JAYARAJ ANNAPACKIAM COLLEGE FOR WOMEN (AUTONOMOUS)

A Unit of the Sisters of St. Anne of Tiruchirappalli
Accredited with 'A+' Grade (Cycle 4) by NAAC
DST FIST Supported College
Affiliated to Mother Teresa Women's University, Kodaikanal

PERIYAKULAM – 625 601, THENI DT.
TAMIL NADU.

M.Sc. Mathematics
(2023-2026)

PG AND RESEARCH DEPARTMENT OF MATHEMATICS

PG PROGRAMME OUTCOME

PO. NO.	UPON COMPLETION OF THIS PROGRAM THE STUDENTS WILL BE ABLE TO
1.	Instill knowledge and evaluate analytically in their specific disciplines.
2.	Analyze and apply the acquired knowledge to solve the complex problems in professional and social life.
3.	Evolve new technologies in the specific discipline leading to innovation and employability.
4.	Develop critical thinking required to pursue research.
5.	Apply the computational skills, life skills to the challenging problems in life.
6.	Design and develop independent projects.

PG PROGRAMME SPECIFIC OUTCOMES

PSO. NO.	UPON COMPLETION OF THE PROGRAM THE STUDENTS WILL BE ABLE TO	PO MAPPED
PSO-1	Solve complex mathematical problems using the knowledge of pure and applied mathematics	PO-1
PSO-2	Involve in research by incorporating the mathematical tools in science and technology	PO-4 PO-6
PSO-3	Analyze and apply logical arguments to understand and apply mathematical concepts and techniques	PO-3
PSO-4	Model and solve real life problems using mathematical techniques and to develop scientific outlook in other disciplines	PO-2 PO-4
PSO-5	Interpret creatively the mathematical facts and figures to inculcate the individual scholarly research and to crack competitive examinations and procure their professional career	PO-1 PO-5

PG COURSE PATTERN (2023-2026) (UGC/TANSCHE/MTU)

Sem.	Part	Code	Title of the Course	Hours	Credit
I	A	23PMA1C01	Algebraic Structures	6	6
		23PMA1C02	Real Analysis-I	6	5
		23PMA1C03	Mathematical Statistics	6	5
		23PMA1E1A/ 23PMA1E1B/ 23PMA1E1C	Graph Theory/ Classical Mechanics/ Combinatorics	6	3
	B	23PMA1SE1	**# Skill Enhancement Course - 1 (SEC-1)** Office Automation and ICT Tools	4	2
		23PAE1SK1	**# Ability Enhancement Course-1 (AEC- 1)** Soft Skill	2	2
			Total	**30**	**23**
II	A	23PMA2C04	Linear Algebra	6	5
		23PMA2C05	Real Analysis-II	6	5
		23PMA2C06	Ordinary Differential Equations	6	5
		23PMA2ID1	Mathematical Modelling	6	3
	B	23PMA2SE2	**# Skill Enhancement Course - 2 (SEC-2)** Research Tools and Techniques	4	2
		23PAE2SK2	**# Ability Enhancement Course-2 (AEC-2)** Cyber Security	2	2
	C	23PSL2EX1	Extension Activity (Can be carried outside the class hours)	-	1
			Total	**30**	**23**
III	A	23PMA3C07	Partial Differential Equations	6	5
		23PMA3C08	Complex Analysis	6	5
		23PMA3C09	Topology	6	5
		23PMA3E2A/ 23PMA3E2B/ 23PMA3E2C	Calculus of Variations/ Numerical Analysis / Mathematical Python	6	4
	B	23PMA3SE3	**Skill Enhancement Course -3 (SEC-3)** Probability and Reliability	6	3
		23PMA3IN1/ 23PMA3IT1	# Internship /Industrial Activity (Carried out in summer vacation at the end of Semester II)/ (atleast 10 Days)	-	2
			Total	**30**	**24**
IV	A	23PMA4C10	Mathematical Methods	6	5
		23PMA4C11	Functional Analysis	6	5
		23PMA4C12	Optimization Techniques	5	4
		23PMA4E3A/ 23PMA4E3B/ 23PMA4E3C	Financial Mathematics/ Differential Geometry/ Algebraic Topology	5	3
		23PMA4R01	Project with Viva -Voce	6	3
	B	23PMA4SE4	**# Skill Enhancement Course - 4 (SEC-4)** Training for Competitive Examinations	2	1
			Total	**30**	**21**
			Total for All Semesters	**120**	**91**

 # Purely Internal Paper

K1-Remember; **K2**-Understand; **K3** -Apply; **K4** -Analyze; **K5** -Evaluate; **K6** -Create

CONTINUOUS INTERNAL ASSESSMENT COMPONENT (CIA) - 2023-2026

THEORY

Component	Marks	Marks
Internal test I	40	Converted to 25
Internal test II	40	
Seminar	10	
Term Paper	5	
Attendance	5	
Total	**100**	**25**

PRACTICAL

Continuous Internal Assessment (CIA) - 40 Marks

External Practical Exam - 60 Marks

PROJECT WORK

The ratio of marks for Internal and External Examination is 50:50. The Internal Components of project work are given below:

The Internal Components of Project

Component	Marks
First Review	10
Second Review	10
Final Review (Internal Viva Voce)	30
Total	**50**

External Valuation of Project Work

Component	Marks
Project Report	25
External Viva Voce	25
Total	**50**

Internship

Component		Marks
Internal	:	50 Marks
External	:	50 Marks
Total	**:**	**100 Marks**

INTERNAL COMPONENTS

Components		Marks
Report Submission	:	25 Marks
Presentation and viva (internal)	:	25 Marks
External (Awarded by the Respective Guide / Intern site)	:	50 Marks

Continuous Internal Assessment Component (CIA) for the practicals can be decided by the respective Dept.

PG - INTERNAL QUESTION PATTERN

Max. Marks - 40 **Duration - 2 Hours**

Section	Bloom's level	Course Outcome	Questions
A MCQs (10×1=10)	K1	CO1	1.
		CO1	2.
		CO1	3.
		CO1	4.
		CO1	5.
		CO1	6.
		CO1	7.
		CO1	8.
		CO1	9.
		CO1	10.
B Answer all the Questions (2×5=10)	K2	CO2	11. a) (or) 11. b)
	K3	CO3	12. a) (or) 12. b)
C Answer all the questions (2×10=20)	K4	CO4	13. a) (or) 13. b)
	K5, K6	CO5	14. a) (or) 14. b)

PG - INTERNAL QUESTION PATTERN (FULLY INTERNAL PAPERS)

Max. Marks – 40 **Duration - $1\frac{1}{2}$ Hours**

Section	Bloom's level	Course Outcome	Questions
A MCQs (10×1=10)	K1	CO1	1.
		CO1	2.
		CO1	3.
		CO1	4.
		CO1	5.
		CO1	6.
		CO1	7.
		CO1	8.
		CO1	9.
		CO1	10.
B Answer all the Questions (2×5=10)	K2	CO2	11. a) (or) 11. b)
	K3	CO3	12. a) (or) 12. b)
C Answer all the questions (2×10=20)	K4	CO4	13. a) (or) 13. b)
	K5, K6	CO5	14. a) (or) 14. b)

PG - EXTERNAL QUESTION PATTERN

For Credits 5 and above

Sections	Bloom's level	Course Outcome	Questions
A MCQs 15×1=15	K1	CO1	1
			2
			3
			4
			5
			6
			7
			8
			9
			10
			11
			12
			13
			14
			15
B Answer All the Questions 5×2=10	K2	CO2	16
			17
			18
			19
			20
C Answer ALL the Questions 5×5=25	K1	CO1	21. a)
			Or
			21. b)
	K2	CO2	22. a)
			Or
			22. b)
	K3	CO3	23. a)
			Or
			23. b)
	K4	CO4	24. a)
			Or
			24. b)
	K5	CO5	25. a)
			Or
			25. b)

D Answer All the Questions 5×10=50	K2	CO2	26. a)
			Or
			26. b)
	K3	CO3	27. a)
			Or
			27. b)
	K4	CO4	28. a)
			Or
			28. b)
	K5	CO5	29. a)
			Or
			29. b)
	K6	CO5	30. a)
			Or
			30. b)

PG - EXTERNAL QUESTION PATTERN

For Below 5 Credits

Sections	**Bloom's level**	**Course Outcome**	**Questions**
A MCQs 15×1=15	K1	CO1	1
			2
			3
			4
			5
			6
			7
			8
			9
			10
			11
			12
			13
			14
			15
B Answer ALL the Questions 5×6=30	K2	CO2	16. a)
			Or
			16. b)
	K3	CO3	17. a)
			Or
			17. b)
	K4	CO4	18. a)
			Or
			18. b)
	K5	CO5	19. a)
			Or
			19. b)
	K6	CO5	20. a)
			Or
			20. b)
C Answer All the Questions 3×10=30	K2	CO2	21. a)
			Or
			21. b)
	K4	CO4	22. a)
			Or
			22. b)
	K5	CO5	23. a)
			Or
			23. b)

ALGEBRAIC STRUCTURES

Semester: I **Hours: 6**

Code : 23PMA1C01 **Credit: 6**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Acquire knowledge of groups and rings	PSO - 1	K1
CO - 2	Understand different types of groups and rings	PSO - 4	K2
CO - 3	Apply the facts to solve different problems	PSO - 2	K3
CO - 4	Correlate the properties of groups and rings	PSO - 3	K4
CO - 5	Appraise the utilization of properties of groups and rings in various fields	PSO - 5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMESAND PROGRAMME SPECIFIC OUTCOMES

Semester: I				**ALGEBRAIC STRUCTURES**							**Hours: 6**
Code : 23PMA1C01											**Credit: 6**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO1	5	3	3	3	3	3	5	3	3	3	3	3.36
CO2	3	5	3	5	3	3	3	3	3	5	3	3.55
CO3	3	3	3	5	3	5	3	5	3	3	3	3.55
CO4	3	3	5	3	3	3	3	3	5	3	3	3.36
CO5	5	3	3	3	5	3	3	3	3	3	5	3.55
Overall Mean Score												**3.47**

Result: The Score for this Course is **3.47** (High Relationship)

Note:

Mapping	1 - 20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of CO's = $\frac{\text{Total of Values}}{\text{Total No. of PO's \& PSO's}}$	Mean Overall Score for CO's = $\frac{\text{Total of Mean Scores}}{\text{Total No. of CO's}}$

UNIT I

Another Counting Principle - Cauchy theorem - Sylow's theorem - Second part of Sylow's theorem - Third part of Sylow's theorem. **(18 Hours)**

UNIT II

Direct Products - External direct product - Internal direct product - Finite Abelian groups - Every finite abelian group is the direct product of cyclic groups. **(18 Hours)**

UNIT III

Ideals and Quotient rings - More Ideals and Quotient rings - The field of quotientsof an integral domain. **(18 Hours)**

UNIT IV

Euclidean rings - Principal ideal ring - Unique Factorization theorem - A particular Euclidean ring J[i] - Fermat theorem. **(18 Hours)**

UNIT V

Polynomial rings - Division Algorithm - Polynomial rings over the rational field - Gauss' Lemma - The Eisenstein Criterion - Polynomial rings over commutative rings. **(18 Hours)**

COURSE BOOK:

1. N. Herstein, Topics in Algebra, Second Edition, Wiley India Adaptation, WileyIndia Pvt. Ltd., 2022.

Unit I	:	Chapter 2: Sections 2.11 & 2.12. (Theorem 2.12.1, Lemma 2.12.1 & 2.12.2 are omitted)
Unit II	:	Chapter 2: Sections 2.13 & 2.14
Unit III	:	Chapter 3: Sections 3.4, 3.5 & 3.6
Unit IV	:	Chapter 3: Sections 3.7 & 3.8
Unit V	:	Chapter 3: Sections 3.9, 3.10 & 3.11

BOOKS FOR REFERENCE:

1. Surjeet Singh, Modern Algebra, Edition 9, Vikas Publishing House Pvt. Ltd., 2021.
2. Vijay K. Khanna., & Bhambri, S. K., A Course in Abstract Algebra (Fifth Edition),Vikas Publishing House Pvt. Ltd., 2013.
3. William Paulsen, Abstract Algebra, An interactive Approach, Second Edition, 2018.

E-RESOURCE:

https://books.google.co.in/books?id=Nn90DwAAQBAJ&pg=PR6&dq=standard+books+for+groups+and+rings+pg+level&hl=en&newbks=1&newbks_redir=1&sa=X&ved=2ahUKEwigiKa9y5n9AhVBRWwGHRgGDg0Q6AF6BAgNEAI

REAL ANALYSIS - I

Semester: I **Hours: 6**

Code : 23PMA1C02 **Credit: 5**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Visualize finite, countable and uncountable sets in real-world scenarios	PSO - 1	K1
CO - 2	Understand the correlation of metric spaces with compact and perfect sets	PSO - 4	K2
CO - 3	Apply various tests to test the convergence of sequences and series	PSO - 2	K3
CO - 4	Express the impact of continuity on compactness and connectedness of metric spaces	PSO - 3	K4
CO - 5	Evaluate the implications of rearrangements in series critically	PSO - 5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMESAND PROGRAMME SPECIFIC OUTCOMES

Semester: I				**REAL ANALYSIS I**							**Hours: 6**
Code : 23PMA1C02											**Credit: 5**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO1	5	3	3	3	3	3	5	3	3	3	3	3.36
CO2	3	5	3	5	3	3	3	3	3	5	3	3.55
CO3	3	3	3	5	3	5	3	5	3	3	3	3.55
CO4	3	3	5	3	3	3	3	3	5	3	3	3.36
CO5	5	3	3	3	5	3	3	3	3	3	5	3.55
Overall Mean Score												**3.47**

Result: The Score for this Course is **3.47** (High Relationship)

Note:

Mapping	1 - 20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of CO's = $\frac{\text{Total of Values}}{\text{Total No. of PO's \& PSO's}}$	Mean Overall Score for CO's = $\frac{\text{Total of Mean Scores}}{\text{Total No. of CO's}}$

UNIT I

Finite, countable and uncountable sets - Metric spaces - Compact sets - Perfect sets - Connected sets **(18 Hours)**

UNIT II

Numerical sequences and series - Convergent sequences - Subsequences - Cauchy sequences - Upper and lower limits - Some special sequences - Series - Series of nonnegative terms. **(18 Hours)**

UNIT III

The number e - The root and ratio tests - Power series - Summation by parts - Absolute convergence - Addition and multiplication of series - Rearrangements. **(18 Hours)**

UNIT IV

Continuity - Limits of functions - Continuous functions - Continuity and compactness - Continuity and connectedness - Discontinuities - Monotonic functions - Infinite limits and limits at infinity. **(18 Hours)**

UNIT V

Differentiation - The derivatives of a real function - Mean value theorems - The continuity of derivatives - L' Hospital's rule - Derivatives of higher order - Taylor's theorem - Differentiation of vector valued functions. **(18 Hours)**

COURSE BOOK:

- Walter Rudin, Principles of Mathematical Analysis (Third Edition), McGraw - Hill Education (India) Private Limited, Chennai, 2013.

