/preview
4. https://ocw.mit.edu/resources/res-6-012-introduction-to-probability-spring-2018/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

Cos	Programme Outcomes								Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	-	-	2	2	2	2
CO2	2	2	2	3	2	-	-	2	3	2	2
CO3	2	2	3	2	2	-	-	2	2	2	2
CO4	2	2	2	2	2	-	-	2	2	2	2
CO5	2	2	2	2	2	-	-	2	2	2	2
Mean	2	2	2.4	2.2	2	-	-	2	2.2	2	2

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
Dr. K. Mahaboob Hassain Sherieff	HOD

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
III	*CC*	***P24EMA301***	***Algebraic Number Theory (Elective - V)***	***75***	***3***	***25***	***75***	***100***

Objectives:

The course aims to provide a study on modules over rings, finite fields, algebraic extensions, number fields and cyclotomic fields, Noetherian rings and modules and Dedekind rings.

Course Outcomes (COs)

Cos	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Explain the basics concepts of rings, fields, modules and abelian groups.	K2
CO2	Identify the conjugates, norms, traces and rings of integers.	K3
CO3	Derive the Quadratic fields and cyclotomatic fields with some examples	K3
CO4	Analyze the consequences of unique factorization and discuss about the Ramanujan -Nagell Theorem.	K4
CO5	Discuss the norms of an ideal and non-unique Factorization in Cyclotomic Fields.	K4

Cognitive Levels (K1-Remember**; K2-**Understand**; K3-**Apply**; K4-**Analyze**; K5-**Evaluate**; K6-**Create**)**

UNIT-I ALGEBRAIC BACKGROUND (15 Hours)

Rings and Fields- Factorization of Polynomials - Field Extensions - Symmetric Polynomials - Modules - Free Abelian Groups.

Chapter 1: Sec. 1.1 to 1.6

UNIT-II ALGEBRAIC NUMBERS (15 Hours)

Algebraic numbers - Conjugates and Discriminants - Algebraic Integers - Integral Bases - Norms and Traces - Rings of Integers.

Chapters 2: Sec. 2.1 to 2.6

UNIT-III QUADRATIC AND CYCLOTOMIC FIELDS (15 Hours)

Quadratic fields and Cyclotomic fields.

Factorization into Irreducibles: Trivial factorizations - Factorization into irreducibles - Examples of non-unique factorization into irreducibles.

Chapter 3: Sec. 3.1 and 3.2; Chapter 4: Sec. 4.2 to 4.4

UNIT-IV Factorization into Irreducibles (Contd.): (15 Hours)

Prime Factorization - Euclidean Domains - Euclidean Quadratic fields - Consequences of unique factorization - The Ramanujan -Nagell Theorem.

Chapter 4: Sec. 4.5 to 4.9

UNIT-V IDEALS **(15 Hours)**

Prime Factorization of Ideals - The norms of an Ideal - Non-unique Factorization in Cyclotomic Fields.

Chapter 5: Sec. 5.2 to 5.4

Text Book:

I. Steward and D.Tall. Algebraic Number Theory and Fermat's Last Theorem (3rd Edition) A.K.Peters Ltd., Natrick, Mass. 2002.

Reference Books:

1. Z.I.Bosevic and I.R.Safarevic, Number Theory, Academic Press, New York, 1966.

2. J.W.S.Cassels and A.Frohlich, Algebraic Number Theory, Academic Press, New York, 1967.

3. P.Ribenboim, Algebraic Numbers, Wiley, New York, 1972.

4. P. Samuel, Algebraic Theory of Numbers, Houghton Mifflin Company, Boston, 1970.

5. A.Weil. Basic Number Theory, Springer, New York, 1967.

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc25_ma08/preview
2. https://archive.nptel.ac.in/courses/111/104/111104138/
3. http://elearn.psgcas.ac.in/nptel/courses/video/111101137/L59.html

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

Cos	Programme Outcomes								Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	2	2	2	-	-	-	2	2	2	2
CO2	3	2	3	2	-	-	-	2	2	2	2
CO3	3	2	2	2	-	-	-	2	2	2	2
CO4	2	2	2	2	-	-	-	2	3	2	2
CO5	2	2	2	2	-	-	-	2	2	2	2
Mean	2.4	2	2.2	2	-	-	-	2	2.2	2	2

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
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Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
III	*CC*	***P24EMA302***	***Fluid Dynamics (Elective - V)***	***75***	***3***	***25***	***75***	***100***

Objectives:

To discuss Kinematics in motion, to know about three dimensional flow and to analyze viscous flows.

Course Outcomes (COs) and Cognitive Level Mapping:

Cos	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Explain the concepts of kinematics of fluids in motions.	**K2**
CO2	Determine the pressure at a point in a moving fluid	**K5**
CO3	Discuss the Stokes stream function	**K4**
CO4	Analyze complex velocity potential for two dimensional flows.	**K4**
CO5	Describe the Navier – Stokes equations of motion of a Viscous fluid	**K6**

Cognitive Levels (K1-Remember**; K2-**Understand**; K3-**Apply**; K4-**Analyze**; K5-**Evaluate**; K6-**Create**)**

Syllabus:

UNIT-I: Kinematics of Fluids in Motion (15 Hours)

Real fluids and ideal fluids – Velocity of a fluid at a point, Stream lines, Path lines, steady and unsteady flows –Velocity potential – The vorticity vector – Local and particle rates of changes – Equations of continuity – Worked examples.

Chapter 2: Sections 2.1 to 2.8.

