CAUVERY COLLEGE FOR WOMEN (AUTONOMOUS)
Nationally Accredited with 'A' Grade by NAAC

ISO 9001:2015 Certified

TIRUCHIRAPPALLI

PG AND RESEARCH DEPARTMENT OF MATHEMATICS

M. Sc. MATHEMATICS
AUTONOMOUS SYLLABUS
2022 – 2023 and onwards

CAUVERY COLLEGE FOR WOMEN (AUTONOMOUS)
PG AND RESEARCH DEPARTMENT OF MATHEMATICS

VISION

To strive for excellence in the mathematical sciences in addition to encourage people to undertake opportunities in transdisciplinary domains.

MISSION

- To enhance analytical and logical problem-solving capabilities.
- To provide excellent mathematical science knowledge for a suitable career and to groom students for national prominence.
- To teach students how to use data analytics.
- To prepare students for transdisciplinary research and applications.
- Value-based education and service-oriented training programmes are used to acquire life skills.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEOs	Statements
PEO1	**LEARNING ENVIRONMENT** To facilitate value-based holistic and comprehensive learning by integrating innovative learning practices to match the highest quality standards and train the students to be effective leaders in their chosen fields.
PEO2	**ACADEMIC EXCELLENCE** To provide a conducive environment to unleash their hidden talents and to nurture the spirit of critical thinking and encourage them to achieve their goal.
PEO3	**EMPLOYABILITY** To equip students with the required skills in order to adapt to the changing global scenario and gain access to versatile career opportunities in multidisciplinary domains.
PEO4	**PROFESSIONAL ETHICS AND SOCIAL RESPONSIBILITY** To develop a sense of social responsibility by formulating ethics and equity to transform students into committed professionals with a strong attitude towards the development of the nation.
PEO5	**GREEN SUSTAINABILITY** To understand the impact of professional solutions in societal and environmental contexts and demonstrate the knowledge for an overall sustainable development.

PROGRAMME OUTCOMES FOR M.Sc MATHEMATICS

PO NO.	On completion of M.Sc Mathematics, the students will be able to
PO 1	**Problem Analysis** Provide opportunities to develop innovative design skills, including the ability to formulate problems, to think creatively, to synthesize information, and to communicate effectively.
PO 2	**Scientific Skills** Create and apply advanced techniques and tools to solve the societal environmental issues.
PO 3	**Environment and Sustainability** Ascertain eco-friendly approach for sustainable development and inculcate scientific temper in the society.
PO 4	**Ethics** Imbibe ethical and social values aiming towards holistic development of learners.
PO 5	**Life long learning** Instill critical thinking, communicative knowledge which potentially leads to higher rate of employment and also for higher educational studies.

PROGRAMME SPECIFIC OUTCOMES FOR M.Sc MATHEMATICS

PSO NO.	The Students of M.Sc Mathematics will be able to	POs Addressed
PSO1	Make a significant contribution to society's development through mathematical study	PO1 PO2 PO3
PSO2	Provide an in-depth and extensive functional understanding of mathematical basics.	PO1
PSO3	Develop the experimental abilities in order to solve scientific and technical problems.	PO1 PO5
PSO4	Promote the learners and explore the potential in emerging fields.	PO4 PO5
PSO5	Enhance problem-solving, thinking, and creative skills through assignments and project work.	PO4 PO5

Cauvery College for Women (Autonomous), Trichy-18
PG & Research Department of Mathematics
M.Sc Mathematics
Learning Outcome Based Curriculum Framework (CBCS-LOCF)
For the Candidates admitted from the Academic year 2022-2023 onwards

Semester	Course	Course Title	Course Code	Inst. Hrs. / Credits		Exam			Total
						Hrs.	Marks		
							Int.	Ext.	
I	Core Course– I (CC)	Algebra-I	22PMA1CC1	6	5	3	25	75	100
	Core Course – II (CC)	Ordinary Differential Equations	22PMA1CC2	6	5	3	25	75	100
	Core Course –III (CC)	Integral Equations, Calculus of Variations and Transforms	22PMA1CC3	6	5	3	25	75	100
	Core Course - IV (CC)	Algebraic Number Theory	22PMA1CC4	6	5	3	25	75	100
	Discipline Specific Elective Course-I (DSE)	A. Advanced Numerical Analysis	22PMA1DSE1A	6	3	3	25	75	100
		B. Mathematical Modelling	22PMA1DSE1B						
		C. Boundary Value Problems	22PMA1DSE1C						
	Total			**30**	**23**	**-**	**-**	**-**	**500**

15 Days INTERNSHIP during Semester Holidays

Semester	Course	Course Title	Course Code	Inst. Hrs. / week	Credits	Exam			Total
						Hrs.	Marks		
							Int.	Ext.	
II	Core Course– V (CC)	Algebra-II	22PMA2CC5	6	5	3	25	75	100
	Core Course – VI (CC)	Real Analysis	22PMA2CC6	6	5	3	25	75	100
	Core Course -VII (CC)	Linear Algebra	22PMA2CC7	6	5	3	25	75	100
	Core Choice Course– I (CCC)	A. Partial Differential Equations	22PMA2CCC1A	6	4	3	25	75	100
		B. Mathematical Programming	22PMA2CCC1B						
		C. Difference Equations	22PMA2CCC1C						
	Discipline Specific Elective Course-II (DSE)	A. Computational Mathematics Using MATLAB (P)	22PMA2DSE2AP	6	3	3	40	60	100
		B. Mathematical Modelling Using MATLAB (P)	22PMA2DSE2BP						
		C. Ordinary Differential Equations and Partial Differential Equations Using MATLAB (P)	22PMA2DSE2CP						
	Internship	Internship	22PMA2INT	-	2	-	-	100	100
	Extra Credit Course	**SWAYAM**	**As per UGC's Recommendation**						
	Total			**30**	**24**	**-**	**-**	**-**	**600**