  Unit I **:** Chapter 2

  Unit II **:** Chapter 3 (3.1 - 3.29)

  Unit III**:** Chapter 3 (3.30 - 3.55)

  Unit IV**:** Chapter 4

  Unit V **:** Chapter 5

BOOKS FOR REFERENCE:

1. Tom P. Apostol, Mathematical Analysis (Second Edition), Narosa Publishing House, sNew Delhi, 2002.
2. A. J. White, Real Analysis: An Introduction, Addison Wesley Publishing Co., Inc.1968.

E-RESOURCE:

https://www.abebooks.com/servlet/BookDetailsPL?bi=31048210009&searchurl=isbn%3D020108645X%26sortby%3D17&cm_sp=snippet-_-srp1-_-image2

MATHEMATICAL STATISTICS

Semester: I **Hours: 6**

Code : 23PMA1C03 **Credit: 5**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THISCOURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Acquire the knowledge of the essentials of distribution theory	PSO-1	K1
CO - 2	Understand the most common discrete and continuous probability distributions	PSO-4	K2
CO - 3	Apply the knowledge of special distributions to compute marginal and conditional distributions	PSO-2	K3
CO - 4	Analyze effective methods of finding the distribution of a function of several random variables	PSO-3	K4
CO - 5	Evaluate the data and perform appropriate analysis	PSO-5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMESAND PROGRAMME SPECIFIC OUTCOMES

Semester : I				**MATHEMATICAL STATISTICS**							**Hours: 6**
Code : 23PMA1C03											**Credit: 5**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	5	3	3	3	3	3	5	3	3	3	3	3.36
CO - 2	3	5	3	5	3	3	3	3	3	5	3	3.55
CO - 3	3	3	3	5	3	5	3	5	3	3	3	3.55
CO - 4	3	3	5	3	3	3	3	3	5	3	3	3.36
CO - 5	5	3	3	3	5	3	3	3	3	3	5	3.55
Overall Mean Score												**3.47**

Result: The Score for this Course is **3.47** (High Relationship)

Note:

Mapping	1 - 20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of CO's = $\frac{\text{Total of Values}}{\text{Total No. of PO's \& PSO's}}$	Mean Overall Score for CO's = $\frac{\text{Total of Mean Scores}}{\text{Total No. of CO's}}$

UNIT I

Probability and Distributions: The probability set function - Conditional Probability and Independence - Random Variables of the Discrete Type - Random Variables of the Continuous Type - Properties of the Distribution Function - Expectations of a Random Variable - Some Special Expectations - Chebyshev's Inequality. **(18 Hours)**

UNIT II

Multivariate Distributions: Distributions of Two Random Variables - Conditional Distributions and Expectations - The Correlation Coefficient - Independent Random Variables. **(18 Hours)**

UNIT III

Some Special Distributions: The Binomial and Related Distributions - The Poisson Distribution - The Gamma and Chi-square Distributions - The Normal Distribution - The Bivariate Normal Distribution. **(18 Hours)**

UNIT IV

Distributions of functions of Random variables: Sampling Theory - Transformations of Variables of the discrete type - Transformations of Variables of the continuous type - The Beta, t and F Distributions - Extensions of the Change of Variable Technique. **(18 Hours)**

UNIT V

Distributions of Order Statistics - The Moment Generating Function Technique - The Distributions of $\bar{X}$ and nS^2/σ^2 - Expectations of Functions of Random Variables. **(18 Hours)**

COURSE BOOK:

- Robert V. Hogg & Allen T. Craig, Introduction to Mathematical Statistics, Fifth Edition, Pearson Education (Singapore) Pte. Ltd, Indian Branch, 482 F.I.E. Patparganj, Delhi, India, 2004.

  Unit I : Chapter 1: Sections 1.3 - 1.10
  Unit II : Chapter 2: Sections 2.1 - 2.4
  Unit III : Chapter 3: Sections 3.1 - 3.5
  Unit IV: Chapter 4: Sections 4.1 - 4.5
  Unit V : Chapter 4: Sections 4.6 - 4.9

BOOKS FOR REFERENCE:

1. Miller and M. Miller, Mathematical Statistics with Applications, Seventh Edition,Pearson Education, 2004.
2. Jun Shao, Mathematical Statistics, Second Edition, Springer, 2003.

E-RESOURCE:

https://minerva.it.manchester.ac.uk/~saralees/statbook2.pdf

GRAPH THEORY

Semester: I **Hours: 6**

Code : 23PMA1E1A **Credit: 3**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THISCOURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Acquire knowledge on various properties of graphs	PSO - 1	K1
CO - 2	Understand planarity of graphs and their association to platonic bodies	PSO- 2	K2
CO - 3	Develop the skill of constructing models using graphs	PSO - 3	K3
CO - 4	Discover solutions to problems using algorithmic approach	PSO - 4	K4
CO - 5	Inculcate the spirit of research in network Problems	PSO - 5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMESAND PROGRAMME SPECIFIC OUTCOMES

Semester : I				GRAPH THEORY								Hours: 6
Code : 23PMA1E1A												Credit: 3
Course Outcomes	Programme Outcomes (PO)						Programme Specific Outcomes (PSO)					Mean Score of CO's
	1	2	3	4	5	6	1	2	3	4	5	
CO - 1	5	3	3	3	3	3	5	3	3	3	3	3.36
CO - 2	3	3	3	5	3	5	3	5	3	3	3	3.55
CO - 3	3	3	5	3	3	3	3	3	5	3	3	3.36
CO - 4	3	5	3	5	3	3	3	3	3	5	3	3.55
CO - 5	5	3	3	3	5	3	3	3	3	3	5	3.55
Overall Mean Score												3.47

Result: The Score for this Course is **3.47** (High Relationship)

Note:

Mapping	1 - 20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of CO's = Total of Values / Total No. of PO's & PSO's	Mean Overall Score for CO's = Total of Mean Scores / Total No. of CO's

UNIT I

Trees and Connectivity - Definitions and simple properties - Bridges - Spanning trees Connector problems - Shortest path problems - Cut vertices and connectivity. **(18 Hours)**

UNIT II

Euler Tours and Hamiltonian Cycles - Euler Tours - The Chinese Postman Problem - Hamiltonian Graphs - The Travelling Salesman Problem.

(18 Hours)

UNIT III

Matchings - Matchings and Augmenting paths - The Marriage Problem – The Personnel Assignment Problem. **(18 Hours)**

UNIT IV

Planar Graphs - Plane and Planar Graphs - Euler's Formula - The Platonic Bodies - Non-Hamiltonian Plane Graphs - The Dual of a plane Graph.

(18 Hours)

UNIT V

Colouring - Vertex Colouring - Vertex Colouring Algorithms - Critical Graphs - Cliques - Edge colouring **(18 Hours)**

COURSE BOOK:

- John Clark and Derek Allan Holton, A First Look At Graph Theory, Allied Publishers Ltd., 1995.

  Unit I : Chapter 2
  Unit II : Chapter 3
  Unit III : Chapter 4 : Sections 4.1 - 4.3
  Unit IV : Chapter 5 : Sections: 5.1 - 5.3, 5.5 & 5.6
  Unit V : Chapter 6 : Sections : 6.1 - 6.5

BOOKS FOR REFERENCE:

1. R. Balakrishnan and K. Ranganathan, A Textbook of Graph Theory, Springer International Edition, New Delhi, 2008.
2. F.Harary, Graph Theory, Addison - Wesley, Reading, Mass, 1969.

E-RESOURCE:

https://link.springer.com/book/10.1007/978-3-662-53622-3

CLASSICAL MECHANICS

Semester: I **Hours: 6**

Code : 23PMA1E1B **Credit: 3**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Acquire the knowledge on the elementary principles of mechanics	PSO - 1	K1
CO - 2	Understand motion of bodies, Variational Principles, Lagrangian equations, Hamilton's Principle and Two body central force problem	PSO - 2	K2
CO - 3	Analyse the given system and obtain the equation of motion	PSO - 3	K3
CO - 4	Apply the variational principles and interpret the results	PSO - 5	K4
CO - 5	Reframe the given system as mathematical models	PSO - 4	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMESAND PROGRAMME SPECIFIC OUTCOMES

Semester: I							**CLASSICAL MECHANICS**					**Hours: 6**
Code : 23PMA1E1B												**Credit: 3**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	5	3	3	3	3	3	5	3	3	3	3	3.36
CO - 2	3	3	3	5	3	5	3	5	3	3	3	3.55
CO - 3	3	3	5	3	3	3	3	3	5	3	3	3.36
CO - 4	5	3	3	3	5	3	3	3	3	3	5	3.55
CO - 5	3	5	3	5	3	3	3	3	3	5	3	3.55
Overall Mean Score												**3.47**

Result: The Score for this Course is **3.47** (High Relationship)

Note:

Mapping	1 - 20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of CO's = $\frac{\text{Total of Values}}{\text{Total No. of PO's \& PSO's}}$	Mean Overall Score for CO's = $\frac{\text{Total of Mean Scores}}{\text{Total No. of CO's}}$

UNIT I

Survey of the elementary principles - Mechanics of a particle, mechanics of a system of particles - Constraints - D' Alembert's Principle and Lagrange's Equations - Velocity - dependent potentials and the dissipation function – Simple applications of the Lagrangian formulation. **(18 Hours)**

UNIT II

Variational principles and Lagrange's Equation - Hamilton's principle - Some techniques of the calculus of variations - Derivation of Lagrangian's equations from Hamilton's Principle. **(18 Hours)**

UNIT III

Extension of Hamilton's principle to non holonomic systems - Advantages of variational priniciple formulation - Conservation theorems and symmetry properties. **(18 Hours)**

UNIT IV

The two body central force problem - Reduction to the equivalent one body problem- The equations of motion and first integrals - The equivalent one dimensional problem and classification of orbits - The Virial theorem - The differential equation for the orbit and integrable power - law potentials - Conditions for closed orbits (Bertrand's theorem). **(18 Hours)**

UNIT V

The Kepler problem - Inverse square law of force - The motion in time in the Kepler problem - The Laplace Runge - Lenz vector. **(18 Hours)**

COURSE BOOK:

- Herbert Goldstein, Classical Mechanics (Second Edition), Narosa Publishing House, 2001.

Unit I	:	Chapter 1
Unit II	:	Chapter 2: Sections 2.1 - 2.3
Unit III	:	Chapter 2: Sections 2.4 - 2.6
Unit IV	:	Chapter 3: Sections 3.1 - 3.6
Unit V	:	Chapter 3: Sections 3.7 - 3.9

BOOKS FOR REFERENCE:

1. D. E. Rutherford, Classical Mechanics, Oliver Boyd, New York, 2000.
2. J. C. Upadhyaya, Classical Mechanics, Himalaya publishing House, Mumbai, 2003.

E-RESOURCE:

https://www.academia.edu/51116553/Classical_Mechanics_John_R_Taylor

COMBINATORICS

Semester: I **Hours: 6**
Code : 23PMA1E1C **Credit: 3**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Understand the advanced concept of permutations, combinations, recurrence relations, generating function	PSO -1	K1
CO - 2	Compute generating function and apply them to a combinatorial problem	PSO-3	K2
CO - 3	Solve linear recurrence relation	PSO-4	K3
CO - 4	Apply the inclusion /exclusion principles and solve the problems	PSO-2	K4
CO - 5	Signify the principles in real life	PSO-5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMESAND PROGRAMME SPECIFIC OUTCOMES

Semester: I				**COMBINATORICS**							**Hours: 6**
Code : 23PMA1E1C											**Credit: 3**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	5	3	3	3	3	3	5	3	3	3	3	3.36
CO - 2	3	3	5	3	3	3	3	3	5	3	3	3.36
CO - 3	3	5	3	5	3	3	3	3	3	5	3	3.55
CO - 4	3	3	3	5	3	5	3	5	3	3	3	3.55
CO - 5	5	3	3	3	5	3	3	3	3	3	5	3.55
Overall Mean Score												**3.47**

Result: The Score for this Course is **3.47** (High Relationship)

Note:

Mapping	1 - 20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of CO's = $\frac{\text{Total of Values}}{\text{Total No. of PO's \& PSO's}}$	Mean Overall Score for CO's = $\frac{\text{Total of Mean Scores}}{\text{Total No. of CO's}}$

UNIT I

Permutations and combinations: Introduction - The rules of sum and product - Permutations - Combinations - Distribution of distinct objects - Distribution of non distinct objects Stirling's formula. **(18 hours)**

UNIT II

Generating functions: Introduction - Generating functions for combinations - Enumerators for permutations - Distribution of distinct objects into non-distinct cells - Partitions of integers - The Ferrer's graph - Elementary relations.

(18 Hours)

UNIT III

Recurrence relations : Introduction - Linear recurrence relations with constant coefficients - Solutions by the technique of generating functions - A special class of non linear difference equations - Recurrence relation with two indices.