UNIT-II: Equations of Motion of a Fluid (15 Hours)

Pressure at a point in a fluid at rest – Pressure at a point in a moving fluid – Conditions at a boundary of two inviscid immiscible fluids – Euler's equation of motion –Bernoulli's equation – Worked Examples - Discussion of the case of steady motion under conservative body forces.

Chapter 3: Sections 3.1 to 3.7

UNIT-III: Some Three Dimensional Flows (15 Hours)

Introduction – Sources, sinks and doublets – Images in a rigid infinite plane – Axis symmetric flows – Stokes stream functions.

Chapter 4: Sections 4.1 - 4.3, 4.5 (Omit 4.4).

UNIT-IV: Some Two Dimensional Flows (15 Hours)

The stream function – The complex potential for two dimensional, irrational incompressible flow – Complex velocity potentials for standard two dimensional flows – Some worked examples – Two dimensional image systems –The Milne-Thompson circle Theorem.

Chapter 5: Sections 5.3 to 5.8

UNIT-V: Viscous Flows (15 Hours)

Stress components in a real fluid – Relations between Cartesian components of stress – Translational motion of fluid elements –The coefficient of viscosity and Laminar flow – The Navier Stokes equations of motion of a Viscous fluid.

Chapter 8: Sections 8.1 to 8.3, 8.8 and 8.9

Text Book:

F. Chorlton, Text Book of Fluid Dynamics, CBS Publications. Delhi ,1985

Reference Books

1. R.W.Fox and A.T.McDonald. Introduction to Fluid Mechanics, Wiley, 1985.

2.E.Krause, Fluid Mechanics with Problems and Solutions, Springer, 2005.

3.B.S.Massey, J.W.Smith and A.J.W.Smith, Mechanics of Fluids, Taylor and Francis, New York, 2005 4. P.Orlandi, Fluid Flow Phenomena, Kluwer, New Yor, 2002.
4.T.Petrila, Basics of Fluid Mechanics and Introduction to Computational Fluid Dynamics,Springer, Berlin, 2004.

Website and e-Learning Source

https://archive.nptel.ac.in/courses/112/105/112105269
https://archive.nptel.ac.in/courses/112/105/112105254
https://archive.nptel.ac.in/courses/112/104/112104118
https://web.mit.edu/1.63/www/lecnote.html

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	2	-	2	3	3	3
CO2	3	3	2	2	2	2	-	2	2	2	3
CO3	3	3	3	2	3	2	-	2	3	3	3
CO4	3	3	3	3	3	1	-	2	3	2	3
CO5	3	3	3	3	3	3	-	2	1	3	2
Mean	3	3	2.8	2.4	2.8	2	-	2	2.4	2.6	2.8

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
R.SUGUMAR	HOD

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
III	*DSEC*	***P24EMA303***	***Mathematical Python (Elective - V)***	***75***	***3***	***25***	***75***	***100***

Objectives:

To Study Cauchy integral formula, local properties of analytic functions, general form of Cauchy's theorem and evaluation of definite integral and harmonic functions.

Course Outcomes (COs)

Cos	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Classify the basic concepts of Python.	**K2**
CO2	Compute python commands for various problems on matrix, Calculus, Geometry.	**K5**
CO3	Evaluate the roots of Systems of Linear Equations.	**K5**
CO4	Solve the problems in numerical differentiation and integration	**K6**
CO5	Apply finite difference method to boundary value problems.	**K3**

Cognitive Levels (K1-Remember**; K2-**Understand**; K3-**Apply**; K4-**Analyze**; K5-**Evaluate**; K6-**Create**)**

Syllabus:

Unit – I Introduction to Python (15 Hours)

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 (15 Hours)

Python command storeduce 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 (15 Hours)

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 (15 Hours)

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 points boundary value Problems (15 Hours)

Second order differential equations Higher order differential equations solution of second order differential equation using Finite Difference Method.

Text Books:

1. J. Kiusalaas, Numerical methods in engineering with Python 3. Cambridge University Press, 2013.
2. H.P. Langtangen, Solving PDE sin Python: the FEniCS tutorial I. Springer Open, 2016

E-Resources

1. www.python.org
2. www.rosettacode.org
3. http://faculty.msmary.edu/heinold/python.html
4. https://nptel.ac.in/courses/106106145
5. https://onlinecourses.nptel.ac.in/noc23_ph46/preview

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	-	2	-	-	2	2	2	3
CO2	2	3	2	-	2	-	-	2	3	2	2
CO3	2	2	2	-	2	-	-	2	2	2	2
CO4	2	2	2	-	2	-	-	2	2	2	2
CO5	2	2	2	-	2	-	-	2	2	2	2
Mean	2.2	2.4	2.2	-	2	-	-	2	2.2	2	2.2

Prepared by	Verified by
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Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
III	*SEC*	***P24SMAP31***	***Practical - Differential Equations using SCILAB (SBS - II)***	***30***	***2***	***25***	***75***	***100***

Objectives:

In this course, we introduce the SCILAB software an alternative to MATLAB is a scientific software package providing a powerful open Computing environment for engineering and scientific applications.