Semester	Course	Course Title	Course Code	Inst. Hrs. / week	Credits	Exam			Total
						Hrs.	Marks		
							Int.	Ext.	
III	Core Course– VIII(CC)	Topology	22PMA3CC8	6	5	3	25	75	100
	Core Course – IX (CC)	Discrete Mathematics	22PMA3CC9	6	5	3	25	75	100
	Core Course - X (CC)	Measure and Integration	22PMA3CC10	6	5	3	25	75	100
	Core Choice Course– II (CCC)	A. Cyber Security	22PGCS3CCC2A	3(T) + 2(P)	4	3	25	75	100
		B. Introduction to Coding Theory	22PMA3CCC2B	5					
		C. Mechanics	22PMA3CCC2C						
	Discipline Specific Elective Course-III (DSE)	A. Analytical Skills for Competitive Examinations	22PMA3DSE3A	4	3	2	-	100	100
		B. Stochastic Processes	22PMA3DSE3B			3	25	75	
		C. Fuzzy Sets and their Applications	22PMA3DSE3C						
	Generic Elective Course -I (GEC)	Foundation for Logical Thinking	22PMA3GEC1	3	2	3	25	75	100
	Extra Credit Course	**SWAYAM**	**As per UGC Recommendation**						
	Total			**30**	**24**	**-**	**-**	**-**	**600**

Semester	Course	Course Title	Course Code	Inst. Hrs. / week	Credits	Exam			Total
						Hrs.	Marks		
							Int.	Ext.	
IV	Core Course– XI(CC)	Complex Analysis	22PMA4CC11	6	5	3	25	75	100
	Core Course - XII(CC)	Functional Analysis	22PMA4CC12	6	5	3	25	75	100
	Core Choice Course– III (CCC)	A. Differential Geometry	22PMA4CCC3A	6	4	3	25	75	100
		B. Formal Language and Automata Theory	22PMA4CCC3B						
		C. Fluid Dynamics	22PMA4CCC3C						
	Generic Elective Course-II (GEC)	Optimization Techniques	22PMA4GEC2	3	2	3	25	75	100
	Project	Project Work	22PMA4PW	9	5	-	-	100	100
	Total			**30**	**21**	**-**	**-**	**-**	**500**
	Grand Total			**120**	**92**	**-**	**-**	**-**	**2200**

Courses & Credits for PG and Research Department of Mathematics

S. No	Courses	No. of Courses	No. of Credits	Marks
1.	Core Course– (CC)	12	60	1200
2.	Core Choice Course– (CCC)	3	12	300
3.	Discipline Specific Elective- (DSE)	3	9	300
4.	Generic Elective Course - (GEC)	2	4	200
5.	Project	1	5	100
6.	Internship	1	2	100
	Total	22	92	2200

Students will go for internship after completing the I Semester exams and the internship will be calculated in the II Semester and credits for internship is 02.
For each semester marks will be for 500(600 for II Semester due to internship)
The internal and external marks for theory and practical papers are as follows:

Subject	Internal	External
Theory	25	75
Practical	40	60

Separate passing minimum is prescribed for Internal and External

For Theory:

a) The passing minimum for CIA shall be 40% out of 25 marks (i.e. 10 marks).
b) The passing minimum for End Semester Examination shall be 40% out of 75 marks (i.e. 30 marks).
c) The passing minimum not less than 50% in the aggregate.

For Practical:

a) The passing minimum for CIA shall be 40% out of 40 marks (i.e. 16 marks)
b) The passing minimum for End Semester Examinations shall be 40% out of 60 marks (i.e. 24 marks)
c) The passing minimum not less than 50% in the aggregate.

For Project:

Project : 100 Marks
Dissertation : 80 Marks
Viva Voce : 20 Marks

Semester I	Internal Marks: 25		External Marks: 75	
COURSECODE	**COURSE TITLE**	**CATEGORY**	**Hrs / WEEK**	**CREDITS**
22PMA1CC1	**ALGEBRA- I**	**CORE**	**6**	**5**

Course Objectives

- **Gain** expertise and confidence in proving theorems to progress in mathematical studies.
- **Acknowledge** the students with experience in axiomatic mathematics while keeping in close touch with the computational aspects of the subject.
- **Enhance** students to understand principles, concepts necessary to formulate, solve and analyze Algebra.

Prerequisite

Basic knowledge of sets, relations and functions.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On successful completion of this work, students will be able to	Cognitive Level
CO1	Apply the basic concepts of group theory with the help of numerous examples	K3
CO2	Examine in detail about Permutation Groups and Normal Groups and discuss about counting tricks in algebra	K4
CO3	Solve problems related to theorems	K3
CO4	Classify groups of finite order using Sylow's theorems	K4
CO5	Analyze the Field of Quotients of an integral domain	K4

Mapping of CO with POs and PSOs

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	3	3	2	2	2	3
CO2	2	3	3	2	2	2	3	2	2	3
CO3	2	2	3	3	3	3	3	2	3	3
CO4	3	3	2	2	3	3	3	3	2	2
CO5	2	2	3	3	2	3	2	2	2	3

"1" – Slight (Low) Correlation ¬ "2" – Moderate (Medium) Correlation ¬

"3" – Substantial (High) Correlation ¬ "-" indicates there is no correlation.