(18 Hours)

UNIT IV

The principle of inclusion and exclusion: Introduction - The principle of inclusion and exclusion - The general formula - Derangements - Permutations with restrictions on relative positions - The Rook's polynomials - Permutations with forbidden positions. **(18 Hours)**

UNIT V

Polya's theory of counting: Introduction - Sets, relations and groups - Equivalence classes under permutation groups - Equivalence classes of functions - Weights and inventories of functions - Polya's fundamental theorem - Generalisation of Polya's theorem. **(18 Hours)**

COURSE BOOK:

- C. L. Liu, Introduction to Combinatorial Mathematics, McGraw Hill Publishing Company Ltd., 1968.

Unit I	:	Chapter 1: Sections 1.1 - 1.7
Unit II	:	Chapter 2: Sections 2.1- 2.7
Unit III	:	Chapter 3: Sections 3.1 - 3.5
Unit IV	:	Chapter 4: Sections 4.1 - 4.6
Unit V	:	Chapter 5: Sections 5.1 - 5.7

BOOKS FOR REFERENCE:

1. Anderson, Combinatorial Mathematics. Elarendon Press, 1974.
2. Balaji, G., Discrete Mathematics. 14th Edition, G. Balaji Publishers , 2021.

E-RESOURCE:

https://www.cs.uleth.ca/~morris/Combinatorics/Combinatorics.pdf

OFFICE AUTOMATION AND ICT TOOLS

Semester: I **Hours: 4**

Code : 23PMA1SE1 **Credit: 2**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO-1	Acquire the knowledge of office automation and ICT Tools	PSO-1	K1
CO-2	Understand the concepts of Office Automation and ICT tools	PSO-2	K2
CO-3	Apply the tools of ICT and Office Automation	PSO-3	K3
CO-4	Illustrate proficient use of Microsoft Office applications and other ICT tools for academic and research purposes.	PSO-4	K4
CO-5	Critically evaluate and select appropriate ICT tools and resources for learning and research.	PSO-5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: I				**OFFICE AUTOMATION AND ICT TOOLS**							**Hours: 4**
Code : 23PMA1SE1											**Credit: 2**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes(PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO-1	5	3	3	3	3	3	5	3	3	3	3	3.36
CO-2	3	3	3	5	3	5	3	5	3	3	3	3.55
CO-3	3	3	5	3	3	3	3	3	5	3	3	3.36
CO-4	3	5	3	5	3	3	3	3	3	5	3	3.55
CO-5	5	3	3	3	5	3	3	3	3	3	5	3.55
Overall Mean Score												**3.47**

Result: The Score for this Course is **3.47** (High Relationship)

Note:

Mapping	1- 20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of CO's = $\frac{\text{Total of Values}}{\text{Total No. of PO's \& PSO's}}$	Mean Overall Score for CO's = $\frac{\text{Total of Mean Scores}}{\text{Total No. of CO's}}$

UNIT I

Microsoft Word: Features of MS Word - MS Word Window Components - Creating, Editing, Formatting and Printing of Documents - Headers and Footers – Insert / Draw Tables, Table Auto format - Page Borders and Shading - Inserting Symbols, Shapes, Word Art, Page Numbers, Equations - Spelling and Grammar - Thesaurus - Mail merge. **(12 Hours)**

UNIT II

Microsoft Excel: Using Functions - Sum, Average, Max, Min, Count – Customizing the Ribbon - Using and Customizing Auto Correct - Changing Excel's Default Options - Logical Functions - If Function - How to Fix Errors - if error - Nested if - Complex if and or functions. **(12 Hours)**

UNIT III

Microsoft Power Point: Features of Power Point - Creating a Blank Presentation - Creating a Presentation using a Template - Inserting and Deleting Slides in a Presentation - Adding Clip Art / Pictures - Inserting other Objects, Audio, Video -Resizing and Scaling of an Object - Slide Transition - Custom Animation. **(12 Hours)**

UNIT IV

ICT Tools for Academics: Google Slides, Google Meet, Google forms, Google Sites and Google Documents - Concept of OER and FOSS for education - Plagiarism Tools. **(12 Hours)**

UNIT V

ICT for Learning and Research: Introduction of MOOC and Open Source LMS, LMS Activities and Resources - MOOC (NPTEL, Spoken Tutorials, e-PG Pathshala, Coursera, eDX, Udemy, Unacademy) - Awareness of Academic Social Networking Sites (Academia.edu, Research Gate, Linkedin, Google Scholar, ORCID) **(12 Hours)**

COURSE BOOK:

- Course material prepared by the Department

BOOK FOR REFERENCE:

1. Microsoft Office 2010 Bible by John Walkenbach, Herb Tyson, Michael R.Groh andFaithe Wempen, Publishers: Wiley, 2010.

E-RESOURCES:

S. No.	Topic	Reference / Link
1	MOOC	1. https://www.indiaeducation.net/online-education/all-about-moocs- massive-open-online-courses-india-abroad.html 2. https://www.mooc.org/about-moocs
2	LMS	3. https://elearningindustry.com/what-is-an-lms- learning-management-system-basic-functions- features 4. https://docs.moodle.org/38/en/Activities 5. https://www.youtube.com/watch?v=DsQNAprWBfg 6. https://www.youtube.com/watch?v=BENxpst5yM8
3	Plagiarism Tools	7. https://www.techtimes.com/brandspin/238059/20190130/to p-5- best-plagiarism-checking-tools-2019.htm 8. https://elearningindustry.com/top-10-free-plagiarism- detection- tools-for-teachers 9. https://www.scribbr.com/plagiarism/free-plagiarism- checker- comparison/
4	Google slides	10. https://support.google.com/docs/answer/2763168?co=GENIE.Platform%3DDesktop&hl=en 11. https://www.youtube.com/watch?v=o7wvajrAxUQ 12. https://www.youtube.com/watch?v=KFPB68S7L54
5	Google Meet	13. https://support.google.com/a/users/answer/9282720?hl=en 14. https://www.techradar.com/in/how-to/how-to-use-google- meet 15. https://teachercenter.withgoogle.com/first-day- trainings/welcome- to-google-hangouts-meet
6	Google forms	16. do- i-use- google-forms-and-sheets-to-automatically-generate- custom-certificates 17. https://www.youtube.com/watch?v=G98B8_JZo-0
7	Digital Initiative of government of India in highereducation	18. https://mhrd.gov.in/ict-initiatives 19. https://www.lisportal.com/en/lis-result/3720-digital- initiative-of- govt-of-india-in-higher-education

OFFICE AUTOMATION AND ICT TOOLS - PRACTICAL

1. Create a new document and working on multiple document
2. Formatting text
3. Mail merge
4. Preparation of invitation using templates
5. Excel function (statistical and mathematical)
6. Data filtering and sorting
7. Stock preparation analysis using statistical function
8. Data analysis using chart (import the dataset in CSV format)
9. Theme based presentation with animation effects.
10. E- content Preparation
11. Creating quiz using Google form
12. Translating the document of content
13. Create your own blog using google sites
14. How to apply for online course in Swayam and Udemy.
15. Creating ID in academic social Networking site.

Components	Marks
Internal Test I	40
Internal Test II	40
Lab Work	10
Continuous Assessment	10
Total	**100**

SOFT SKILL

Semester: I **Hours: 2**

Code : 23PAE1SK1 **Credit: 2**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	State their short and long term goals	PSO - 1	K1
CO - 2	Associate their social, interpersonal, cognitive, ethical, professional, reading and communication skills	PSO-5	K2
CO - 3	Administer their self - esteem and confidence	PSO - 4	K3
CO - 4	Formulate their resumes wisely	PSO - 2	K4
CO - 5	Assess the mock group discussions and interviews with a challenge to choose their right career	PSO - 3	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: I				**SOFT SKILL**							**Hours: 2**
Code : 23PAE1SK1											**Credit: 2**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	4	2	2	5	2	4	5	2	2	2	4	3.09
CO - 2	5	4	4	3	4	5	3	4	4	4	5	4.09
CO - 3	4	2	5	2	2	4	2	2	2	5	4	3.09
CO - 4	4	2	2	2	5	4	2	5	2	2	4	3.09
CO - 5	4	5	3	2	2	4	2	2	5	3	4	3.27
Overall Mean Score												**3.33**

Result: The score for this course is **3.33** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = Total of Values / Total No. of POs & PSOs	Mean Overall Score for COs= Total of Mean Scores / Total No. of COs

UNIT I: SOFT SKILLS-INTRODUCTION

What are soft skills? - Importance of Soft skills-Difference between hard skills and soft skills-Top 60 soft skills. SWOC analysis-Self-Discovery-Advantages of SWOC analysis-Identifying your soft skills. **(6 Hours)**

UNIT II: ATTITUDE AND PERCEPTION

what is attitude? -formation of attitudes-positive and negative attitudes -power of positive attitude-developing positive attitude-obstacles in developing positive attitudes-results of positive attitude-overcoming negative attitude and its impacts. Perception - factors influencing perception-changing and improving perception towards positive attitude. **(6 Hours)**

UNIT III: TIME AND STRESS MANAGEMENT

Value of time-Sense of time management-Difficulties in time management-Evils of not planning-Reasons for procrastination-Overcoming procrastination- Effective scheduling-Steps to and Tips for Time Management-Deciding upon priorities-Grouping activities. Stress-Definition -Causes of Stress-Effects of Stress-Signs of stress-Stress as appositive and negative reinforcer-spotting stress in you-Behaviours identified with stress- for stress management. **(6 Hours)**

UNIT IV: EMOTIONAL BALANCE-TEAM BUILDING AND LEADERSHIP QUALITIES

What is Emotional Intelligence? -Emotional IQ-Intellectual IQ-Why emotional balance is important-Benefits of Emotional IQ-Four important Elements of Emotional IQ-Control of your reaction to situation. Skills needed for teamwork-Role of a team leader-challenges faced in collaboration-advantages of team-spirit. **(6 Hours)**

UNIT V: INTERVIEW SKILLS, GROUP DISCUSSION, PREPARING RESUME/CV

Types of interview-One to one Interview-Interview panel-Dress code at interview-punctuality-interview etiquettes-Group Discussion- Why group discussion-Types of group discussion-Skills required-GD Etiquette-Movement and gestures to be avoided-initiating a GD-Resolving conflicts. Preparing Resume/CV-Tips.**(6 Hours)**

COURSE BOOK:

- Dr. K. Alex, *Soft skills,* Chand & company Pvt. Ltd., New Delhi, 2010.

BOOK FOR REFERENCE:

- Kumar, Suresh, Sreehari and Savithri. *Communication Skills and Soft Skills: An Integrated Approach,* Pearson India, 2010.

INTERNAL QUESTION PATTERN

SOFT SKILL - 23PAE1SK1

INTERNAL COMPONENTS

Test 1	40
Test 2	40
Term Paper	5
Seminar	10
Attendance	5
Total	**100**

LINEAR ALGEBRA

Semester: II **Hours: 6**

Code : 23PMA2C04 **Credit: 5**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Acquire knowledge of vector spaces and linear transformations	PSO-5	K1
CO - 2	Understand the features of matrices and characteristic equations	PSO-2	K2
CO - 3	Apply eigen vectors in various fields	PSO-4	K3
CO - 4	Connect matrices and linear transformations	PSO-3	K4
CO - 5	Reframe matrices into different forms	PSO-1	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMESAND PROGRAMME SPECIFIC OUTCOMES

Semester: II				**LINEAR ALGEBRA**							**Hours: 6**
Code : 23PMA2C04											**Credit: 5**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO -1	5	3	3	3	5	3	3	3	3	3	5	3.55
CO 2	3	3	3	5	3	5	3	5	3	3	3	3.55
CO 3	3	5	3	5	3	3	3	3	3	5	3	3.55
CO 4	3	3	5	3	3	3	3	3	5	3	3	3.36
CO 5	5	3	3	3	3	3	5	3	3	3	3	3.36
Overall Mean Score												**3.47**

Result: The Score for this Course is **3.47** (High Relationship)

Note:

Mapping	1 - 20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of CO's = Total of Values / Total No. of PO's & PSO's	Mean Overall Score for CO's = Total of Mean Scores / Total No. of CO's

UNIT I

Vector Spaces: Elementary Basic Concepts - Subspaces - Homomorphism - Isomorphism - Internal direct Sum - Linear Independence and Bases - Linear Span - Finite dimensional vector space - Linearly independent vectors - Basis of vectorSpace- Dual spaces. **(18 Hours)**

UNIT II

Inner Product Spaces - Norm of a vector - Orthogonal vectors - Orthogonal complement - Orthonormal Set-Modules - Cyclic modules and Finitely generated modules. **(18 Hours)**

UNIT III

Linear Transformations: The algebra of linear transformations - Algebra over a field F - Invertible or Regular Transformation - Singular transformation - Characteristic roots - Matrices - Algebra of matrices - Canonical forms: Triangular form . **(18 Hours)**

UNIT IV

Canonical Forms: Nilpotent transformations - A decomposition of V: Jordanform - Jordan canonical form - Rational canonical form - Trace and Transpose. **(18 Hours)**

UNIT V

Determinants - The Characteristic Polynomial -Hermitian, Unitary, and Normal Transformations - Real Quadratic Forms. **(18 Hours)**

COURSE BOOK:

- I.N. Herstein, Topics in Algebra, Second Edition, Wiley India Adaptation, WileyIndia Pvt. Ltd., 2022.

Unit I	:	Chapter 4 Sections 4.1 - 4.3
Unit II	:	Chapter 4 Sections 4.4 - 4.5
Unit III	:	Chapter 6 Sections 6.1 - 6.4
Unit IV	:	Chapter 6 Sections 6.5 - 6.8
Unit V	:	Chapter 6 Sections 6.9 - 6.11

BOOKS FOR REFERENCE:

1. Vijay K. Khanna., & Bhambri, S. K. A Course in Abstract Algebra. (Fourth Edition). Vikas Publishing House Pvt. Ltd, 2013.
2. Kenneth Hoffman, Ray Kunze, Linear Algebra (Second Edition), Pearson IndiaEducation Services Pvt. Ltd, 1984.