Cos	After completing the course, the students will able to	Cognitive Level
CO1	Create basic SCILAB syntax.	**K6**
CO2	Create plot and visualize 2D graphs of various functions.	**K6**
CO3	Determine the numerical solutions of ODEs by using Runge Kutta method	**K6**
CO4	Solve the system of ODEs using Eigenvalues and Eigenvectors.	**K6**
CO5	Solve the linear PDEs.	**K6**

Cognitive Levels (K1-Remember**; K2-**Understand**; K3-**Apply**; K4-**Analyze**; K5-**Evaluate**; K6-**Create**)**

Syllabus: (30 Hours)

1. Verification of Euler's Theorem and modified Euler's Theorem for given homogeneous function.
2. Solving first order ordinary differential equations.
3. Solution of second order ordinary differential equations with initial conditions.
4. Solving Ordinary differential equations using Euler's method.
5. Runge- Kutta method of 3rd order.
6. Runge- Kutta method of 4th order.
7. Solving ODEs using Laplace Transform.
8. Solving system of ODEs using Eigenvalues and Eigenvectors.
9. Solving linear Partial differential equations.
10. Applications of differential equations.
11. Solving and plotting.

Reference Books:

1. Anil Kumar Verma, Scilab - A beginners approach, First Edition,Cengage.
2. Sandeep Nagar, Introduction to Scilab For engineers and scientists, First Edition, Apress.
3. Rachna Verma Arvind Kumar Verma- Introduction to Scilab (Student Edition), First Edition.

E-Resources:

1. https://x-engineer.org/ode-scilab/
2. https://flexbooks.ck12.org/cbook/ck-12-calculus-concepts/section/8.14/primary/lesson/numerical-methods-for-solving-odes-calc/
3. https://www.youtube.com/watch?v=vMrI4ePxZ_c

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	2	3	-	2	-	-	2	3	2	2
CO2	2	2	2	-	2	-	-	2	2	2	2
CO3	2	2	2	-	2	-	-	2	2	2	3
CO4	2	2	2	-	3	-	-	2	2	2	2
CO5	3	2	2	-	2	-	-	2	2	2	2
Mean	2.2	2	2.2	-	2.2	-	-	2	2.2	2	2.2

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
N. IMRAN	HOD

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
IV	*CC*	***P24MMA401***	***Functional Analysis***	***75***	***4***	***25***	***75***	***100***

Objectives: To provide students with a strong foundation in functional analysis, focusing on spaces, operators and fundamental theorems. To develop student's skills and confidence in mathematical analysis and proof techniques.

Course Outcomes (COs) and Cognitive Level Mapping:

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Analyze the concepts of Banach space, Hilbert space, and Banach Algebra.	**K4**
CO2	Explain continuous linear transformation, Natural imbedding, orthonormal sets.	**K2**
CO3	Apply the properties of adjoint, self-adjoint, normal, and unitary operators in the context of Hilbert spaces.	**K3**
CO4	Examine the spectrum, resolvent and spectral radius of an operator.	**K4**
CO5	Prove various results in Banach spaces, Hilbert spaces and Banach Algebras.	**K5**

Syllabus:

Unit – I Banach Spaces: (18 Hours)

The definition and some examples – Continuous linear transformations – The Hahn-Banach theorem – The natural imbedding of N in N^{**}

Chapter 9: Sections 46-49

Unit – II (18 Hours)

Banach Spaces:

The open mapping theorem – The conjugate of an operator.

Hilbert Spaces:

The definition and some simple properties–Orthogonal complements–Orthonormal sets–The conjugate space H^*.

Chapter 10: Sections 50-55

Unit – III (18 Hours)

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

Finite-Dimensional Spectral Theory: The spectral theorem.

Chapter 10: Sections 56-59

Chapter 11: Sections 62

Unit – IV General Preliminaries on Banach Algebras: (18 Hours)

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

Chapter 12: Sections 64-69.

Unit – V The Structure of Commutative Banach Algebras: (18 Hours)

The Gelfand mapping – Applications of the formula $r(x) = \lim \|x^n\|^{1/n}$– Involutions in Banach algebras –The Gelfand-Neumark theorem.

Chapter 13: **Sections 70-73**

Text Book:

G. F. Simmons, Introduction to Topology and Modern Analysis, Tata McGraw Hill Edition (India), New Delhi, 1963.

Reference Books:

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.

e-Resources:

https://ocw.mit.edu/courses/18-102-introduction-to-functional-analysis-spring-2009/

https://ocw.mit.edu/courses/18-102-introduction-to-functional-analysis-spring-2021/

onlinecourses.nptel.ac.in/noc25_ma25/preview

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	-	2	-	-	2	2	2	3
CO2	2	3	2	-	2	-	-	2	3	2	2
CO3	2	2	2	-	2	-	-	2	2	2	2
CO4	2	2	2	-	2	-	-	2	2	2	2
CO5	2	2	2	-	2	-	-	2	2	2	2
	2.2	2.4	2.2	-	2	-	-	2	2.2	2	2.2

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
Dr.S.SURESH KUMAR	HOD

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
IV	*CC*	***P24MMA402***	***Differential Geometry***	***75***	***4***	***25***	***75***	***100***

Objectives:

This course introduces space curves and their intrinsic properties of a surface and geodesics. Further the non-intrinsic properties of surfaces are explored. To be able to understand the fundamental theorem for plane curves.