Syllabus

Unit I **(17 Hours)**

Binary Operations – Groups – Subgroups - Permutations I - Permutations II.

Unit II **(18 Hours)**

Isomorphism - Direct products - Finitely Generated Abelian Groups - Groups of Cosets- Normal Subgroups and Factor Groups.

Unit III **(17 Hours)**

Series of Groups - Isomorphism Theorems; Proof of the Jordan - Holder Theorem - Sylow Theorems**.**

Unit IV **(20 Hours)**

Rings - Integral domains - The Field of Quotients of an Integral Domain - Quotient Rings and Ideals.

Unit V **(18 Hours)**

Factorization of Polynomials over a Field - Unique Factorization Domains -Euclidean Domains -

Gaussian Integers and Norms**.**

Unit VI- Self-Study for Enrichment (Not included for End Semester Examinations)

Cyclic Groups – Homomorphisms - Applications of the Sylow Theorem - Some Noncommutative examples - Homomorphism of Rings.

Text Book

1**.** John B. Fraleigh,(2018(Reprint)), *A First Course in Abstract Algebra*, Narosa Publishing House, Third edition.

Chapters and Sections

UNIT-I	Chapters 1 to 5[1]
UNIT-II	Chapters 7,8,9,11 and 12[1]
UNIT-III	Chapter 14,15 and 18[1]
UNIT-IV	Chapter 23,24,26 and 28[1]
UNIT-V	Chapter 31 to 34[1]

Reference Books

1. David S. Dummit and Richard M. Foote, (2004), *Abstract Algebra*, Wiley and Sons, Third Edition.
2. Joseph A. Gallian, (1999), *Contemporary Abstract Algebra*, Narosa Publishing House, Fourth Edition.
3. Herstein. I.N, (1975), *Topics in Algebra*, John Wiley, Second Edition.

Web References

1. **https://www.youtube.com/watch?v=g7L_r6zw4-c**
2. **https://www.youtube.com/watch?v=VSB8jisn9xI**
3. **https://www.youtube.com/watch?v=WwndchnEDS4**
4. **https://www.youtube.com/watch?v=xTCxmr4ISU4**
5. **https://www.youtube.com/watch?v=iobTKR4-19o**
6. **https://www.youtube.com/watch?v=NfmJQ1ah4vM**
7. **https://www.youtube.com/watch?v=vrFd-5uEv4k**

Pedagogy

Power Point Presentations, Group Discussions, Seminar, Quiz, Assignment.

Course Designer

Dr. K. Kalaiarasi.

Semester I	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs / Week**	**CREDITS**
22PMA1CC2	**ORDINARY DIFFERENTIAL EQUATIONS**	**CORE**	**6**	**5**

Course Objectives

- **Recognize** certain basic types of first order ODEs for which exact solutions may be obtained and to apply the corresponding methods of solution
- **Qualitative Analysis** of Solutions of First Order Autonomous Equations.
- **Analyze** the concepts of existence and uniqueness of solutions.

Prerequisite

Fundamental knowledge of ordinary differential equations in UG.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On successful completion of this work, students will be able to	Cognitive Level
CO1	**Define** linear, non-linear, homogeneous and autonomous system of ordinary differential equations.	**K1**
CO2	**Understand** the Qualitative properties of solutions by Sturm separation and Sturm comparison theorems.	**K2**
CO3	**Diagnose** the power series solution for ordinary differential equations such as Gauss Hyper Geometric, Bessel's and Legendre equations.	**K4**
CO4	**Discriminate** the Qualitative properties of solutions for Boundary value problems by using Sturm theorems.	**K4**
CO5	**Analyze** the Stability nature of Linear and Non-Linear system for various methods.	**K4**

Mapping of CO with POs and PSOs

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3	3	3	3	2	3
CO2	3	3	3	3	3	3	3	3	2	3
CO3	3	3	3	3	3	3	3	3	2	3
CO4	3	3	2	3	3	3	3	3	2	3
CO5	3	3	3	3	3	3	3	3	2	3

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Syllabus

UNIT I **(18 Hours)**

The General Solution of the Homogeneous Equation – The Use of a Known Solution to Find Another – The Method of Variation of Parameters – Power Series Solutions and Special Functions: Introduction: A Review of Power Series – Series Solutions of First Order Equations – Second Order Linear Equations. Ordinary Points.

UNIT II **(18 Hours)**

Regular Singular Points – Gauss's Hypergeometric Equation – The Point at Infinity. Legendre Polynomials – Properties of Legendre Polynomials - Bessel Functions. The Gamma Function, Properties of Bessel Functions.

UNIT III **(18 Hours)**

Linear Systems – Homogeneous Linear Systems with Constant Coefficients – The Existence and Uniqueness of Solutions: The Method of Successive Approximations - Picard's Theorem.

UNIT IV **(18 Hours)**

Qualitative Properties of Solutions: Oscillations and the Strum Separation Theorem – The Sturm Comparison Theorem – Eigen Values , Eigen Functions and the Vibrating String.