E-RESOURCE:

http://students.aiu.edu/submissions/profiles/resources/onlineBook/Y5B7M4_Introduction_to_Linear_Algebra-_Fourth_Edition.pdf

REAL ANALYSIS - II

Semester: II **Hours: 6**
Code : 23PMA2C05 **Credit: 5**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO -1	Acquire in depth knowledge of integrals, sequences and series of functions	PSO -1, PSO - 4	K1
CO - 2	Predict and explore integral properties, existence, and differentiation intricacies	PSO - 2	K2
CO - 3	Articulate uniform convergence, equicontinuity, and their implications	PSO-3	K3
CO - 4	Illustrate sequences and series of functions, including special functions and power series	PSO-2	K4
CO - 5	Signify the properties of Lebesgue and Riemann integrals	PSO-5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMESAND PROGRAMME SPECIFIC OUTCOMES

Semester : II				**REAL ANALYSIS - II**								**Hours: 6**
Code : 23PMA2C05												**Credit: 5**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO -1	5	5	3	5	2	3	5	3	3	5	2	3.73
CO - 2	3	3	3	5	3	5	3	5	3	3	3	3.55
CO - 3	3	3	5	3	3	3	3	3	5	3	3	3.36
CO - 4	3	3	3	5	3	5	3	5	3	3	3	3.55
CO - 5	5	3	3	3	5	3	3	3	3	3	5	3.55
Overall Mean Score												**3.55**

Result: The Score for this Course is **3.55** (High Relationship)
Note:

Mapping	1 - 20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of CO's = $\frac{\text{Total of Values}}{\text{Total No. of PO's \& PSO's}}$	Mean Overall Score for CO's = $\frac{\text{Total of Mean Scores}}{\text{Total No. of CO's}}$

UNIT I

The Riemann - Stieltjes integral - Definition and existence of the integral - properties of the integral - Integration and differentiation. **(18 Hours)**

UNIT II

Sequences of series of functions - Discussion of main problem - Uniform convergence - Uniform convergence and continuity - Uniform convergence and integration - Uniform convergence and differentiation. **(18 Hours)**

UNIT III

Equicontinuous families of functions - Stone - Wierstrass theorem - Some special functions - Power series - The exponential and logarithmic functions - The trigonometric functions. **(18 Hours)**

UNIT IV

The algebraic completeness of the complex field - Fourier series - The Gamma function - Some consequences - Stirling's formula. **(18 Hours)**

UNIT V

The Lebesgue theory- Set functions - Construction of the Lebesgue measure - Measure spaces - Measurable functions - Simple functions - Integration- comparison with the Riemann integral - Integration of complex functions- Functions of class f^2. **(18 Hours)**

COURSE BOOK:

- Walter Rudin, Principles of Mathematical Analysis (Third Edition), McGraw - Hill Education (India) Private Limited, Chennai, 2013.

Unit I	:	Chapter 6 (6.1 to 6.22)
Unit II	:	Chapter 7 (7.1 to 7.18)
Unit III	:	Chapter 7 (7.19 to 7.33) & Chapter 8 (8.1 to 8.7)
Unit IV	:	Chapter 8 (8.8 to 8.22)
Unit V	:	Chapter 11

BOOKS FOR REFERENCE:

1. Tom P. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.
2. J. White, Real Analysis, An Introduction, Addison Wesley Publishing Co., Inc. 1968.

E-RESOURCE:

https://www.abebooks.com/servlet/BookDetailsPL?bi=31048210009&searchurl=isbn%3D020108645X%26sortby%3D17&cm_sp=snippet-_-srp1-_-image2

ORDINARY DIFFERENTIAL EQUATIONS

Semester: II **Hours: 6**
Code : 23PMA2C06 **Credit: 5**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THISCOURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Acquire the knowledge to classify the differential equations	PSO - 1	K1
CO - 2	Understand the concept of existence and uniqueness of the solutions	PSO - 4	K2
CO - 3	Solve problems in ordinary differential equations using multiple approach	PSO - 2	K3
CO - 4	Derive an inference of the theory of ordinary differential equations and work with variant approach	PSO - 3	K4
CO - 5	Create and analyze real life problems	PSO - 5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMESAND PROGRAMME SPECIFIC OUTCOMES

Semester: II			ORDINARY DIFFERENTIAL EQUATIONS						Hours: 6		
Code : 23PMA2C06									Credit: 5		
Course Outcomes	Programme Outcomes (PO)						Programme Specific Outcomes (PSO)					Mean Score of CO's
	1	2	3	4	5	6	1	2	3	4	5	
CO-1	5	3	3	3	2	3	5	3	3	3	2	3.18
CO-2	3	5	3	5	3	3	3	3	3	5	3	3.55
CO-3	3	3	2	5	3	5	3	5	2	3	3	3.36
CO-4	3	3	5	3	3	3	3	3	5	3	3	3.36
CO-5	5	2	3	2	5	3	3	3	3	2	5	3.27
Overall Mean Score												3.34

Result: The Score for this Course is **3.34** (High Relationship)

Note:

Mapping	1 - 20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of CO's = Total of Values / Total No. of PO's & PSO's	Mean Overall Score for CO's = Total of Mean Scores / Total No. of CO's

UNIT I

Linear Equations with Constant Coefficients: Introduction - The second order homogeneous equation - Initial value problems for second order equations - Linear dependence and independence - A formula for the Wronskian - The non- homogeneous equation of order two. **(18 Hours)**

UNIT II

Linear Equations with Constant Coefficients: The homogeneous equation of order n - Initial value problems for n^{th} order equations - Equations with real constants - The non-homogeneous equation of order n - A special method for solving the non- homogeneous equation - Algebra of constant coefficient operators. **(18 Hours)**

UNIT III

Linear Equations with Variable Coefficients: Introduction - Initial value problems for the homogenous equation - Solutions of the homogenous equation - The Wronskian and linear independence - Reduction of the order of a homogenous equation - The non-homogenous equation - Homogeneous equations with analytic coefficients - The Legendre equation. **(18 Hours)**

UNIT IV

Linear Equations with Regular Singular Points: Introduction - The Euler equation - Second order equations with regular singular points-an example - Second order equations with regular singular points-the general case - The exceptional cases - The Bessel equation. **(18 Hours)**

UNIT V

Existence and Uniqueness of Solutions to First Order Equations: Introduction - Equations with variable separated - Exact equations - The method of successive approximations - The Lipschitz condition - Convergence of the successive approximations. **(18 Hours)**

COURSE BOOK:

- Earl A. Coddington, An Introduction to Ordinary Differential Equations, PHI Learning Private Limited, 2012.

  Unit I : Chapter- 2: Sections 1 - 6

  Unit II : Chapter - 2: Sections 7 - 12

  Unit III : Chapter - 3: Sections 1 - 8

  Unit IV : Chapter - 4: Sections 1 - 4 & 6 - 8

  Unit V : Chapter - 5: Sections 1 - 6

BOOKS FOR REFERENCE:

1. S. G. Deo and V. Raghavendra, Ordinary Differential Equations and Stability Theory,Tata McGraw-Hill Publishing Company Ltd., 1987.
2. M. D. Raisinghania, Ordinary and Partial Differential Equations, S. Chand &Company Ltd., 2012.
3. George F Simmons, Differential equations with applications and historical notes, TataMcGraw Hill, New Delhi, 2018.
4. B. Rai, D. P. Choudary and H.I. Freedman, A Course in Ordinary Differential Equations, Narosa Publishing House, New Delhi, 2011.
5. https://nsufl.libguides.com/cnso-diffeq/websites
6. https://users.math.msu.edu/users/gnagy/teaching/ode.pdf

E-RESOURCE:

https://archive.nptel.ac.in/courses/111/107/111107111/

MATHEMATICAL MODELLING

Semester: II **Hours: 6**

Code : 23PMA2ID1 **Credit: 3**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THISCOURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIV ELEVEL
CO - 1	Identify fundamental steps involved in constructing mathematical models	PSO-1	K1
CO - 2	Understand the purpose of mathematical modelling and its relevance in solving problems	PSO- 2	K2
CO - 3	Apply different mathematical modelling techniques to solve specific problems in various domains	PSO - 3	K3
CO - 4	Analyze the sensitivity of mathematical model	PSO-4	K4
CO - x5	Create models to represent complex real-life situations	PSO-5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMESAND PROGRAMME SPECIFIC OUTCOMES

Semester : II				**MATHEMATICAL MODELLING**							**Hours: 6**
Code : 23PMA2ID1											**Credit: 3**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO-1	5	3	3	3	3	3	5	3	3	3	3	3.36
CO-2	3	3	3	5	3	5	3	5	3	3	3	3.55
CO-3	3	3	5	3	3	3	3	3	5	3	3	3.36
CO-4	3	5	3	5	3	3	3	3	3	5	3	3.55
CO-5	5	3	3	3	5	3	3	3	3	3	5	3.55
Overall Mean Score												**3.47**

Result: The Score for this Course is **3.47** (High Relationship)

Note:

Mapping	1 - 20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of CO's = $\frac{\text{Total of Values}}{\text{Total No. of PO's \& PSO's}}$	Mean Overall Score for CO's = $\frac{\text{Total of Mean Scores}}{\text{Total No. of CO's}}$

UNIT I

Mathematical Modelling: Need, Techniques, Classifications and simple illustrations - Simple situations requiring Mathematical modelling - The techniques of Mathematical modelling - Classification of a Mathematical model - Simple Illustrations - Limitations of Mathematical modelling. **(18 Hours)**

UNIT II

Mathematical Modelling through Graphs: Situations that can be modelled through graphs - The seven bridge problem - Senior-subordinate relationship - Food Webs - Decanting Problem - Seating arrangement Problem. **(18 Hours)**

UNIT III

Mathematical modelling through Graphs (continued): Shortest Path problem - The instant insanity problem - Uses of graphs in Markov Processes - Transition Graph. **(18 hours)**

UNIT IV

Mathematical Modelling through Programming: Mathematical representation of a linear programming problem - Diet problem - Relocation of Emergency unit - Equipment Bags problem - Making money with matrices. **(18 Hours)**

UNIT V

Mathematical Models in Biology and medicine: Scope of Mathematical Bio Sciences - Role of mathematics in Bio Sciences - Genetic Matrices - Medical Diagnosis problem - The Hospital Diet problem - Optimization Model for Blood testing & patient care (Dorfman Procedure). **(18 Hours)**

COURSE BOOK:

- Course material prepared by the Department

BOOKS FOR REFERENCE:

1. J. N. Kapur, Mathematical Modelling, New Age International Publishers, New Delhi, 2011.
2. S. A. Choudum, A First Course in Graph Theory, Macmillan India Ltd., 2011.

E-RESOURCE:

https://nptel.ac.in/courses/111107113

RESEARCH TOOLS AND TECHNIQUES

Semester: II **Hours: 4**

Code : 23PMA2SE2 **Credit: 2**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Acquire knowledge of the fundamental concept of research, research design and research problems	PSO-1	K1
CO - 2	Understand the meaning and significance of research in various fields	PSO-3	K2
CO - 3	Apply various techniques involved in defining a research problem	PSO-2, PSO -4	K3
CO - 4	Analyze different methods and techniques of research in real life problems	PSO-3	K4
CO - 5	Evaluate the challenges encountered by researchers in the Indian context	PSO-5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMESAND PROGRAMME SPECIFIC OUTCOMES

Semester: II				**RESEARCH TOOLS AND TECHNIQUES**							**Hours: 4**
Code : 23PMA2SE2											**Credit: 2**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO1	5	3	3	3	3	3	5	3	3	3	3	3.36
CO2	3	3	5	3	3	3	3	3	5	3	3	3.36
CO3	3	5	3	5	3	5	3	5	3	5	3	3.91
CO4	3	3	5	3	3	3	3	3	5	3	3	3.36
CO5	5	3	3	3	5	3	3	3	3	3	5	3.55
Overall Mean Score												**3.51**

Result: The Score for this Course is **3.51** (High Relationship)

Note:

Mapping	1 - 20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of CO's = $\frac{\text{Total of Values}}{\text{Total No. of PO's \& PSO's}}$	Mean Overall Score for CO's = $\frac{\text{Total of Mean Scores}}{\text{Total No. of CO's}}$

UNIT I

Meaning of research - Objectives of research - Types of research - Research Approaches -Significance of research - Research Methods versus Methodology - Research and Scientific Method - Research Process - Criteria of Good Research - Problems encountered by researchers in India.

(12 Hours)

UNIT II

What is a research problem? - Selecting the problem - Necessity of defining the problem - Techniques involved in defining a problem - An illustration.

(12 Hours)

UNIT III

Meaning of research design - Need for research design - Features of a good design- Important concepts relating to research design - Different research designs. **(12 Hours)**

UNIT IV

Sample Design - Sampling and non-sampling errors - Sample survey Vs. Census survey - Types of sampling designs. **(12 Hours)**

UNIT V

Experiments and surveys - Collection of primary data - Collection of secondary data - Selection of appropriate method for data collection - Case study method. **(12 Hours)**

COURSE BOOK:

- C.R. Kothari, Gaurav Garg, Research Methodology - Methods and Techniques, IV Edition, 2021, New Age International (P) Limited Publishers.