COs	After completing the course, the students will be able to	Cognitive Level
CO1	Explain the space curves and distinguish tangent, normal and bi normal.	K2
CO2	Define a surface and Determine the surface of revolution	K5
CO3	Determine the geodesics on various types of surfaces and its properties. Compute the Gaussian curvature and surface of constant curvature	K5
CO4	Classify the curvature as principal and lines of curvature.	K4
CO5	Construct and analyze the problems on curvature and minimal surfaces	K6

Syllabus:

UNIT: I The Theory of Space Curves (18 Hours)

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

Chapter I: Sections 1 to 9

UNIT: II The Metric: Local Intrinsic Properties of a Surface (18 Hours)

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

Chapter II: Sections 1 to 9

UNIT: III The Metric: Local Intrinsic Properties of a Surface (Conti.) (18 Hours)

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

Chapter II: Sections 10 to 14

UNIT: IV The Metric: Local Intrinsic Properties of a Surface (Conti.) (18 Hours)

Geodesic curvature - Gauss - Bonnet Theorem - Gaussian curvature - Surfaces of constant curvature.

Chapter II: Sections 15 to 18

UNIT: V The Second Fundamental Form: Local Non-Intrinsic Properties of a Surface

(18 Hours)

The second fundamental form - Principal curvatures- Lines of curvature - Developables - Developables associated with space curves and with curves on surfaces - Minimal surfaces - Ruled surfaces.

Chapter III: Sections 1 to 8 (Omit Sections 9,10 and 11)

Text Book:

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

Reference Books:

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

E- Resources:

1. https://people.math.ethz.ch/~salamon/PREPRINTS/diffgeo.pdf
2. https://math.ou.edu/~npetrov/final-paper-nathan-leiphart.pdf
3. https://bimsa.net/activity/Basofdifgeo/
4. https://www.cmat.edu.uy/~lessa/tesis/fundamentals_of_differential_geometry_gtm_191_.pdf

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	2	2	-	2	-	-	2	2	2	2
CO2	2	2	2	-	2	-	-	2	2	2	2
CO3	2	2	2	-	2	-	-	2	3	2	2
CO4	3	2	2	-	2	-	-	2	2	2	2
CO5	2	2	2	-	2	-	-	2	2	2	2
Mean	2.2	2	2	-	2	-	-	2	2.2	2	2

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
N. IMRAN	HOD

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
IV	*CC*	***P24MMA403***	***Mechanics***	***75***	***4***	***25***	***75***	***100***

Objectives:

1. To study mechanical systems under generalized coordinate systems, virtual work, energy and momentum.
2. To study mechanics developed by Newton, Lagrange's, Hamilton, Jacobi and theory of relativity due to Einstein.

Course Outcomes (COs)

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Explain the basics concepts of mechanical systems under generalized coordinate systems.	K2
CO2	Evaluate differential equation of motion using Lagrange's equation.	K5
CO3	Apply Euler Lagrange's equation to compute the stationary values and to study Hamilton's and Jacobi's equations.	K3
CO4	Analyze the Hamilton's Principle and Hamilton-Jacobi Equation and separability.	K4
CO5	Discuss the Lagrange and Poisson brackets.	K6

UNIT-I: MECHANICAL SYSTEMS (18 Hours)

The Mechanical system - Generalized coordinates - Constraints - Virtual work - Energy and Momentum.
Chapter 1: Sections 1.1 to 1.5

UNIT-II: LAGRANGE'S EQUATIONS (18 Hours)

Derivation of Lagrange's equations- Examples - Integrals of the motion.
Chapter 2: Sections 2.1 to 2.3. (Omit Section 2.4)

UNIT-III: HAMILTON'S EQUATIONS (18 Hours)

Hamilton's Principle - Hamilton's Equations - Other variational principles.
Chapter 4: Sections 4.1 to 4.3. (Omit Section 4.4)

UNIT-IV: HAMILTON-JACOBI THEORY (18 Hours)

Hamilton's Principle function - Hamilton-Jacobi Equation - Separability.
Chapter 5: Sections 5.1 to 5.3.

UNIT-V : CANONICAL TRANSFORMATIONS (18 Hours)

Differential forms and generating functions - Lagrange and Poisson brackets.
Chapter 6: Sections 6.1 and 6.3.

Text Book:

Donald T. Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1979.

Reference Books

1. H. Goldstein, Classical Mechanics, (2nd Edition) Narosa Publishing House, New Delhi.
2. N.C.Rane and P.S.C.Joag, Classical Mechanics, Tata McGraw Hill, 1991.
3. J.L.Synge and B.A.Griffth, Principles of Mechanics (3rd Edition) McGraw Hill Book Co.,New York, 1970.

E-Resources:

https://ocw.mit.edu/courses/physics/8-09-classical-mechanics-iii-fall-2014/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	Programme Outcomes								Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	-	-	2	2	2	2
CO2	2	2	2	2	-	-	-	2	3	2	2
CO3	2	2	3	2	-	-	-	2	2	2	2
CO4	2	2	2	2	-	-	-	2	3	2	2
CO5	2	2	2	2	-	-	-	2	2	2	2
Mean	2.2	2	2.2	2	-	-	-	2	2.4	2	2

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
Dr. K. Mahaboob Hassain Sherieff	HOD

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
IV	*DSEC*	***P24EMA401***	***Calculus of Variations and Integral Equations (Elective VI)***	***75***	***3***	***25***	***75***	***100***

Objectives:

This course aims to get the knowledge of variational calculus and integral equations.

Course Outcomes (COs)

Cos	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Determine the extremum of the functional with fixed boundaries.	**K5**
CO2	Solve the variational problems with moving boundaries.	**K3**
CO3	Solve integral equations with separable kernels.	**K3**
CO4	Evaluate the resolvent kernel and find the solution of the integral equations.	**K5**
CO5	Formulate the initial and boundary value problems into Volterra and Fredholm integral equations respectively and solve singular integral equations.	**K6**

Syllabus:

Unit – I: VARIATIONAL PROBLEMS WITH FIXED BOUNDARIES: **(15 Hours)**

The concept of Variation and its properties - Euler's equation - Variational problems for functionals of the form $\int_a^b F\left(x, y_1(x), \dots, y_n(x), y_1'(x), \dots, y_n'(x)\right)dx$ - Functionals dependent on higher order derivatives – Functionals dependent on functions of several independent variables - variational problems in parametric form- Some applications to problems of mechanics.