UNIT V **(18 Hours)**

Nonlinear Equations: Autonomous Systems. The Phase Plane and Its Phenomena – Types of Critical Points. Stability – Critical Points and Stability for Linear Systems – Stability by Liapunov's Direct Method - Simple Critical Points of Nonlinear Systems.

UNIT VI - Self- Study for Enrichment(Not included for End Semester Examinations)

The Homogeneous Equation with Constant Coefficients - Regular Singular Points (Continued) – Systems. The Second Order Linear Equation - Sturm Liouville Problems -Nonlinear Mechanics, Conservative systems.

Text Book

George F. Simmons (2003). Differential Equations with Applications and Historical Notes, Second Edition. Tata McGraw- Hill Editions.

Chapters and Sections

UNIT – I	Chapter 3	Sections 15, 16, 19
	Chapter 5	Sections 26 to 28
UNIT – II	Chapter 5	Sections 29, 31, 32
	Chapter 8	Sections 44 to 47
UNIT – III	Chapter 10	Sections 55, 56
	Chapter 13	Sections 68, 69
UNIT – IV	Chapter 4	Sections 24, 25
	Chapter 7	Sections 40
UNIT –V	Chapter 11	Sections 58 to 62

Reference Books

1. Raisinghania M.D. (2006), Ordinary and Partial Differential Equations,1st Edition, S.Chand & Co.
2. Coddington E.A. and Levinson N. (2002), Theory of Ordinary Differential Equations, Mc- Graw Hill Publishing Company, NewYork.
3. Chicone, Carmen. (2006), A Ordinary Differential Equations With Applications,2nd Edition, Spring Verlag, NewYork.

Web References

1. https://www.youtube.com/watch?v=gd1FYn86P0c
2. https://www.youtube.com/watch?v=6o7b9yyhH7k
3. https://www.youtube.com/watch?v=HAb9JbBD2ig
4. https://www.youtube.com/watch?v=kj-qTWhH5N4
5. https://www.youtube.com/watch?v=CV81OjuHUS8
6. https://www.youtube.com/watch?v=oTN7hGoSPMw
7. https://www.youtube.com/watch?v=IWm6Coa3_bQ
8. https://www.youtube.com/watch?v=1HUnrokDN0U
9. https://www.youtube.com/watch?v=1HUnrokDN0U

Pedagogy

Chalk and Talk method, Power point presentations, Group Discussions, Seminar, Quiz, Assignment.

Course Designer

Dr. G. Janaki

Semester I	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs / Week**	**CREDITS**
22PMA1CC3	**INTEGRAL EQUATIONS, CALCULUS OF VARIATIONS AND TRANSFORMS**	**CORE**	**6**	**5**

Course Objectives

- To introduce the concept of calculus of variations and integral equations and their applications.
- To learn the different types of transforms and their properties.
- To give an experience in the implementation of Mathematical concepts like integral transforms, integral equations and calculus of variations in various field of Engineering.

Prerequisite

Basic Knowledge of Integral Calculus and Fourier Series

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On successful completion of this work, students will be able to	Cognitive Level
CO1	Apply the concepts of calculus of variations to find the maxima and minima of quantities defined as integrals containing unknown functions.	K3
CO2	Classify various kinds of Fourier sine and cosine transforms with their properties and simple problems.	K3
CO3	Explain the concept of Fourier transform, Hankel transform and its inverse transform.	K3
CO4	Recognize and solve particular cases of Fredholm and Volterra integral equations and variational problem	K4
CO5	Evaluate the integral equations by the method of successive approximations.	K5

Mapping of CO with POs and PSOs

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	3	3	2	2	2	3
CO2	2	3	3	2	2	2	3	2	2	3
CO3	2	2	3	3	3	3	3	2	2	3
CO4	3	3	2	2	3	3	3	2	2	2
CO5	2	2	3	3	2	3	2	2	2	3

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"3" – Substantial (High) Correlation ¬ "-" indicates there is no correlation.

Syllabus

UNIT I **(18 Hours)**

Calculus of variations and applications: Maxima and Minima – The simplest case – Illustrative examples - Natural boundary conditions and transition conditions – The Variational notation – The More general case – constraints and Lagrange multipliers – variable end points – Sturm-Liouville problems.

UNIT – II **(18 Hours)**

Fourier transforms: Dirichlet's conditions – Fourier series – Fourier's 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 - Inversion formula for Fourier cosine transform – Linearity property of Fourier transform – Change of scale property – Shifting Property – Modulation Theorem – Multiple Fourier transforms - Convolution - The convolution or Falting theorem for Fourier transforms - Parseval's identity for transforms – Relationship between Fourier and Laplace transforms – Fourier transform of the derivatives of a function – Problems related to integral equations.

UNIT III **(18 Hours)**

Hankel Transforms :Definition – Inverse formula for the Hankel transform – Some important results for Bessel function – Linearity property – Hankel Transform of the derivatives of the function – Hankel Transform of differential operators.

UNIT IV **(18 Hours)**

Definition, Regularity Conditions – Special Kind of Kernels – Eigen values and Eigen functions – Convolution Integral – The Inner or Scalar Product of Two Functions – Notation – Integral Equations with Separable Kernals: Reduction to a System of Algebraic Equations – Examples– Fredholm Alternative – Examples.

UNIT V **(18 Hours)**

Method of Successive Approximations: Iterative Scheme – Examples – Volterra Integral Equation – Examples – Some Results about the Resolvent Kernel - Classical Fredholm Theory: The Method of Solution of Fredholm – Fredholm's First Theorem – Examples – Fredholm's Second Theorem.