Unit I	:	Chapter 1 : Sections 1 – 10
Unit II	:	Chapter 2 : Sections 1 - 5
Unit III	:	Chapter 3 : Sections 1- 5
Unit IV	:	Chapter 4 : Sections 1 - 5
Unit V	:	Chapter 6 : Sections 1 - 5

BOOK FOR REFERENCE:

1. Singh, Rama Nand, Research Methodology and Techniques in Mathematics - FirstEdition, New Delhi, Centrum Press, 2014.

E-RESOURCE:

https://www.researchgate.net/publication/319207471_HANDBOOK_OF_RESEARCH_METHODOLOGY

CYBER SECURITY

Semester: II **Hours: 2**

Code : 23PAE2SK2 **Credit: 2**

COURSE OUTCOMES

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO-1	State the need of Cyber Security and history of Internet	PSO-1	K1
CO-2	Understand history and types of Cyber Crime	PSO-2	K2
CO-3	Apply critical thinking in Security Policies and Cyber Laws	PSO-3	K3
CO-4	Discuss and demonstrate the cyber security components and infrastructure security	PSO-4	K4
CO-5	Diagnose the ways and means of fighting Cyber Attacks	PSO-5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: II							**CYBER SECURITY**					**Hours: 2**
Code : 23PAE2SK2												**Credit: 2**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO-1	5	3	3	3	3	3	5	3	3	3	3	3.36
CO-2	4	3	3	5	3	3	4	5	3	3	3	3.55
CO-3	3	5	3	4	3	3	3	4	5	3	3	3.55
CO-4	3	3	5	4	5	3	3	4	3	5	3	3.73
CO-5	2	3	3	2	3	5	2	2	3	3	5	3.00
Overall Mean Score												**3.44**

Result: The score for this course is **3.44** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs= $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

UNIT I

Introduction: Cyber Security – The need of the Hour - History of Internet – Impact of Internet – Internet in India **(6 Hours)**

UNIT II

Introduction to Cyber Security: Cyber Security – CIA Triad - Reasons for Cyber Crimes – Why we need Cyber Security – Damage to the Organizations – History of Cyber Crimes – Types of Cyber Crimes **(6 Hours)**

UNIT III

Cyber Security Components: OSI Layer – Zero Day Attacks – Types of Network Attacks – Application Security – Endpoint Security – Identify and Access Management (IAM) – Mobile Security – Data Security - Drive-By Download - Infrastructure Security - Disaster Recovery (DR) - End-user Education **(6 Hours)**

UNIT IV

Fighting Cyber Attacks: Defense in Depth – Authentication - Cryptography – Firewall - Data Loss Prevention - Antivirus Software - Virtual Private Network (VPN)- Web browsers - Data Backup – Conclusion **(6 Hours)**

UNIT V

Introduction to Security Policies and Cyber Laws: Need for an Information Security Policy - Information Security Standards – ISO - Introducing Various Security Policies and Their Review Process - Introduction to Indian Cyber Law - Objective and Scope of the IT Act, 2000 - Intellectual Property Issues - Overview of Intellectual-Property- Related Legislation in India - Patent - Copyright - Law Related to Semiconductor Layout and Design - Software License **(6 Hours)**

BOOKS FOR STUDY

1. **"Introduction to Cyber Security: Guide to the World of Cyber Security",** Anand Shinde, Notion Press, 2021

   Unit I : Chapter: 1
   Unit II : Chapter: 2.
   Unit III : Chapter: 3
   Unit IV : Chapter: 4.

2. "Introduction to information security and cyber laws", Dr. Surya Prakash Tripathi, Ritendra Goyal, Praveen Kumar Shukla, KLSI, Dreamtech Press, 2014

   Unit V : Chapter: 4

BOOKS FOR REFERENCE

1. **"Information and Cyber security: Principles and Practices",** S U, Aswathy; Faizal, Ajesh; V, Antony Asir Daniel, Noor Publishing, 2020
2. "**Security in the Digital Age: Social Media Security Threats and Vulnerabilities**", Henry A. Oliver, Create Space Independent Publishing Platform, 2015
3. "**Cybersecurity for Beginners**", Raef Meeuwisse, Second Edition, 2017
4. "**Auditing IT Infrastructures for Compliance**", Martin Weiss, Michael G. Solomon, 2nd Edition, Jones Bartlett Learning, 2017

WEB RESOURCES

1. https://www.coursera.org/professional-certificates/google-cybersecurity
2. https://www.coursera.org/learn/cybersecurity-for-everyone
3. https://www.coursera.org/specializations/intro-cyber-security
4. https://www.udemy.com/course/cybersecurity-from-beginner-to-expert/
5. https://www.udemy.com/course/it-law-cyber-crimes-and-data-protection-laws/

JACEP - EXTENSION

P.G. PROGRAMME OUTCOMES (2023 - 2026)

PO. NO.	UPON COMPLETION OF THIS PROGRAMME THE STUDENTS WILL BE ABLE TO
1.	Acquire comprehensive knowledge and evaluate analytically in their specific disciplines.
2.	Apply the acquired knowledge in professional and social life.
3.	Evolve new methodologies in the specific disciplines leading to innovation and employability.
4.	Develop critical thinking required to pursue research.
5.	Apply the computational and life skills to the challenging problems in life.
6.	Design and develop independent projects.

P.G. PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO. NO.	UPON COMPLETION OF THIS PROGRAM THE STUDENTS WILL BE ABLE TO	PO MAPPED
PSO - 1	Understand and identify the needs of the community and articulate viewpoints both practically and theoretically.	PO-1
PSO - 2	Develop among themselves a sense of social and civic responsibility to be more culturally equipped.	PO-2,
PSO - 3	Apply their education in finding practical solutions to individual, community problems to exercise their rights properly.	PO- 3,
PSO - 4	Acquire leadership qualities and a democratic attitude by carrying out their duties as effective citizens of the country.	PO- 4
PSO - 5	Develop the capacity to think clearly and cogently to meet emergencies and national disasters and practise national integration and social harmony.	PO- 5, PO-6

JACEP - EXTENSION

Semester: II **Hours: 30**

Code : 23PSL2EX1 **Credit: 1**

COURSE OUTCOMES

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Impart knowledge of the importance of education	PSO-1	K1
CO - 2	Apply Knowledge to the society	PSO-2	K2
CO - 3	Analyse the reasons for health problems and impart knowledge on a balanced diet.	PSO-3	K3
CO - 4	Develop a concern for the voiceless and faceless	PSO-4	K4
CO - 5	Get awareness of environmental issues	PSO-5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: II				**JACEP - EXTENSION**							**Hours: 30**
Code : 23PSL2EX1											**Credit: 1**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	5	3	4	3	3	3	5	4	3	3	3	3.54
CO - 2	3	5	3	3	4	3	4	5	4	3	2	3.54
CO - 3	3	4	5	3	4	4	3	3	5	3	4	3.72
CO - 4	2	4	3	5	3	3	3	3	5	5	3	3.54
CO - 5	3	4	5	3	4	5	3	4	3	3	5	3.81
Overall Mean Score												**3.63**

Result: The score for this course is **3.63** (High relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = Total of Values / Total No. of POs & PSOs	Mean Overall Score for COs= Total of Mean Scores / Total No. of COs

UNIT I: LITERACY GROUP:

Giving orientation to the students about JACEP - focusing on School dropouts and counseling the parents to re-admit the school dropouts - conducting awareness programs through kindling culturals - organizing games based on the disciplines - conducting competitions for school children – educating the school children about the positives and negatives of social media.

UNIT II: HEALTH AND HYGIENE GROUP:

Doing a survey on health problems - organizing medical camps and talks - organizing general check-ups by B. Voc. students of JAC to the adopted villages.

UNIT III: LIAISON GROUP AND PEOPLE ORGANIZATION GROUP:

Motivating NREGA workers to access government savings schemes - celebrating important days - organizing income generation skill training for self-help groups. organizing population education programmes - conducting awareness programmes on emerging social issues - fostering tie-ups with non-governmental organizations and local bodies to ensure the development of the villages - organizing youth, farmers and self-help group to function democratically.

UNIT IV: ENVIRONMENTAL GROUP:

Tree and sapling plantation - promotion of Herbal Gardens - organizing personal hygiene awareness talk – observing environmental-related days –awareness campaign to educate the villagers to protect the environment.

UNIT V: APPLICATION OF KNOWLEDGE:

Conducting Special Skill Training for self-employment based on discipline to the target group with the help of JAC SARWODEEP and government organizations – serving as intermediaries between unorganized sector workers and government welfare schemes.

SCHEME OF EVALUATION

Continuous Internal Assessment		
1.	Attendance (30 hours)	10 Marks
2.	Field Visit & Report	50 marks
3.	Assignment	40 Marks
Total		**100 marks**

PARTIAL DIFFERENTIAL EQUATIONS

Semester: III **Hours: 6**

Code : 23PMA3C07 **Credit: 5**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Acquire the knowledge to classify the partial differential equations	PSO-2	K1
CO - 2	Understand the standard form in partial differential equations	PSO- 1	K2
CO - 3	Apply appropriate methods to solve partial differential equations	PSO-5	K3
CO - 4	Analyze appropriate methods to solve the given equation	PSO-3	K4
CO - 5	Create mathematical models of real life problems	PSO-4	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: III				**PARTIAL DIFFERENTIAL EQUATIONS**							**Hours: 6**
Code : 23PMA3C07											**Credit: 5**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	3	3	3	5	3	5	3	5	3	3	3	3.54
CO - 2	5	3	3	4	2	4	5	4	3	3	2	3.45
CO - 3	5	2	2	3	5	3	3	3	2	2	5	3.18
CO - 4	3	3	5	3	3	3	2	3	5	3	3	3.27
CO - 5	3	5	2	5	3	2	2	2	2	5	3	3.09
Overall Mean Score												**3.31**

Result: The score for this course is **3.31** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs= $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

UNIT I

Second Order Partial Differential Equations**:** Origin of Second Order Partial Differential Equations - Linear Partial differential equations with constant coefficients - Method of solving linear partial differential equations - classification of second order partial differential equations - adjoint operators - second order non - linear partial differential equations. **(18 Hours**)

UNIT II

Elliptic Differential Equations **:** Occurrence of the Laplace and Poisson equations - Boundary value problems - Interior Dirichlet problem for a circle -Exterior Dirichlet problem for a circle - Interior Neumann Problem for a circle.

(18 Hours)

UNIT III

Parabolic Differential Equations**:** Occurrence and Derivation of the Diffusion Equation - Diffusion Equation in Cylindrical coordinates - Diffusion Equation in Spherical coordinates - Maximum - Minimum Principle. **(18 Hours)**

UNIT IV

Hyperbolic Differential Equations**:** Occurrence of the Wave Equation - derivation of one - dimensional wave equation - Reduction of one - dimensional wave equation to Canonical form and its solution - D' Alemberts solution of one-dimensional wave equation - separation of variables method. **(18 Hours)**

UNIT V

Integral Transform and Green Function Methods: Introduction - Laplace transforms - solution of partial differential equations - Fourier Transforms and their applications - Green's function method and its applications. **(18 Hours)**

COURSE BOOK:

- J. N. Sharma , Kehar Singh, Partial Differential Equations for Engineers and Scientists, Narosa Publishing House, Second Edition - 2009

  Unit I : Chapter-2: Sections 2.1- 2.6.

  Unit II : Chapter-3: Sections 3.1, 3.2, 3.6 - 3.8.

  Unit III : Chapter-4 : Sections 4.1, 4.4 - 4.7.

  Unit IV : Chapter-5: Sections 5.1 - 5.5.

  Unit V : Chapter- 6: Sections 6.1 - 6.5.

BOOKS FOR REFERENCE:

1. Ian Sneddon, Elements of Partial Differential Equations, McGraw-Hill International Student Edition,1982.
2. Tyn Myint-U, Lokenath Debnath, Partial Differential Equations for Scientists and Engineers, Appleton and Lange Publishers - III Edition 1987

E - RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc24_ma02/preview
2. https://www.classcentral.com/course/swayam-partial-differential-equations-17721

COMPLEX ANALYSIS

Semester: III **Hours: 6**

Code : 23PMA3C08 **Credit: 5**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Acquire basic knowledge about the underlying principles of complex analysis	PSO-1	K1
CO - 2	Understand the local properties of analytic functions	PSO-5	K2
CO - 3	Apply Cauchy's formula, power series and its properties to evaluate complex contour integrals	PSO-3	K3
CO - 4	Represent functions as Taylor and Laurent series and analyze the convergence	PSO-2	K4
CO - 5	Signify the applications of complex analysis in real life	PSO-4	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: III				**COMPLEX ANALYSIS**							**Hours: 6**
Code : 23PMA3C08											**Credit: 5**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	5	3	3	3	3	3	5.	3	3	3	3	3.36
CO - 2	5	3	2	3	5	3	3	3	2	3	5	3.36
CO - 3	3	3	5	3	3	3	3	3	5	3	3	3.36
CO - 4	3	2	3	5	3	5	3	5	3	5	3	3.36
CO - 5	3	5	3	5	3	3	3	3	3	5	3	3.55
Overall Mean Score												**3.40**

Result: The score for this course is **3.40** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs= $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

UNIT I

Elementary Theory of Power Series: Uniform Convergence- Power Series - Abel's Limit Theorem - Arcs and Closed Curves - Analytic Functions in Regions - Conformal Mapping - Length and Area. **(18 Hours)**

UNIT II

Fundamental Theorems: Line Integrals - Rectifiable Arcs - Line Integrals as Functions of Arcs - Cauchy's Theorem for a Rectangle - Cauchy's Theorem in a Disk - Cauchy's Integral Formula: The Index of a point with respect to a closed curve - The Integral formula - Higher derivatives. **(18 Hours)**

UNIT III

Local Properties of analytical Functions: Removable Singularities - Taylors's Theorem - Zeros and Poles - The local Mapping - The Maximum Principle - The General Form of Cauchy's Theorem: Residue theorem - The argument principle - Evaluation of Definite Integrals. **(18 Hours)**

UNIT IV

Harmonic Functions: Definition and basic properties - Mean value property - Poisson formula - Schwarz's Theorem- Power Series Expansions: Weierstrass theorem - Taylor's Series - Laurent series. **(18 Hours)**

UNIT V

Partial Fractions and Factorization: Partial fractions - Infinite products - Canonical products - Gamma Function- Stirling's Formula - Entire Functions: Jensen's formula- Hadamard's Theorem. **(18 Hours)**

COURSE BOOK:

- Lars V. Ahlfors, Complex Analysis, Mc Graw Hill Student Edition, Third Edition,1979.

  Unit I : Chapter 2: Section 2: 2.3 - 2.5
  Chapter 3: Section2: 2.1 - 2.4
  Unit II : Chapter 4: Section 1: 1.1 - 1.5 & Section 2: 2.1 to 2.3
  Unit III : Chapter 4: Section 3: 3.1 - 3.4 & Section 5: 5.1to 5.3
  Unit IV : Chapter 4: Section 6: 6.1 - 6.4
  Chapter 5: Section 1: 1.1 - 1.3
  Unit V : Chapter 5: Section 2: 2.1 - 2.5 & Section 3: 3.1 & 3.2

BOOKS FOR REFERENCE:

1. S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House Pvt. Ltd., Second Edition 2005.
2. V. Karunakaran, Complex Analysis, Narosa Publishing House Pvt. Ltd., Second Edition 2005.