Chapter 1: 1.1 to 1.7 (BOOK 1)

UNIT - II: VARIATIONAL PROBLEMS WITH MOVING BOUNDARIES (15 Hours)

Functional of the form $\int_{x_1}^{x_2} F(x, y, y')dx$ – Variational problem with a movable boundary for a functional dependent on two functions - One sided variations - Reflection and Refraction of extremals - Diffraction of light rays.

Chapter 2: 2.1 to 2.5 (BOOK 1)

UNIT – III: INTEGRAL EQUATIONS (15 Hours)

INTRODUCTION: Definition - Regularity conditions - Special kinds of Kernals – Eigenvalues and Eigen functions - Convolution integral.

INTEGRAL EQUATIONS WITH SEPARABLE KERNELS: Reduction to a system of algebraic equations - Examples - Fredholm alternative - Examples - An approximate method.

Chapter 1: 1.1 to 1.5 and Chapter 2: 2.1 to 2.5 (BOOK 2)

UNIT – IV: **(15 Hours)**

METHOD OF SUCCESSIVE APPROXIMATIONS: Iterative scheme - Examples - Volterra integral equation - Examples - Some results about the resolvent kernel.

CLASSICAL FREDHOLM THEORY:

The method of solution of Fredholm equation - Fredholm first theorem - Examples.

Chapter 3: 3.1 to 3.5 and Chapter 4: 4.1 to 4.3 (BOOK 2)

UNIT – V: **(15 Hours)**

APPLICATIONS TO ORDINARY DIFFERENTIAL EQUATIONS: Initial value problems - Boundary value problems – Examples.

SINGULAR INTEGRAL EQUATIONS: The Abel integral equations - Examples.

Chapter 5: 5.1 to 5.3 and Chapter 8: 8.1 and 8.2 (BOOK 2)

Text Books:

1. A. S. Gupta, Calculus of Variations with Applications, PHI, New Delhi, 2005. **(for Units I and II)**
2. Ram P. Kanwal, Linear Integral Equations, Theory and Techniques, Academic Press, New York, 1971. **(for Units III, IV and V)**

Reference Books:

1. M. D. Raisinghania, Integral Equations and Boundary Value Problems, S. Chand & Co., New Delhi, 2007.
2. Sudir K. Pundir and Rimple Pundir, Integral Equations and Boundary Value Problems, Pragati Prakasam, Meerut. 2005.

E-Resources

https://archive.nptel.ac.in/courses/111/107/111107103/#

https://nptel.ac.in/courses/111104025

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	-	2	-	-	2	2	2	3
CO2	3	3	2	-	2	-	-	2	3	2	2
CO3	3	2	3	-	2	-	-	2	2	2	2
CO4	2	3	2	-	2	-	-	2	3	2	2
CO5	2	2	2	-	2	-	-	2	2	2	2
	2.6	2.6	2.4	-	2	-	-	2	2.4	2	2.2

Prepared by	Verified by
Mr. A.S. FAIZUR RAHMAN	HOD

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
IV	*DSEC*	***P24EMA402***	***Stochastic Processes (Elective VI)***	***75***	***3***	***25***	***75***	***100***

Objectives: The main objectives of this course are to:
1. Suffice the students to have an overall exposure to the elements of stochastic processes so as to gain a complete knowledge of stochastic processes
2. Create analytical skills and practical thinking to apply the gained knowledge in real life situations
3. Sharpen the knowledge of students towards generalizing the existing results for advanced technological applications.

Course Outcomes (COs) and Cognitive Level Mapping:

Cos	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Explain the basic concepts of stochastic processes and Markov chains.	**K2**
CO2	Evaluate their pros and cons of Markov Chains.	**K4**
CO3	Examine Markov process with discrete state space and generalization of Poisson process	**K5**
CO4	Explain Birth and death process and continuous time Markov chains	**K2**
CO5	Analyze the impact of Brownian motion in models involving random phenomena	**K4**

Cognitive Levels (K1-Remember**; K2-**Understand**; K3-**Apply**; K4-**Analyze**; K5-**Evaluate**; K6-**Create**)**

Syllabus:

Unit – I **(15 Hours)**

Stochastic processes: An introduction – Specification of Stochastic processes.

Markov Chains: Definitions and Examples – Higher transition probabilities – Generalisation of independent Bernoulli trials.

Chapter 1: Section 1.5

Chapter 2: Sections 2.1 to 2.3

Unit – II Markov Chains: **(15 Hours)**

Stability of a Markov system – Graph theoretic approach – Markov chain with denumerable number of states – Reducible chains – Statistical inference for Markov chains.

Chapter 2: Sections 2.6 to 2.10

Unit – III Markov Processes with Discrete State Space: **(15 Hours)**

Poisson process – Poisson process and related distributions – Generalizations of Poisson process.

Chapter 3: Sections 3.1 to 3.3

Unit – IV Markov Processes with Discrete State Space (Cont…) **(15 Hours)**

Birth and death process – Markov processes with discrete state space (Continuous time Markov chain).