UNIT VI - Self-Study for Enrichment(Not included for End Semester Examinations)

Hamilton's Principle - Finite Fourier transforms- Parseval's Theorem- An Approximate Method – Fredholm Integral Equation of the First Kind - Fredholm's Third Theorem.

Text books

1. Francis.B. Hildebrand,(1972), Methods of Applied Mathematics, Prentice – Hall of India Pvt Ltd, New Delhi.
2. Vasishtha.A.R. and Gupta.R.K,(2002), Integral Transforms, Krishna Prakashan Media Pvt Ltd
3. Ram.P.Kanwal,(1971), Linear Integral Equations, Academic Press.

Chapters and Sections

Unit I	Chapter 2	Sections 2.1 to 2.8 [1]
Unit II	Chapter 6	Sections 6.1 to 6.20[2]
Unit III	Chapter 9	Sections 9.1 to 9.6[2]
Unit IV	Chapter 1	Sections 1.1 to 1.7[3]
	Chapter 2	Sections 2.1 to 2.4[3]
Unit V	Chapter 3	Sections 3.1 to 3.5[3]
	Chapter 4	Sections 4.1 to 4.4[3]

Reference Books

1. Gupta,A.S.(2006), Calculus of Variations with Applications, Prentice Hall of India Private Limited, New Delhi.
2. Raisinghania,M.D. (2007), Integral Equations and Boundary Value Problems, S.Chand & Company Ltd, New Delhi.
3. Gupta.P.P and Sunjay Gupta,(2003), Integral Transforms, Kedarnath Ram Nath , Meerut.

Web References

1. https://youtu.be/70lYJs2xL6Q
2. https://youtu.be/HlwYQqUdrQs
3. https://youtu.be/6HeQc7CSkZs
4. https://youtu.be/UKHBWzoOKsY
5. https://youtu.be/3OCYjT5h23w
6. https://youtu.be/pAwvErIGIV8
7. https://youtu.be/HH9QH692AZE

Pedagogy

Chalk and talk, Power point presentation, Discussion, Assignment, Quiz, Seminar.

Course Designers

1. Dr. S.Sasikala.
2. Dr.R.Radha.

Semester I	Internal Marks: 25		External Marks: 75	
COURSE CODE	COURSE TITLE	CATEGORY	Hrs / Week	CREDITS
22PMA1CC4	ALGEBRAIC NUMBER THEORY	CORE	6	5

Course Objectives

- **Explore** fundamental concepts of divisibility, Congruences and primes.
- **Analyze** the quadratic Residues, The Mobius Inversion formula, Diophantine equations and their problems.
- **Apply** the ideas of Pythagorean triangle and The Chinese remainder theorem to solve problems.

Prerequisite

Theory of Numbers, Abstract Algebra

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On successful completion of this work, students will be able to	Cognitive Level
CO1	Apply the concepts of divisibility, congruences, primes, primitive roots, quadratic residues, greatest integer functions and linear equations.	K3
CO2	Explore the concepts of arithmetic functions, prime modulus and congruences of Degree two.	K3
CO3	Relate the ideas of Chinese remainder theorem, quadratic reciprocity and The Mobius Inversion formula.	K3
CO4	Determine the solutions of congruences, techniques of numerical calculations, Jacobi symbol, recurrence functions and simultaneous linear equations.	K4
CO5	Examine the conceptual understanding in Pythagorean triangles, Legendre Symbol and related problems.	K4

Mapping of CO with POs and PSOs

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3	3	3	2	2	3
CO2	2	3	2	3	2	2	2	2	2	3
CO3	3	3	2	3	3	3	2	2	2	3
CO4	3	3	3	3	3	3	3	2	2	3
CO5	3	3	3	3	3	3	3	2	2	3

"1" – Slight (Low) Correlation ¬ "2" – Moderate (Medium) Correlation ¬
"3" – Substantial (High) Correlation ¬ "-" indicates there is no correlation.

Syllabus

UNIT I **(18 Hours)**

Divisibility and Congruences

Introduction – Divisibility – The Binomial Theorem – Congruences – Solutions of Congruences – The Chinese Remainder Theorem.

UNIT II **(18 Hours)**

Congruences

Techniques of Numerical Calculation — Prime Power Moduli – Prime Modulus – Congruences of Degree Two, Prime Modulus – Public Key Cryptography.

UNIT III **(18 Hours)**

Quadratic Reciprocity and Quadratic Forms

Quadratic Residues – Quadratic Reciprocity – The Jacobi Symbol – Binary Quadratic Forms –

Equivalence and Reduction of Binary Quadratic Forms – Sums of Two Squares.

UNIT IV **(18 Hours)**

Some Functions of Number Theory

Greatest Integer Function – Arithmetic Functions – The Mobius Inversion Formula.

UNIT V **(18 Hours)**

Some Diophantine Equations

The Equation $ax + by = c$ – Simultaneous Linear Equations – Pythagorean Triangles.

UNIT VI - Self-Study for Enrichment (Not included for End Semester Examinations)

Primes - Primitive Roots and Power Residues - Positive Definite Binary Quadratic Forms - Recurrence Functions - Assorted Examples**.**

Text Books

Ivan Niven, Herbert S. Zuckerman & Hugh L. Montgomery (2016) Reprint, *An Introduction to the Theory of Numbers*, (*Fifth Edition, Reprint 2016*). Wiley Publishers.