E - RESOURCES:

1. https://archive.nptel.ac.in/courses/111/103/111103070/#
2. https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449

TOPOLOGY

Semester: III **Hours: 6**

Code : 23PMA3C09 **Credit: 5**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Know the fundamental concepts and methods in general topology	PSO-1	K1
CO - 2	Understand the notion of product topology, subspace topology, metric topology and quotient topology	PSO-3	K2
CO - 3	Demonstrate the concepts of topological spaces and their role in mathematics	PSO-4	K3
CO - 4	Apply theoretical concepts in topology to understand real world applications	PSO-5	K4
CO - 5	Create new topological spaces by using countability and separation axioms	PSO-2	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: III						**TOPOLOGY**					**Hours: 6**
Code : 23PMA3C09											**Credit: 5**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	5	3	3	3	3	3	5	3	3	3	3	3.36
CO - 2	3	3	5	3	3	3	3	3	5	3	3	3.36
CO - 3	3	5	3	5	3	3	3	3	3	5	3	3.54
CO - 4	5	2	3	2	5	3	3	3	3	2	5	3.27
CO - 5	3	3	3	5	2	5	3	5	3	3	2	3.36
Overall Mean Score												**3.38**

Result: The score for this course is **3.38** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs= $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

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. **(18 Hours)**

UNIT II

Continuous functions: Continuous functions - the product topology - the metric topology. **(18 Hours)**

UNIT III

Connectedness: Connected space- connected subspaces of the real line - components and local connectedness. **(18 Hours)**

UNIT IV

Compactness: Compact spaces - compact subspaces of the Real line - Limit Point Compactness - local compactness. **(18 Hours)**

UNIT V

Countability and Separation axiom: The countability axioms - the separation axioms - normal spaces - the Urysohn lemma - the Urysohn metrization theorem - the Tietz extension theorem. **(18 Hours)**

COURSE BOOK:

- James. R. Munkres, Topology, PHI Learning Private Ltd., New Delhi, Second Edition, 2017.

  Unit I : Chapter 2 : Sections 12 - 17

  Unit II : Chapter 2 : Sections 18 - 21

  Unit III : Chapter 3 : Sections 23 - 25

  Unit IV : Chapter 3 : Sections 26 - 29

  Unit V : Chapter 4 : Sections 30 - 35

BOOKS FOR REFERENCE:

1. G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Book Co.; New York, 1963.
2. S. T. Hu, Elements of General Topology, Holden Day Inc., New York, 1965.

E - RESOURCES:

1. https://onlinecourses.swayam2.ac.in/ugc19_ma04/preview
2. https://onlinecourses.nptel.ac.in/noc22_ma36/preview

CALCULUS OF VARIATIONS

Semester: III **Hours: 6**

Code : 23PMA3E2A **Credit: 4**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Acquire the knowledge on the concept of calculus of variations	PSO - 1	K1
CO - 2	Understand functionals and their applications	PSO - 4	K2
CO - 3	Apply appropriate techniques to solve the initial and boundary value problems	PSO - 2	K3
CO - 4	Analyse appropriate methods to solve problems in mechanics	PSO - 3	K4
CO - 5	Reframe real life problems into mathematical models	PSO - 5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: III				**CALCULUS OF VARIATIONS**							**Hours: 6**
Code : 23PMA3E2A											**Credit: 4**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	5	3	3	3	3	3	5	3	3	3	3	3.36
CO - 2	3	5	3	5	3	3	3	3	3	5	3	3.55
CO - 3	3	3	2	5	3	5	3	5	2	3	3	3.36
CO - 4	3	3	5	3	3	3	3	3	5	3	3	3.36
CO - 5	5	3	2	3	5	3	3	3	2	3	5	3.36
Overall Mean Score												**3.40**

Result: The score for this course is **3.40** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs= $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

UNIT I

The concept of Variation and its properties - Euler's equation - Variational properties for functional - Functionals dependent on higher order derivatives - Functions of several independent variables - Some applications to problems of mechanics. **(18 Hours)**

UNIT II

Movable boundary for a functional dependent on two functions - One sided variations - Reflection and Refraction of extremals - Diffraction of light rays.

(18 Hours)

UNIT III

Introduction - Definition - Regularity conditions - Special kinds of Kernals - Eigen values and eigen functions - Convolution integral - Reduction to a system of algebraic equations - Examples - Fredholm alternative - Examples - An approximation method. **(18 Hours)**

UNIT IV

Method of successive approximations - Iterative scheme - Examples - Volterra integral equations - Examples - Some results about the resolvent kernel - The method of solution of Fredholm equation - Fredholm first theorem - Examples.

(18 Hours)

UNIT V

Initial value problems - Boundary value problem - Examples - Singular integral equations - The Abel integral equations - Examples. **(18 hours)**

COURSE BOOKS:

1. A. S. Gupta, Calculus of Variations with Applications, PHI, New Delhi, 2005.
2. Ram P. Kanwal, Linear Integral Equations, Theory and Techniques, Academic Press, New York, 1971.

Unit I : Chapter - 1 : Sections 1.1 - 1.7 (Book 1)
Unit II : Chapter - 2 : Sections 2.1 - 2.5 (Book 1)
Unit III : Chapter - 1 : Sections 1.1 - 1.5 (Book 2)
Chapter - 2 : Sections 2.1 - 2.5 (Book 2)
Unit IV : Chapter - 3 : Sections 3.1 - 3.5 (Book 2)
Chapter - 4 : Sections 4.1 - 4.3 (Book 2)
Unit V : Chapter - 5 : Sections 5.1 - 5.3 (Book 2)
Chapter - 8 : Sections 8.1 - 8.2 (Book 2)

BOOK FOR REFERENCE:

- R. K.Sharma, Calculus of Variations, Scientific International Publishers & Distributors, 2017.

E - RESOURCE:

1. https://www.pdfdrive.com/calculus-of-variations-d185491426.html

NUMERICAL ANALYSIS

Semester: III **Hours: 6**

Code : 23PMA3E2B **Credit: 4**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Acquire the knowledge on numerical differentiation, integration, and error analysis	PSO-1	K1
CO - 2	Understand the concepts of interpolation, numerical differentiation, and integration	PSO-3	K2
CO - 3	Apply numerical methods to obtain approximate solutions to nonlinear equations	PSO-2	K3
CO - 4	Analyse the raw data and apply the appropriate analytic technique to solve	PSO-5	K4
CO - 5	Formulate and solve real life problems using appropriate technique.	PSO-4	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: III				**NUMERICAL ANALYSIS**							**Hours: 6**
Code : 23PMA3E2B											**Credit: 4**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	5	3	4	3	3	3	5	3	4	3	3	3.54
CO - 2	2	3	5	3	3	3	2	3	5	3	3	3.18
CO - 3	3	4	3	5	3	5	3	5	3	4	3	3.72
CO - 4	5	3	3	3	5	3	3	3	3	3	5	3.54
CO - 5	3	5	3	5	3	2	3	2	3	5	3	3.36
Overall Mean Score												**3.47**

Result: The score for this course is **3.47** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs= $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

UNIT I

Transcendental and polynomial equations - Introduction -Bisection method - Iteration methods based on first degree equation - methods based on second degree equation - Rate of Convergence - Iteration Methods - Methods for Complex roots - Polynomial Equations. **(18 Hours)**

UNIT II

Interpolation and Approximation - Introduction - Lagrange and Newton Interpolation- finite difference operators - Interpolating polynomials using finite differences - Hermite interpolations. **(18 Hours)**

UNIT III

Numerical Differentiation - Introduction - numerical differentiation - extrapolation methods - partial differentiation. **(18 Hours)**

UNIT IV

Numerical Integration - Methods based on interpolation - composite integration methods - Romberg integration - double integration. **(18 Hours)**

UNIT V

Ordinary Differential Equations - Introduction - numerical methods - single step methods. **(18 Hours)**

COURSE BOOK:

- M. K. Jain, S. R. K. Iyengar & R. K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Pvt. Ltd., Publishers, Third Edition, 1996.

  Unit I : Chapter 2 : Sections 2.1 to 2.8

  Unit II : Chapter 4 : Sections 4.1 to 4.5

  Unit III : Chapter 5 : Sections 5.1 to 5.5

  Unit IV : Chapter 5 : Sections 5.6, 5.7, 5.9, 5.10, 5.11

  Unit V : Chapter 6 : Sections 6.1 to 6.3

BOOKS FOR REFERENCE:

1. John H. Mathews, Numerical Methods for Mathematics, science, and Engineering, Volume 54 of Lecture notes in Physics, Prentice hall, 1992.
2. Shankara Rao K., Numerical Methods for Scientists and Engineers, Prentice Hall of India, 2001.

E -RESOURCES:

1. https://archive.nptel.ac.in/courses/111/101/111101165/
2. https://nptel.ac.in/courses/111106101
3. https://www.coursera.org/courses?query=numerical%20analysis

MATHEMATICAL PYTHON

Semester: III **Hours: 6**

Code : 23PMA3E2C **Credit: 4**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Acquire the knowledge on Python	PSO - 1	K1
CO - 2	Understand the fundamentals of Python	PSO- 3	K2
CO - 3	Apply Python data structures, functions to solve the system of equations	PSO- 2	K3
CO - 4	Analyze Python programs to assess eigenvalue problems	PSO- 5	K4
CO - 5	Evaluate mathematical problems to obtain approximate solutions	PSO- 4	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: III				MATHEMATICAL PYTHON							Hours: 6
Code : 23PMA3E2C											Credit: 4
Course Outcomes	Programme Outcomes (PO)						Programme Specific Outcomes (PSO)					Mean Score of CO's
	1	2	3	4	5	6	1	2	3	4	5	
CO - 1	5	3	2	3	3	3	5	3	2	3	3	3.18
CO - 2	3	3	5	3	3	3	3	3	5	3	3	3.36
CO - 3	3	2	3	5	3	5	3	5	3	2	3	3.36
CO - 4	5	3	3	3	5	2	3	2	3	3	5	3.36
CO - 5	3	5	3	5	3	3	2	3	3	5	3	3.45
Overall Mean Score												3.34

Result: The score for this course is **3.34** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = Total of Values / Total No. of POs & PSOs	Mean Overall Score for COs= Total of Mean Scores / Total No. of COs

UNIT I

Python basics: Getting started with Python - setting up your working environment - three ways to run Python code - Python as a calculator - managing packages - managing packages using package managers - install packages from source - Introduction to Jupyter notebook - starting the Jupyter notebook - within the notebook - close a notebook - shutting down the Jupyter notebook server - logical expressions and operators. **(18 Hours)**

UNIT II

Variables and Basic Data Structures: Variables and assignment - data structure - string, list, tuple, set, dictionary - Introducing NumPy arrays. **(18 Hours)**

UNIT III

Functions: Basics - Built-In functions in Python - define your own function - local variables and global variables - nested functions - lambda functions - functions as arguments to functions. Branching statements: If-Else statements - ternary operators - Iteration: for-loops - while loops. **(18 Hours)**

UNIT IV

Linear algebra and systems of linear equations: basics of linear algebra-sets-vectors - matrices - linear transformations - systems of linear equations - solutions of systems of linear equations - Gauss elimination method - Gauss Jordan method - LU decomposition method - Iterative methods - Gauss Seidel method - Solving systems of linear equations in Python - matrix inversion. **(18 Hours)**

UNIT V

Eigenvalues and Eigenvectors: the motivation behind eigenvalues and eigenvectors - the characteristic equation - the power method - finding the largest eigenvalue - the inverse power method - the shifted power method - the QR method - Eigenvalues and Eigenvectors in Python. Least Squares Regression: Least Squares Regression Problem Statement - Least Squares Regression Derivation (Linear Algebra) - Least Squares Regression Derivation (Multivariate Calculus) - Least Squares Regression in Python. **(18 Hours)**

COURSE BOOK:

- Qingkai Kong, Timmy Siauw & Alexandre M. Bayen, Python Programming and Numerical Methods: A guide for Engineers and Scientists, Elsevier, 2021.

Unit I : Chapter1: Sections1.1 - 1.5

Unit II : Chapter2: Sections 2.1 - 2.7

Unit III: Chapter 3: Sections 3.1 - 3.5

Chapter 4: Sections: 4.1 - 4.2

Chapter 5: Sections: 5.1 - 5.2

Unit IV: Chapter14: Sections 14.1 - 14.6

Unit V : Chapter15: Sections15.1 - 15.4

Chapter 16: Sections: 16.1 - 16.4

BOOK FOR REFERENCE:

- Numerical Methods in Engineering with Python, Jaan Kiusalaas, Second Edition, Cambridge University press, 2010.

E-RESOURCES:

1. https://www.upgrad.com/blog/python-free-online-course/
2. https://warwick.ac.uk/fac/sci/maths/people/staff/dwight_barkley/home_page/python_course/

MATHEMATICAL PYTHON - TERM PAPER

1. To find the largest, smallest and sum of a given set of numbers.
2. To find factorial of a number.
3. To create Fibonacci series using recursion.
4. To manipulate strings using dictionaries.
5. To write a program using elementary data items, lists and tuples.
6. To create student's mark sheet using conditional branches and loops.
7. To write a program using nested and lambda functions.
8. To perform matrix operations using NumPy.
9. To find the inverse of a given matrix.
10. To obtain solutions to the systems of linear equations.
11. To decompose a matrix into lower and upper triangular matrices.
12. To determine eigenvectors of a matrix.