Chapter 3: Sections 3.4 and 3.5

Unit – V Markov Processes with Continuous State Space **(15 Hours)**

Brownian motion – Weiner process – Differential equations for a Weiner Process – Kolmogorov equations – First passage time distribution for Weiner process.

Chapter 4: **Sections 4.1 to 4.5**

Text Book:

J. Medhi, Stochastic Processes (3rd Edition), New Academic Science Limited, 2012.

Reference Books:

1. S. Karlin, A first course in Stochastic Processes, (2nd Edition), Academic Press, 1958.
2. U.N. Bhat, Elements of Applied Stochastic Prcesses, John Wiley Sons, 1972.
3. E. Cinlar, Introduction to Stochastic Processes, PHI, 1975.
4. S.K. Srinivasan and A. Vijayakumar, Stochastic Processes, Narosa, 2003.

e-Resources:

https://archive.nptel.ac.in/courses/111/102/111102098/

https://ocw.mit.edu/search/?q=stochastic%20process

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	2	-	2	-	-	2	2	2	2
CO2	2	3	2	-	2	-	-	2	2	3	3
CO3	2	2	2	-	2	-	-	2	2	2	2
CO4	2	2	2	-	2	-	-	3	2	2	2
CO5	2	2	2	-	2	-	-	2	2	2	2
	2.2	2.2	2	-	2	-	-	2.2	2	2.2	2.2

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
Dr. S. SURESH KUMAR	HOD

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
IV	*DSEC*	***P24EMAP41***	***Mathematical Python - Practical (Elective VI)***	***75***	***3***	***25***	***75***	***100***

Objectives:

To apply basic Python and to solve mathematical problems, Graphical representation and manipulation of data using python.

Course Outcomes (COs)

Cos	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Solve basic problems in Calculus.	K6
CO2	Evaluate problems on matrix.	K5
CO3	Solutions of difference equations.	K6
CO4	Solve system of linear equations.	K6
CO5	Solve differential equations.	K6

List of Practical:

1. Find minimum/maximum in a list / guess an integer in given range.
2. Distance between two points.
3. Find GCD.
4. Sum an array of numbers.
5. Find the numbers which are divisible by n in a given range.
6. Print first n Fibonacci numbers.
7. Selection sort.
8. Insertion sort.
9. Generate adjacency matrix of any graph on n vertices.
10. Find degree of vertices from given adjacency matrix of the graph.
11. Find odd number in given array/ Replace odd numbers with given integer in the given array.
12. Compute multiplication of two 3x3 matrices.
13. Compute mean and standard deviation of given array.
14. Create a Bar plot / Pie chart for comparing three features.
15. Matrix to echelon form and normal form.
16. The consistency or otherwise and solving system of linear equations.
17. The nth derivatives with and without Leibnitz rule.
18. Partial derivative of some standard functions.
19. Verification of Euler's theorem, its extension and Jacobean.
20. Reduction formulae with or without limits.
21. Equation and plot sphere, cone, cylinder.
22. Simple Iterations Method.
23. Finite Differences Method.
24. Gauss Elimination Method.
25. Jacobi's Method.
26. Gauss-Seidel's Method.
27. Euler's Method.
28. Second Order Runge – Kutta's Method.
29. Fourth Order Runge –Kutta's Method.

30. Fourth Order Runge- Kutta's Method: Plot Numerical and Exact Solutions.
31. Second order differential equation using Finite Difference Method.

Reference Books:

1. Allen B. Dowley, Think Python: How to Think Like a Computer Scientist, 2nd Edition
2. Wes McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Ipython, O'Reilly, 2nd Edition, 2018.
3. Jake Vander Plas, Python Data Science Hand Book: Essential Tools for working with Data, O'Reilly, 2017.
4. Wesley J. Chun, Core Python Programming, Prentice Hall, 2006.
5. N. Safina Devi and C. Devamanoharan, Algorithmic Problem Solving and Python- A Beginner's Guide, Francidev Publications, 2023.

E-Resources

1.http://www.python.org
2.www.rosettacode.org
3.http://faculty.msmary.edu/heinold/python.html

4. https://onlinecourses.nptel.ac.in/noc23_ph46/preview

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	3	2	-	-	-	2	3	3	2
CO2	2	3	3	3	-	-	-	2	3	3	2
CO3	3	3	3	3	-	-	-	2	2	3	2
CO4	3	3	3	2	-	-	-	2	2	2	2
CO5	3	3	3	2	-	-	-	2	3	2	2
	2.6	3	3	2.4	-	-	-	2	2.4	2.6	2

Prepared by	Verified by
Mr. A.S. FAIZUR RAHMAN	HOD

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
IV	*DSEC*	***P24EMA404***	***Algebraic Geometry (Elective VII)***	***75***	***3***	***25***	***75***	***100***

Objectives:

The course aims at giving an introduction to Basic Algebraic geometry, that is, the theory of algebraic varieties, elliptic curves, and cubic surfaces.