Chapters and Sections

UNIT – I	Chapter 1	Sections 1.1, 1,2 & 1.4
	Chapter 2	Sections 2.1 to 2.3
UNIT – II	Chapter 2	Sections 2.4 to 2.7 & 2.9
UNIT – III	Chapter 3	Sections 3.1 to 3.6
UNIT – IV	Chapter 4	Sections 4.1 to 4.3
UNIT – V	Chapter 5	Sections 5.1 to 5.3

Reference Books

1. David M. Burton (2012), *Elementary Number Theory (Sixth Edition)***,** Tata McGraw Hill Education Private Limited, New Delhi.
2. Telang S. G. (2005), *Number Theory* (Reprint 2001),Tata McGraw Hill Education Private Limited, New Delhi.
3. Melvyn B. Nathanson (2005), *Methods in Number Theory*(Reprint 2006), Springer-Verlag, New York, Inc.

Web References

1. **https://www.youtube.com/watch?v=ChG_7jeNRHo**
2. **https://www.youtube.com/watch?v=e8DtzQkjOMQ**
3. **https://www.youtube.com/watch?v=3W91U-aNclQ**
4. **https://www.youtube.com/watch?v=bg6CksAkZ-k**
5. **https://www.youtube.com/watch?v=4dVTlX4bwP0**
6. **https://www.youtube.com/watch?v=khfIH1H6iUg**
7. **https://www.youtube.com/watch?v=BC2BdenKsYs**

Pedagogy

Power point Presentations, Group Discussions, Seminar, Quiz, Assignment.

Course Designer

Dr. S. Vidhya.

Semester I	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS /WEEK**	**CREDITS**
22PMA1DSE1A	**ADVANCED NUMERICAL ANALYSIS**	**DSICIPLINE SPECIFIC ELECTIVE**	**6**	**3**

Course Objectives

- To **know** the theory behind various numerical methods.
- To **apply** these methods to solve mathematical problems.
- To **train** the students to develop analytical thinking and the study of stability analysis.

Prerequisite

A reasonable background in linear algebra, numerical analysis, partial differential equations, and finite difference methods.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On successful completion of this work, students will be able to	Cognitive Level
CO1	Apply various methods to solve transcendental and polynomial equations	K3
CO2	Use the concepts of interpolation analyze Eigen value problem with Techniques for Mathematical Problems arising in various fields	K4
CO3	Classify the various techniques of interpolation and approximation	K3
CO4	Compute the numerical differentiation problems	K3
CO5	Apply the knowledge of various methods to solve numerical integration problems	K3

Mapping of CO with POs and PSOs

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	2	3	2	3	2	3	3
CO2	3	3	3	3	3	3	3	3	3	3
CO3	2	2	3	2	3	3	3	2	2	3
CO4	2	2	2	2	3	2	2	2	2	3
CO5	3	3	3	3	3	3	3	3	2	3

"1" – Slight (Low) Correlation ¬ "2" – Moderate (Medium) Correlation ¬

"3" – Substantial (High) Correlation ¬ "-" indicates there is no correlation.

Syllabus

UNIT I **(18 Hours)**

Transcendental and polynomial equations

Rate of convergence – Polynomial equations: Descartes' Rule of Signs - Iterative Methods: Birge-Vieta method - Bairstow's method.

UNIT II **(17 Hours)**

System of Linear Algebraic equations and Eigen Value Problems

Error Analysis for Direct methods – Iteration methods - Eigen values and Eigen vectors – Jacobi method for symmetric matrices - Power method.

UNIT III **(18 Hours)**

Interpolation and Approximation

Hermite Interpolation - Piecewise and Spline Interpolation.

UNIT IV **(17 Hours)**

Differentiation

Numerical Differentiation – Optimum choice of Step length – Extrapolation methods.

UNIT V **(20 Hours)**

Integration

Numerical Integration - Methods based on undetermined coefficients: Newton- Cotes methods: Trapezoidal Method - Simpson's Method - Gauss Legendre Integration Methods - Lobatto Integration Methods.

UNIT VI - Self -Study for Enrichment(Not included for End Semester Examinations)

Direct Method - Graeffe's root squaring method- Gauss Seidel Iteration method - Bivariate Interpolation: Lagrange Bivariate interpolation - Partial Differentiation - Gauss-Chebyshev Integration Methods.

Text Book

Jain. M. K, Iyengar. S. R. K. and Jain. R. K. (Sixth Edition), *Numerical Methods for Scientific and Engineering Computation*, New Age International (P) Limited Publishers, New Delhi.

Chapters and Sections

UNIT-I	Chapter 2	Sections 2.5 and 2.9(Page No. 83 - 93)
UNIT-II	Chapter 3	Sections 3.3 – 3.5, 3.7, 3.11
UNIT-III	Chapter 4	Sections 4.5 and 4.6
UNIT- IV	Chapter 5	Sections 5.2 - 5.4
UNIT- V	Chapter 5	Sections 5.6 (Page No. 348) and 5.8(Page No. 356-365, 380-382)

Reference Books

1. Jain. M. K, (1983), *Numerical Solution of Differential Equations*(2nd Edition), New Age International Pvt Ltd.,
2. Samuel. D. Conte and Carl. DeBoor, (1988), *Elementary Numerical Analysis*(3rd Edition), McGraw-Hill International.
3. Kendall E. Atkinson, (1989), *An Introduction to Numerical Analysis*(2nd Edition), John Wiley & Sons.