PROBABILITY AND RELIABILITY

Semester: III **Hours: 6**

Code : 23PMA3SE3 **Credit: 3**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Acquire the knowledge of probability and reliability	PSO-1	K1
CO - 2	Understand distributions and types of simulation	PSO-3	K2
CO - 3	Apply stochastic processes, system reliability and Monte Carlo simulation	PSO- 4	K3
CO - 4	Analyze the distributions and simulations	PSO-2	K4
CO - 5	Reframe real life problems using probability generating functions and simulation techniques	PSO-5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: III				**PROBABILITY AND RELIABILITY**							**Hours: 6**
Code : 23PMA3SE3											**Credit: 3**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	5	3	3	3	3	3	5	3	3	3	3	3.36
CO - 2	3	3	5	3	3	2	3	2	5	3	3	3.18
CO - 3	3	5	3	5	3	3	3	3	3	5	3	3.54
CO - 4	3	3	3	5	3	5	2	5	3	3	3	3.45
CO - 5	5	3	3	3	5	3	2	3	3	3	5	3.45
Overall Mean Score												**3.40**

Result: The score for this course is **3.40** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs= $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

UNIT I

Random variables and Stochastic Processes: Generating functions - Introduction - Probability generating functions: Mean and Variance - Bernoulli Distribution - Binomial Distribution - Geometric Distribution - Logarithmic series Distribution - Stochastic Processes: An Introduction - Specification of Stochastic Processes.

(18 Hours)

UNIT II

Markov Chains: Definition and examples - Transition Matrix - order of a Markov Chain - Markov chains as Graphs - Higher Transition Probabilities - Generalization of Independent Bernoulli Trails: Sequence of chain - Dependent Trails. **(18 Hours)**

UNIT III

Classification of States and chains - Determination of Higher Transition Probabilities - Stability of a Markov system - Graph Theoretic Approach - Markov chain with Denumerable Number of states. **(18 Hours)**

UNIT IV

System Reliability as a function of component Reliability: The System and its components - Independent Components: System Reliability and stationary Availability - Lifetime Distribution of a system without component Renewal - Parametric Lifetime Distributions - Poisson Process - Exponential and Gamma Distributions. **(18 Hours)**

UNIT V

Simulation Modelling: Monte Carlo Simulation - Types of simulation - Elements of Discrete Event simulation - Generation of Random Numbers. **(18 Hours)**

COURSE BOOKS:

1. J. Medhi, Stochastic Processes, New Age International (P) Limited, Publishers London - New Delhi, Fourth edition, 2019.
2. I. Gertsbakh, Reliability Theory, Springer International Edition, 2009.
3. Hamdy A. Taha, Operations Research, 9th Edition, Published by Pearson Education Inc, 2014.

Unit I : Chapter 1: Sections: 1.1.1, 1.1.2 & 1.5 (Book 1)
Unit II : Chapter 2: Sections: 2.1 - 2.3 (Book 1)
Unit III : Chapter 2: Sections: 2.4 - 2.8 (Book 1)
Unit IV : Chapter 1: Sections: 1: 1.1 - 1.3 (Book 2)
Chapter 2: Sections: 2.1 - 2.2 (Book 2)
Unit V : Chapter 17: Sections: 1 - 4 (Book 3)

BOOKS FOR REFERENCE:

1. Sheldon M. Ross, Stochastic Process, 2nd Edition. John Wiley and Sons Inc, 1996.
2. K. Unnikrishnan Nair, Statistical Methods in Quality and Reliability, Educational Publishers and Distributors, 1998
3. R. K. Guptha, Operation Research, Krishna Prakashan Media (P) Ltd, 2011

E-RESOURCES:

1. https://nptel.ac.in/courses/111102098
2. https://onlinecourses.nptel.ac.in/noc23_mg18/preview
3. https://www.classcentral.com/course/swayam-statistical-learning-for-reliability-analysis-91739
4. https://onlinecourses.nptel.ac.in/noc20_me37/preview

INTERNSHIP

Semester: III

Code : 23PMA3IN1 **Credit: 2**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Recall and summarize the basic scientific concepts involved in concerned internship site/industry	PSO - 1	K1
CO - 2	Understand the principles and methodologies employed during the Internship	PSO - 2	K2
CO - 3	Apply the subject knowledge and skills to conduct experiments, collection of data to be an Entrepreneur	PSO - 3	K3
CO - 4	Analyze the steps involved in the training process	PSO - 4	K4
CO - 5	Critically assess the effectiveness of experimental techniques	PSO - 5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: III				**INTERNSHIP**								
Code : 23PMA3IN1												**Credit: 2**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	5	3	4	3	3	3	5	3	4	3	3	3.54
CO - 2	3	3	3	5	3	5	3	5	3	3	3	3.54
CO - 3	3	3	5	3	3	3	3	3	5	3	3	3.36
CO - 4	3	5	2	5	3	3	3	3	2	5	3	3.36
CO - 5	5	3	3	3	5	3	3	3	3	3	5	3.54
Overall Mean Score												**3.47**

Result: The score for this course is **3.47** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs= $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

PG INTERNSHIP - GUIDELINES

I. Apply mathematical knowledge to real-life problems.

II. Gain research exposure using mathematical tools.

III. Develop logical and analytical thinking skills.

IV. Enhance career and competitive exam readiness.

V. Experience interdisciplinary applications.

MATHEMATICAL METHODS

Semester: IV **Hours: 6**

Code : 23PMA4C10 **Credit: 5**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Acquire knowledge of transforms	PSO-1	K1
CO - 2	Understand the concept of convolution in transforms	PSO-2 PSO-3	K2
CO - 3	Apply transforms to solve real life problems	PSO-3 PSO-5	K3
CO - 4	Analyze properties of Fourier and Hankel transforms	PSO-3 PSO-4	K4
CO - 5	Evaluate differential equations using transforms	PSO-1 PSO-5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: IV				**MATHEMATICAL METHODS**							**Hours: 6**
Code : 23PMA4C10											**Credit: 5**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	5	3	3	3	3	3	5	3	3	3	3	3.36
CO - 2	2	3	5	5	3	5	2	5	5	3	3	3.72
CO - 3	5	3	5	3	5	3	3	3	5	3	5	3.90
CO - 4	2	5	5	5	3	2	2	2	5	5	3	3.54
CO - 5	5	3	3	3	5	3	5	3	3	3	5	3.72
Overall Mean Score												**3.65**

Result: The score for this course is **3.65** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = Total of Values / Total No. of POs & PSOs	Mean Overall Score for COs= Total of Mean Scores / Total No. of COs

UNITI

Fourier Transforms: Dirichlet's conditions - Fourier series - Fourier Integral formula - Fourier transform or complex fourier transform - Inversion Theorem for Complex Fourier transform - Fourier sine transform - Inversion Formula for Fourier sine transform - Fourier cosine transform. **(18 Hours)**

UNIT II

Inversion Formula for Fourier Cosine transform - Linearity Property of Fourier transform - Change of Scale Property - Shifting Property - Modulation Theorem - Multiple Fourier transform - Convolution - The Convolution or Falting theorem for Fourier transforms- Parseval's identity for Fourier Transforms. **(18 Hours)**

UNIT III

Finite Fourier sine transforms - Inversion formula for sine transform - Finite Fourier cosine transform - Inversion formula for cosine transform - Multiple finite fourier transforms - Operational Properties of finite fourier sine transforms - Operational Properties of finite fourier cosine transforms - Combined properties of finite fourier sine and cosine transforms - Convolution. **(18 Hours)**

UNIT IV

Application of infinite Fourier transforms - Choice of infinite sine or cosine transforms - Application of finite fourier Transforms - Finite fourier transforms of partial derivatives - Choice of finite sine or cosine transforms. **(18 Hours)**

UNIT V

Hankel Transform - Inversion formula for the Hankel transform - Some important Results for Bessel functions - Linearity Property - Hankel Transform of the Derivatives of a function - Hankel Tranform of $\frac{d^2f}{dx^2} + \frac{1}{x}\frac{df}{dx} - \frac{n^2}{x^2}f$ - Parseval's Theorem. **(18 Hours)**

COURSE BOOK:

- A.R. Vasishtha and R. K. Gupta, Integral Transforms, Krishna Prakashan Media(P) Ltd, Thirtieth Edition, 2011.

  Unit I : Chapter 6: Sections 6.1 - 6.8
  Unit II : Chapter 6: Sections 6.9 - 6.19
  Unit III : Chapter 7: Sections 7.1 - 7.9
  Unit IV : Chapter 8: Sections 8.1 - 8.5
  Unit V : Chapter 9: Sections 9.1 - 9.7

BOOKS FOR REFERENCE:

1. Hochstad, Integral Equations, Wiley India Pvt Ltd, 2014.
2. K. Vairamanikam, Nirmala P. Ratchagar, Transforms and Partial Differential Equations,Scitech Publications (India) Pvt Ltd, 2012

E - RESOURCE:

1. https://onlinecourses.nptel.ac.in/noc20_ma41/preview

FUNCTIONAL ANALYSIS

Semester: IV **Hours: 6**

Code : 23PMA4C11 **Credit: 5**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Understand the elementary concepts of uniform convergence and spectral operators.	PSO-1	K1
CO - 2	Extend the structure of the real line to complex and vector valued function on intervals	PSO-5	K2
CO - 3	Apply the properties of orthonormal sets and different operators	PSO-3	K3
CO - 4	Discuss integration of real valued functions on intervals	PSO-2	K4
CO - 5	Develop the Lebesque integral in distinct ways	PSO-4	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: IV				**FUNCTIONAL ANALYSIS**							**Hours: 6**
Code : 23PMA4C11											**Credit: 5**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	5	3	3	3	3	3	5	3	3	3	3	3.36
CO - 2	5	3	3	4	5	4	3	4	3	3	5	3.81
CO - 3	3	3	5	3	3	3	3	3	5	3	3	3.36
CO - 4	3	4	3	5	3	5	3	5	3	4	3	3.72
CO - 5	4	5	3	5	3	3	4	3	3	5	3	3.72
Overall Mean Score												**3.59**

Result: The score for this course is **3.59** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs= $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

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. **(18 Hours)**

UNIT II

Hilbert Spaces: The definition and some simple properties - orthogonal complements - ortho normal sets - the conjugate space H^* - the adjoint of an operator - self - adjoint operators- normal and unitary operators - projections.

(18 Hours)

UNIT III

Finite-Dimensional Spectral Theory: Matrices - determinants and the spectrum of an operator -the spectral theorem. **(18 Hours)**

UNIT IV

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- the radical and semi-simplicity. **(18 Hours)**

UNIT V

The Structure of Commutative Banach Algebras: The Gelfand mapping - application of the formula$r(x) = \lim \|x^n\|^{1/n}$ - Involutions in Banach algebras - the Gelfand-Neumark theorem **(18 Hours)**

COURSE BOOK:

- G. F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Education India, 2004.

  Unit I : Chapter9 : Sections 46 - 51

  Unit II : Chapter10 : Sections 52 - 59

  Unit III: Chapter11 : Sections 60 - 62

  Unit IV: Chapter12 : Sections 64 - 69

  Unit V : Chapter13 : Sections 70 - 73

BOOKS FOR REFERENCE:

1. W. Rudin, Functional Analysis, McGraw Hill Education (India) Private Limited, New Delhi, 1973.
2. B.V. Limaye, Functional Analysis, New Age International,1996.

E-RESOURCES

1. https://onlinecourses.nptel.ac.in/noc21_ma25/preview
2. https://onlinecourses.swayam2.ac.in/cec23_ma24/preview

OPTIMIZATION TECHNIQUES

Semester: IV **Hours: 5**

Code : 23PMA4C12 **Credit: 4**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Acquire knowledge on optimization method	PSO-1	K1
CO - 2	Understand constrained optimization techniques	PSO-2	K2
CO - 3	Extend optimization models to real life problems	PSO-3	K3
CO - 4	Analyse the solution of optimization problems	PSO-5	K4
CO - 5	Criticize the abstract properties of various optimization techniques.	PSO-4	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: IV				**OPTIMIZATION TECHNIQUES**							**Hours: 5**
Code : 23PMA4C12											**Credit: 4**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	5	3	3	3	3	3	5	3	3	3	3	3.36
CO - 2	3	3	3	5	3	5	3	5	3	3	3	3.54
CO - 3	3	4	5	4	3	3	3	3	5	4	3	3.63
CO - 4	5	3	3	3	5	3	3	3	3	3	5	3.54
CO - 5	3	5	3	5	3	3	3	3	3	5	3	3.54
Overall Mean Score												**3.52**

Result: The score for this course is **3.52** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs= $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

UNIT I

One Dimensional Optimization: Introduction - function comparison methods-polynomial interpolation methods - iterative methods - function comparison methods: two point equal interval search - method of bisection - Fibonacci Method - golden section search method. **(15 Hours)**

UNIT II

Unconstrained Gradient Based Optimization Methods: Introduction - Gradient and conjugate gradient type algorithms - method of steepest descent - conjugate gradient method. **(15 Hours)**

UNIT III

Classical Optimization theory: Unconstrained Problems - necessary and sufficient conditions-the Newton-Raphson method-constrained problems - equality constraints-Jacobian method-Lagrangian method - inequality constraints - The Kuhn-Tucker Conditions. **(15 Hours)**

UNIT IV

Queuing systems: Elements of queuing model-role of exponential distribution - derivation of exponential distribution - pure birth and death models - Generalized Poisson queuing model - specialized Poisson queues steady-state measures of performance. **(15 Hours)**

UNIT V

Single server models (M/M/1):(GD/∞/∞)-waiting time distribution for (M/M/1):(FCFS/∞/∞) - (M/M/1):(GD/N/∞) - multiple server models - (M/M/c):(GD/∞/∞),(M/M/c):(GD/N/∞). **(15 Hours)**

COURSE BOOKS:

1. Mohan C Joshi & Kannan M Moudgalya, Optimization Theory and Practice, Narosa Publishing House, Chennai, 2004.
2. Hamdy. A. Taha, Operations Research-An Introduction, Prentice Hall of India Private Ltd.,New Delhi, X Edition,2020.

   Unit I : Chapter 2: Sections 2.1.1- 2.1.3, 2.2.2 - 2.2.5 (Book 1)

   Unit II : Chapter 3: Sections 3.1, 3.2, 3.2.2 - 3.2.3 (Book 1)

   Unit III : Chapter 20: Sections 20.1, 20.1.1, 20.1.2, 20.2, 20.2.1, 20.2.2(Book 2)

   Unit IV : Chapter 18: Sections 18.2, 18.3, 18.4-18.5, 18.6, 18.6.1(Book 2)

   Unit V : Chapter 18: Sections 18.6.2, 18.6.3, (Book 2)

BOOKS FOR REFERENCE:

1. Wiehelm Forst, dieter Hoffmann, Optimization - Theory and Practice, 2010th Edition, Springer.
2. Stephen Boyd, Lieven Vandenberghe, Convex Optimization, Cambridge University Press, 2004.