COs	After completing the course, the students will able to	**Cognitive Level**
CO1	Explain Plane Algebraic Curves, Closed Subsets of Affine Spaces, Rational Functions	**K2**
CO2	Explain and classify the singular points and its properties.	**K5**
CO3	Determine the divisors of curves.	**K5**
CO4	Prove Bezouts theorem in a projection space and explain.	**K3**
CO5	Analyze the properties of the points of a spectra of rings	**K4**

Syllabus

UNIT I: **Fundamental Concepts** **(15 Hours)**
Plane Algebraic Curves-Closed Subsets of Affine Spaces- Rational Functions
Chapter I: Section 1 to Section 3

UNIT II: **Local Properties** **(15 Hours)**
Simple and Singular Points-Expansion in Power Series-Properties of Simple Points.
Chapter II: Section 1 to Section 3

UNIT III: **Divisors and Differential Forms** **(15 Hours)**
Divisors-Divisors on Curves-Algebraic Groups.
Chapter III: Section 1 to Section 3

UNIT IV: **Intersection Indices** (15 **Hours)**
Definition and Basic Properties- Applications and Generalizations of Intersection Indices.
Chapter IV: Section 1 to Section 2

UNIT V: **Schemes** (15 **Hours)**
Spectra of Rings-Sheaves-Schemes.
Chapter V: Section 1 to Section 3

Text Book:

Basic Algebraic Geometry by I. R. Shafarevich, Springer- Verlag, Berlin, Heidelberg, New York 1972

Reference Books:

1. C. Musli, Algebraic Geometry for Beginners, TRIM-20, Hindustan Book Agency, 2001.
2. K. Hulek, Elementary Algebraic Geometry, SML, vol 20, American Mathematical Society, 2003.
3. M. Ried, Undergraduate Algebraic Geometry, LMS Student texts 12, Cambridge University Press, 1988.

E- Resources:

1. https://johncarlosbaez.wordpress.com/2019/03/15/algebraic-geometry/
2. https://www.math.purdue.edu/~arapura/algeom.html

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	Programme Outcomes								Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	-	-	2	2	2	2
CO2	2	2	2	3	2	-	-	2	3	2	2
CO3	2	2	3	2	2	-	-	2	2	2	2
CO4	2	2	2	2	2	-	-	2	2	2	2
CO5	2	2	2	2	2	-	-	2	2	2	2
Mean	2	2	2.4	2.2	2	-	-	2	2.2	2	2

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
N. IMRAN	HOD

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
IV	*DSEC*	***P24EMA405***	***Financial Mathematics (Elective VII)***	***75***	***3***	***25***	***75***	***100***

Objectives: To study financial mathematics through various models and to study the various aspects of financial mathematics.

Course Outcomes (COs) and Cognitive Level Mapping:

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Utilize discrete and continuous processes in financial modeling	**K3**
CO2	Identify the relationship between stochastic and deterministic models	**K5**
CO3	Examine the roles of Put and Call options in risk reduction also	**K4**
CO4	Illustrate hedging strategies to reduce risk	**K2**
CO5	Interpret the role of the Black-Scholes partial differential equation and its boundary and final conditions in option pricing.	**K6**

UNIT – I **(15 Hours)**

Single Period Models: Definitions from Finance - Pricing a forward - One-step Binary Model - a ternary Model - Characterization of no arbitrage - Risk-Neutral Probability Measure.

Chapter 1

UNIT – II: **(15 Hours)**

Binomial Trees and Discrete Parameter Martingales: Multi-period Binary model - American Options - Discrete parameter martingales and Markov processes - Martingale Theorems - Binomial Representation Theorem – Overture to Continuous models.

Chapter 2

UNIT – III: **(15 Hours)**

Brownian Motion: Definition of the process - Levy's Construction of Brownian Motion - The Reflection Principle and Scaling - Martingales in Continuous time.

Chapter 3

UNIT – IV: **(15 Hours)**

Stochastic Calculus: Non-differentiability of Stock prices - Stochastic Integration - Ito's formula - Integration by parts and Stochastic Fubini Theorem – Girsanov Theorem - Brownian Martingale Representation Theorem – Geometric Brownian Motion - The Feynman - Kac Representation.

Chapter 4

UNIT – V: **(15 Hours)**

Block-Scholes Model: Basic Block-Scholes Model - Block-Scholes price and hedge for European Options - Foreign Exchange - Dividends - Bonds – Market price of risk.

Chapter 5

Text Book:

Alison Etheridge, A Course in Financial Calculus, Cambridge University Press, Cambridge, 2002.

Reference Book

1. Martin Boxter and Andrew Rennie, Financial Calculus: An Introduction to Derivatives Pricing, Cambridge University Press, Cambridge, 1996.
2. Damien Lamberton and Bernard Lapeyre, (Translated by Nicolas Rabeau and Farancois Mantion),
3. Introduction to Stochastic Calculus Applied to Finance, Chapman and Hall,1996.
4. Marek Musiela and Marek Rutkowski, Martingale Methods in Financial Modeling, Springer Verlag, New York, 1988.
5. Robert J.Elliott and P. Ekkehard Kopp, Mathematics of Financial Markets,Springer Verlag, New York, 2001 (3rd Printing)

e-Resources:

https://archive.org/details/financialmathema032436mbp
https://onlinecourses.nptel.ac.in/noc20_me36/preview

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	-	2	1	3	1
CO2	3	3	2	1	2	2	-	2	3	2	2
CO3	3	2	3	2	3	3	-	2	2	1	3
CO4	3	3	3	3	3	3	-	2	3	2	3
CO5	3	2	3	3	3	3	-	2	1	2	1
Mean	3	2.6	2.8	2.4	2.8	2.8	-	2	2	2	2

3 – Strong; 2 – Medium; 1 – Low

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Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
IV	*DSEC*	***P24EMA406***	***Resource Management Techniques (Elective - VII)***	***75***	***3***	***25***	***75***	***100***

Objectives:

1. Be familiar with resource management techniques.
2. To Learn Problems Games with or without saddle point and Replacement of items.
3. To understand stochastic simulation and random number and to interpret Shannon Fano encoding procedure

Course Outcomes (COs) and Cognitive Level Mapping:

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Categorize Game with saddle point and without saddle point	**K5**
CO2	Construct Gradual failure and Sudden failure	**K5**
CO3	Explain Markov Chains	**K2**
CO4	Relate stochastic simulation and random number	**K5**
CO5	Interpret Shannon-Fano Encoding Procedure	**K6**

UNIT- I: Theory of Games (15 Hours)

Introduction –Two Person Zero-Sum Games-Pure Strategies-Games with Saddle Point -Mixed Strategies: Game without saddle point –The rules of Dominance- Solution methods for games without saddle point (Algebraic method, Arithmetic methods and Graphical methods only).