Web References

1. https://www.youtube.com/watch?v=hTVjuH6J_C8
2. https://www.youtube.com/watch?v=EMPyjetvaDg
3. https://www.youtube.com/watch?v=YkrSgTBznek
4. https://www.youtube.com/watch?v=-fE3I-usIKk
5. https://www.youtube.com/watch?v=gyyKvonahXk.

Pedagogy

Power point presentations, Group Discussions, Seminar, Quiz, Assignment.

Course Designers

1. Ms. R. Soundaria
2. Dr. P.Sudha

Semester I	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS /WEEK**	**CREDITS**
22PMA1DSE1B	**MATHEMATICAL MODELLING**	**DISCIPLINE SPECIFIC ELECTIVE**	**6**	**3**

Course Objectives

- **Analyze** the different mathematical models through Ordinary differential equation and Differential Equations.
- **Understand** the implementation of graph theoretical models.
- **Summarize** and implementation the kinds of Difference equations.

Prerequisite

Classification of ordinary differential equations.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On successful completion of this work, students will be able to	Cognitive Level
CO1	Classify the models through Ordinary Differential equations.	K3
CO2	Evaluate the systems of Ordinary Differential equations for various models.	K4
CO3	Examine the Planetary motions through Ordinary Differential equations of second order.	K4
CO4	Explain the basic concepts of Difference equation.	K4
CO5	Compute various types of models through Difference equation.	K3

Mapping of CO with POs and PSOs

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	3	3	2	2	2	3
CO2	2	3	3	2	2	2	3	2	2	3
CO3	2	2	3	3	3	3	3	2	3	3
CO4	3	3	2	2	3	3	3	3	2	2
CO5	2	2	3	3	2	3	2	2	2	3

"1" – Slight (Low) Correlation ¬ "2" – Moderate (Medium) Correlation ¬

"3" – Substantial (High) Correlation ¬ "-" indicates there is no correlation.

Syllabus

UNIT I **(18 Hours)**

Mathematical Modelling through Ordinary Differential Equations of First order

Mathematical Modelling Through Differential Equations- Linear Growth and Decay Models – Non-Linear Growth and Decay Models – Compartment Models – Mathematical Modelling in Dynamics Through Ordinary Differential Equations of First Order.

UNIT II **(18 Hours)**

Mathematical Modelling through Systems of Ordinary Differential Equations of First Order

Mathematical Modelling in Population Dynamics – Mathematical Modelling of Epidemics Through Systems of Ordinary Differential Equations of First Order – Compartment Models Through Systems of Ordinary Differential Equations – Mathematical Modelling in Medicine, Arms Race, Battles and International Trade in Terms of Systems of Ordinary Differential Equations – Mathematical Modelling in Dynamics Through Systems of Ordinary Differential Equations of First Order.

UNIT III **(20 Hours)**

Mathematical Modelling Through Ordinary Differential Equations of Second Order

Mathematical Modelling in Planetary Motions – Mathematical Modelling in Circular Motion and Motion of Satellites – Mathematical Modelling Through Linear Differential Equations of Second Order.

UNIT IV **(17 Hours)**

Mathematical Modelling Through Difference Equations

The Need for Mathematical Modelling Through Differential Equations: Some Simple Models – Basic Theory of Linear Difference Equations with Constant Coefficients – Mathematical Modelling Through Differential Equations in Economics and Finance– Mathematical Modelling Through Differential Equations in Probability Theory.

UNIT V **(17 Hours)**

Mathematical Modelling through Graphs

Situations that can be Modelled Through Graphs – Mathematical Models in Terms of Directed Graphs– Mathematical Models in Terms of Signed Graphs–Mathematical Models in Terms of Weighted Digraphs.

UNIT VI - Self-Study for Enrichment(Not included for End Semester Examinations)

Mathematical Modellingof Geometrical problems Through Ordinary Differential Equations of First Order - Mathematical Modelling in Economics Through Systems of Ordinary Differential Equations of First Order - Miscellaneous Mathematical Models Through Systems of Ordinary Differential Equations of Second Order - Mathematical Modelling Through Differential Equations in Population Dynamics and Genetics - Mathematical Modelling in Terms of Unoriented Graphs.

Text Book

J N Kapur, (Reprint 2001). *Mathematical Modelling.* New Age International (P) Limited, Publishers, New Delhi.

Chapters and Sections

UNIT-I	Chapter 2	Sections 2.1 to 2.5
UNIT-II	Chapter 3	Sections 3.1 to 3.3 & 3.6
UNIT-III	Chapter 4	Sections 4.1 to 4.3
UNIT- IV	Chapter 5	Sections 5.1 to 5.3&5.5
	Chapter 7	Sections 7.1 to 7.4
UNIT- V	Chapter 15	Sections 15.1 to 15.3.6 [2]
	Chapter 16	Sections 16.2 to16.2.5, 16.5, 16.5.1 to 16.5.3 [2].

Reference Books

1. Bimal K.Mishra & Dipak K.Satpathi (First Edition, Reprint 2009). *Mathematical Modeling Applications, Issues and Analysis(1st Edition).* Ane Books Pvt. Ltd.