E-RESOURCES:

1. https://onlinecourses.swayam2.ac.in/cec20_ma10/preview
2. https://onlinecourses.nptel.ac.in/noc21_me10/preview

FINANCIAL MATHEMATICS

Semester: IV **Hours: 5**

Code : 23PMA4E3A **Credit: 3**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Acquire knowledge on mathematical foundations of quantitative finance	PSO-1	K1
CO - 2	Understand mathematical concepts in financial applications	PSO-2	K2
CO - 3	Apply mathematical formulae in financial management	PSO-3	K3
CO - 4	Analyze various methods of financial investments	PSO-5	K4
CO - 5	Appraise probabilistic states	PSO-4	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: IV				**FINANCIAL MATHEMATICS**							**Hours: 5**
Code : 23PMA4E3A											**Credit: 3**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	5	3	3	3	3	3	5	3	3	3	3	3.36
CO - 2	3	3	4	5	3	5	3	5	4	3	3	3.72
CO - 3	3	4	5	4	3	3	3	3	5	4	3	3.63
CO - 4	5	2	4	3	5	3	3	3	4	2	5	3.54
CO - 5	3	5	3	5	3	3	3	3	3	5	3	3.54
Overall Mean Score												**3.56**

Result: The score for this course is **3.56** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs= $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

UNIT I

Probability: Probabilities and Events - Conditional Probability - Random Variables and Expected Values - Covariance and Correlation - Conditional Expectation - Continuous Random Variables - Normal Random Variables - Properties of Normal Random Variables - Central Limit Theorem. **(15 Hours)**

UNIT II

Interest rates and Present value Analysis: Interest Rates - Present value Analysis - Rate of Return - Continuously Varying Interest Rates - Options Pricing - Pricing Via Arbitrage. **(15 Hours)**

UNIT III

The Arbitrage Theorem: The Arbitrage Theorem - Multiperiod Binomial Model - Arbitrage Theorem - The Black Scholes Formula - Properties of Black Scholes Option Cost - The Delta Hedging Arbitrage Strategy. **(15 Hours)**

UNIT IV

Valuing by Expected utility: Call Options on Dividend Paying Securities - Pricing American Put Options - Estimating the Volatility Parameter - Valuing investments by Expected utility - The capital Assets Pricing Model - Rates of return. **(15 Hours)**

UNIT V

Exotic Options: Introduction - Barrier options - Asian and Lookback Options - Monte Carlo Simulation - Pricing Exotic Options by Simulation. **(15 Hours)**

COURSE BOOK:

- An Elementary introduction to Mathematical Finance, Sheldon M Ross, Cambridge university press, Third Edition, 2011.

Unit I	:	Chapter1	: Sections 1.1- 1.5
		Chapter 2	: Sections 2.1- 2.4
Unit II	:	Chapter 4	: Sections 4.1- 4.4
		Chapter 5	: Sections 5.1- 5.2
Unit III	:	Chapter 6	: Sections 6.1- 6.3
		Chapter 7	: Sections 7.1- 7.4
Unit IV	:	Chapter 8	: Sections 8.1-8.3,8.5
		Chapter 9	: Sections 9.1,9.2, 9.5,9.6
Unit V	:	Chapter 13	: Sections 13.1-13.5

BOOKS FOR REFERENCE:

1. The Mathematics of Financial Models: Solving Real-World Problems with Quantitative Methods, Kannoo Ravindran, Wiley Finance, 2014.
2. Mathematical Techniques in Finance: Tools for Incomplete Markets, Ale˘sCern'y, Princeton University Press, Second Edition, 2009.

E- RESOURCES:

1. http://www.freetechbooks.com
2. https://www.khanacademy.org/
3. https://www.quantstart.com/

DIFERENTIAL GEOMETRY

Semester: IV **Hours: 5**

Code : 23PMA4E3B **Credit: 3**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Acquire the knowledge of space curves and Geodesics	PSO-1	K1
CO - 2	Understand the fundamental existence theorem for space curves, local intrinsic and nonlocal intrinsic properties of a surface	PSO-2	K2
CO - 3	Apply the concepts of differential geometry in various disciplines	PSO-5	K3
CO - 4	Analyze the properties of surfaces	PSO-3	K4
CO - 5	Appraise the applications of differential geometry in real life	PSO-4	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: IV				**DIFERENTIAL GEOMETRY**							**Hours: 5**
Code : 23PMA4E3B											**Credit: 3**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	5	3	3	3	3	3	5	3	3	3	3	3.36
CO - 2	3	3	4	5	3	5	3	5	4	3	3	3.72
CO - 3	5	3	3	3	5	4	3	3	3	3	5	3.63
CO - 4	3	3	5	3	3	3	3	3	5	3	3	3.36
CO - 5	2	5	3	5	3	3	2	3	3	5	3	3.36
Overall Mean Score												**3.49**

Result: The score for this course is **3.49** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs= $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

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. **(15 Hours)**

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. **(15 Hours)**

UNIT III

Geodesics**:** Geodesics - Canonical geodesic equations - Normal property of geodesics- Existence Theorems - Geodesic parallels - Geodesics curvature- Gauss- Bonnet Theorem - Gaussian curvature- surface of constant curvature.

(15 Hours)

UNIT IV

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. **(15 Hours)**

UNIT V

Differential Geometry of Surfaces**:** Compact surfaces whose points are umblics - Hilbert's lemma - Compact surface of constant curvature - Complete surface and their characterization - Hilbert's Theorem - Conjugate points on geodesics.

(15 Hours)

COURSE BOOK:

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

Unit I : Chapter I : Sections : 1 - 9
Unit II : Chapter II : Sections : 1 - 9
Unit III : Chapter II : Sections : 10 - 18
Unit IV: Chapter III : Sections :1 - 8
Unit V **:** Chapter IV : Sections : 1 - 8

BOOKS FOR REFERENCE

1. D. E. Rutherford, Classical Mechanics, Oliver Royd, New York , 2000
2. J. C. Upadhyaya, Classical Mechanics, Himalya Publishing House, Mumbai, 2003

E-RESOURCES:

1. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/364
2. https://ocw.mit.edu/courses/18-950-differential-geometry-fall-2008/

ALGEBRAIC TOPOLOGY

Semester: IV **Hours: 5**

Code : 23PMA4E3C **Credit: 3**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Grasp fundamental ideas behind Algebraic Topology	PSO-1	K1
CO - 2	Understand the structure of homology group and implication of Euler Poincare theorem	PSO-2	K2
CO - 3	Articulate the basic properties of covering spaces and their significance	PSO-3	K3
CO - 4	Illustrate examples of fundamental group in diverse mathematical scenario	PSO-4	K4
CO - 5	Assess the utilization of algebraic topology in mathematical model	PSO-5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: IV				**ALGEBRAIC TOPOLOGY**							**Hours: 5**
Code : 23PMA4E3C											**Credit: 3**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	5	3	3	3	3	3	5	3	3	3	3	3.36
CO - 2	3	3	3	5	3	5	3	5	3	3	3	3.54
CO - 3	3	3	5	3	3	3	3	3	5	3	3	3.09
CO - 4	3	5	3	5	3	3	3	3	3	5	3	3.54
CO - 5	5	3	3	3	5	3	3	3	3	3	5	3.54
Overall Mean Score												**3.41**

Result: The score for this course is **3.41** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs= $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

UNIT I

Introduction - Examples, Geometric Complexes and Polyhedra, Orientation of Geometric complexes. **(15 Hours)**

UNIT II

Simplicial Homology Groups - Chains, cycles, Boundaries, Homology groups - Examples of Homology Groups - The structure of Homology Groups - The Euler Poincare Theorem - Pseudo manifolds and the Homology Groups of S^n.

(15 Hours)

UNIT III

Simplicial Approximation: Introduction - Simplicial Approximation - Induced Homomorphisms on the Homology groups - The Brower fixed point theorem and related results. **(15 Hours)**

UNIT IV

The Fundamental group: Introduction - Homotopic paths and the fundamental group - The covering homotopy property for S^1 -Examples of Fundamental group, the relation between $H_1(K)$ and $\pi_1(|K|)$. **(15 Hours)**

UNIT V

Covering Spaces: Definition and examples - Basic properties of Covering spaces - Classification of covering spaces - Universal covering spaces - Applications.

(15 Hours)

COURSE BOOK:

- Fred H. Croom, Basic Concepts of Algebraic Topology, Springer - Verlang

  Unit I : Chapter - 1: Sections 1.1- 1.4

  Unit II : Chapter - 2: Sections 2.1 - 2.5

  Unit III : Chapter -3: Sections 3.1- 3.4

  Unit IV : Chapter - 4: Sections 4.1- 4.5

  Unit V : Chapter - 5: Sections 5.1 - 5.5

BOOKS FOR REFERENCE:

1. I. M Singer, J. A. Thorpe, Lecture Notes on Elementary Topology and Geometry, Springer International Edition, Springer (India) Private Limited, New Delhi, 2004
2. Satya Deo, Algebraic Topology A Primer, Hindustan Book Agency, New Delhi, 2003.
3. Allen Hatcher, Algebraic Topology, Published 2001by Cambridge University Press

E - RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_ma28/preview
2. https://youtu.be/kdpbfOzkJzI?si=tjh10V-XxTl7Rd7w
3. https://onlinecourses.nptel.ac.in/noc21_ma49/preview

PROJECT VIVA - VOCE

Semester: IV **Hours: 6**

Code : 23PMA4R01 **Credit: 3**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Do literature survey in their respective field and identify a problem	PSO-1	K1
CO - 2	Understand the various methods involved in solving the problem	PSO-2	K2
CO - 3	Adopt suitable analytical techniques to complete the research	PSO-3	K3
CO - 4	Improve their presentation skills through reviews	PSO-4	K4
CO - 5	Compile their research findings	PSO-5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: IV				**PROJECT VIVA - VOCE**							**Hours: 6**
Code : 23PMA4R01											**Credit: 3**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	5	3	3	3	3	3	5	3	3	3	3	3.36
CO - 2	3	3	3	5	3	5	3	5	3	3	3	3.54
CO - 3	3	3	5	3	3	3	3	3	5	3	3	3.09
CO - 4	3	5	3	5	3	3	3	3	3	5	3	3.54
CO - 5	5	3	3	3	5	3	3	3	3	3	5	3.54
Overall Mean Score												**3.41**

Result: The score for this course is **3.41** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs= $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

PG PROJECT WITH VIVA-VOCE - GUIDELINES

I. Clearly state the aims and scope of your project.

II. Choose an original, relevant topic within your area of interest.

III. Research existing work to understand current practices and identify gaps.

IV. Plan your research approach, including data collection and analytical techniques.

V. Create a detailed outline of your project report, including potential chapters.

TRAINING FOR COMPETITIVE EXAMINATIONS

Semester: IV **Hours: 2**

Code : 23PMA4SE4 **Credit: 1**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Acquire knowledge of real life problems	PSO - 4	K1
CO - 2	Understand and interpret mathematical and reasoning concepts	PSO - 2 PSO - 4	K2
CO - 3	Articulate simplification techniques in mathematical expressions	PSO - 1 PSO - 2	K3
CO - 4	Correlate trigonometry principles with real world problems	PSO - 3	K4
CO - 5	Foster critical thinking in math and reasoning for success in exams	PSO - 5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: IV				**TRAINING FOR COMPETITIVE EXAMINATIONS**							**Hours: 2**
Code : 23PMA4SE4											**Credit: 1**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	3	5	3	5	3	3	3	3	3	5	3	3.55
CO - 2	3	5	2	5	3	5	3	5	2	5	3	3.45
CO - 3	5	3	3	5	3	5	5	5	3	3	3	3.63
CO - 4	3	3	5	3	3	3	3	3	5	3	3	3.36
CO - 5	5	3	3	3	5	3	3	3	3	3	5	3.54
Overall Mean Score												**3.51**

Result: The score for this course is **3.51** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs= $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

UNIT I

Simplification - Square Roots and Cube Roots - Surds and indices - Ratio and proportion - Partnership - Chain Rule. **(6 Hours)**

UNIT II

Number series - Letter series - Mathematical Aptitude: Fraction - Time & Distance - Percentage - Profit and Loss - Interest - Discounting - Averages - Reasoning - Blood Relations. **(6 Hours)**

UNIT III

Vector spaces - subspaces - linear dependence - basis - dimension - Algebra of linear transformations - Algebra of matrices - rank and determinant of matrices. **(6 Hours)**

UNIT IV

Linear equations - Eigenvalues and eigenvectors - Cayley-Hamilton Theorem - Matrix representation of linear transformations - Change of basis - canonical forms. **(6 Hours)**

UNIT V

Sequences - Bounded sequences - Monotonic sequences - Convergent sequence - divergent and oscillating sequences - Root test and condensation test - Integral test - Alternating series - absolute convergence - Tests for convergence of series of arbitrary terms. **(6 Hours)**

COURSE BOOK:

Couse material compiled by the Department.

BOOKS FOR REFERENCE:

1. Dr. R. S. Aggarwal, Quantitative Aptitude, S. Chand & Company Ltd. New Delhi.
2. Dr. R.S. Aggarwal, A Modern Approach to Verbal & Non - Verbal Reasoning, S. Chand and Company Ltd. New Delhi.
3. M. Artin, Algebra, Prentice Hall of India, 1991.
4. I.N. Herstein. Topics in Algebra (II Edition) Wiley Eastern Limited, New Delhi, 1975
5. P. B. Bhattacharya, S. K. Jain, and S. R. Nagpaul, Basic Abstract Algebra (II Edition) Cambridge University Press, 1997. (Indian Edition)

E - RESOURCES:

1. https://www.udemy.com/course/arithmetic-for-placementscrt-through-animated-videos/
2. https://unacademy.com/lesson/competitive-exams-preparation/SMBIKM82