Chapter:12-Sections:12.1 to 12.6

UNIT – II: Replacement and Maintenance Models (15 Hours)

Introduction- Types of Failure: Gradual failure and Sudden Failure-Replacement of items whose efficiency deteriorates with time: Model I and Model II - Replacement of items that fail Completely: Individual Replacement Policy and Group Replacement Policy.

Chapter:17: Sections: 17.1 to 17.4

UNIT- III: Markov Chains (15 Hours)

Introduction – Characteristics of a Markov Chain - Applications of Markov Analysis – State and Transition Probabilities – Multi period transition Probabilities - Steady state conditions – Absorbing states and Accounts Receivable Applications.

Chapter:18: Sections:18.1 to 18.7

UNIT- IV: Simulation (15 Hours)

Introduction - Simulation defined -Types of simulation - Steps of simulation Process - Advantages and disadvantages of simulation - Stochastic simulation and random numbers - Simulation inventory problems- Simulation of queuing Problems –Simulation of investment problems.

Chapter:19: Sections:19.1 to 19.8

UNIT- V: Information Theory (15 Hours)

Introduction - Communication Process - A measure of Information - Measure of other information quantities – Channel Capacity, Efficiency and Redundancy – Encoding - Shannon-Fano Encoding Procedure - Necessary and sufficient condition for Noiseless Encoding.

Chapter:21: Sections:21.1 to 21.8

Text Book:

J. K. Sharma, Operations Research: Theory and Applications, Macmillan-Third Edition, 2007.

Reference Books

1. Paneer Selvam, Operations Research, Prentice Hall of India, 2002
2. Anderson Quantitative Methods for Business, 8th Edition, Thomson Learning, 2002.
3. Winston, Operation Research, Thomson Learning, 2003.
4. Vohra, Quantitative Techniques in Management, Tata Mc-Graw Hill, 2002.
5. Anand sharma , Operations Research, Himalaya Publishing House, 2003.
6. Hamdy A.Taha, Operations Research: An introduction –Eight Edition, Pearson Prentice Hall-2007.

e-Learning Source

https://onlinecourses.nptel.ac.in/noc19_ge32/preview
https://archive.nptel.ac.in/courses/105/102/105102176/
https://github.com/jsvine/markovify

https://archive.nptel.ac.in/noc/courses/noc18/SEM2/noc18-ee39/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	2	2	-	2	-	-	2	3	1	3
CO2	3	2	2	-	2	-	-	2	3	2	2
CO3	2	2	2	-	2	-	-	2	3	3	3
CO4	2	2	2	-	2	-	-	2	2	2	1
CO5	2	2	2	-	2	-	-	2	3	3	3
Mean	2.2	2	2	-	2	-	-	2	2.2	2.2	2.4

3 – Strong; 2 – Medium; 1 – Low

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R.SUGUMAR	HOD

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
IV	*SEC*	***P24SMAP41***	***Practical - Computational Mathematics using SageMath (SBS - III)***	***30***	***2***	***25***	***75***	***100***

Objectives:

The main objective of this course is to enable students to see how the computational techniques they have learned in the previous semesters can be put into action with the help of open software SageMath.

Course Outcomes (COs) and Cognitive Level Mapping:

Cos	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Determine limit, continuity, maximum and minimum.	K5
CO2	Solve the system of linear equations.	K6
CO3	Evaluate basis, dimension and orthonormal basis of vector spaces.	K5
CO4	Solve linear differential equations	K6
CO5	Evaluate numerical solutions.	K5

Syllabus:

1. Limit and Continuity of real valued functions
2. Local Maximum and Minimum
3. Application of local maximum and local minimum
4. Constrained optimization using Lagrange multipliers
5. Solving system of linear Equations.
6. Basis and dimensions of vector spaces.
7. Linear Transformations.
8. Orthogonal Decomposition.
9. Least Square Solution.
10. Solving System of linear ODE using Eigenvalues and Eigenvectors.
11. Numerical Solutions of System of linear equations.
12. Interpolations.
13. Numerical Integration.
14. Numerical Eigenvalues

Reference Books:

1. Paul Zimmermann, Computational Mathematics using Sagemath, 2018.
2. Razvan A Mezei, Springer, An Introduction to SAGE Programming: With Applications to SAGE Interacts for Numerical Methods.

E-Resources

https://onlinecourses.nptel.ac.in/noc22_ma24/preview

www.sagemath.org

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	3	2	-	-	-	2	3	3	2
CO2	2	3	3	3	-	-	-	2	3	3	2
CO3	3	3	3	3	-	-	-	2	2	3	2
CO4	3	3	3	2	-	-	-	2	2	2	2
CO5	3	3	3	2	-	-	-	2	3	2	2
	2.6	3	3	2.4	-	-	-	2	2.4	2.6	2

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