2. Edward A. Bender. *An Introduction to Mathematical Modelling*(Reprint 2000).Dover Publications.

3. Rutherford A. *Mathematical Modelling Techniques*(Revised Edition 2012).Dover Publications.

Web References

1. **https://www.youtube.com/watch?v=3Yfsh1SnGIw**
2. **https://www.youtube.com/watch?v=EdtwK8KSwOo**
3. **https://www.youtube.com/watch?v=zczt5GhkylY**
4. **https://www.youtube.com/watch?v=-wVCKOvceok**
5. **https://www.youtube.com/watch?v=BZwp8gAxvUc**

Pedagogy

Power point Presentations, Group Discussions, Seminar, Quiz, Assignment and Smart Classroom.

Course Designer

Dr R. Buvaneswari.

Semester I	Internal Marks: 25		ExternalMarks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS /WEEK**	**CREDITS**
22PMA1DSE1C	**BOUNDARY VALUE PROBLEMS**	**DISCIPLINE SPECIFIC ELECTIVE**	**6**	**3**

Course Objectives

- **Gain** expertise and confidence in proving theorems to progress in mathematical studies.
- **Analyze** the implementation of boundary value problem through various models.
- **Summarize** the various aspects of boundary value problem.

Prerequisite

- Exposure on Fourier series and Differential Equations.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On successful completion of this work, students will be able to	Cognitive Level
CO1	Apply real world scenarios in order to solve the problems using multiple approaches.	K3
CO2	Classify Boundary value problems and learn their distinguishing qualitative properties.	K3
CO3	Relate the applications of Laplace and Poisson Equations	K3
CO4	Determine the understanding of Fourier Bessel Series	K4
CO5	Analyze Dirichlet Problems and its solutions in various Regions.	K4

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	3	3	2	2	2	3
CO2	2	3	3	2	2	2	3	2	2	3
CO3	2	2	3	3	3	3	3	2	3	3
CO4	3	3	2	2	3	3	3	3	2	2
CO5	2	2	3	3	2	3	2	2	2	3

"1" – Slight (Low) Correlation ¬ "2" – Moderate (Medium) Correlation ¬

"3" – Substantial (High) Correlation ¬ "-" indicates there is no correlation.

Syllabus

UNIT I **(18 Hours)**

One-sided Derivatives- An Integration Formula – Preliminary Theory – A Fourier Theorem- Discussion of the Theorem.

UNIT II **(17 Hours)**

Formal and Rigorous Solutions – The Vibrating String, Initially Displaced – Discussion of the Solution – Prescribed Initial Velocity – Non homogeneous Differential Equations – Elastic Bar- Temperatures in a Bar.

UNIT III **(18 Hours)**

A Dirichlet Problem – Fourier Series in Two Variable – An Application of Fourier Integrals – Temperatures $u(x,t)$ in an Unlimited Medium

Fourier-Bessel Series-Temperatures in a Long Cylinder-Heat Transfer at the Surface of the Cylinder.

UNIT IV **(17 Hours)**

Dirichlet Problems in Spherical Regions – Steady Temperature in a Hemisphere.

UNIT V **(20 Hours)**

Cauchy Criterion for Uniform Convergence –Abel's Test for Uniform Convergence – Uniqueness of Solutions of the Heat Equation – Example – Solutions of Laplaces's or Poisson's Equation.

UNIT VI - Self-Study for Enrichment(Not included for End Semester Examinations)

Other Forms of Fourier Series –The Orthonormal Trigonometric Functions - Other Boundary Conditions - Observations and Further Examples - Vibration of a circular Membrane - Other Orthogonal Sets - An Application.

Text Book

Ruel V Churchill. (1963). Fourier Series and Boundary Value Problems (Second Edition). McGraw-Hill Book Company.

Chapters and Sections

UNIT-I	Chapter 4	Sections 38 to 42
UNIT-II	Chapter 7	Sections 55 to 61
UNIT-III	Chapter 7	Sections 63 to 66
	Chapter 8	Sections 78 to 80
UNIT-IV	Chapter 9	Sections 89 to 90
UNIT-V	Chapter10	Sections 92 to 96

Reference Books

1. Raisinghania, M.D.(2014). Ordinary and Partial Differential Equations(1st Edition). S.Chand & Company Pvt.Ltd.
2. George F Simmons, (2003). Differential Equations with Applications and Historical Notes(2nd Edition). Tata McGraw-Hill Publishing Company.
3. Sankara Rao, K. (2019). Introduction to Partial Differential Equations(3rd Edition). Prentice-Hall of India.

Web References

1. **https://www.youtube.com/watch?v=m8aIO-GQkXE**
2. **https://www.youtube.com/watch?v=AgyeJEO2a-k**
3. **https://www.youtube.com/watch?v=O_HgMWx4a5w**
4. **https://www.youtube.com/watch?v=1tDkXMDbvDg&t=119s**
5. **https://www.youtube.com/watch?v=USOmOW-IN3I**

Pedagogy

Power point presentations, Group Discussions, Seminar, Quiz, Assignment.

Course Designer

Ms. P. Geethanjali.

Semester II	Internal Marks: 25		External Marks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs /Week**	**CREDITS**
22PMA2CC5	**ALGEBRA – II**	**CORE**	**6**	**5**

Course Objectives

- Learn the fundamentals in Galois theory
- Expertise and confidence in proving theorems to progress in Galois theory
- Familiarize the concepts of Galois group

Prerequisite

Basic knowledge of algebra.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able To	Cognitive Level
CO1	Analyse the important concepts of Galois theory and identify through various examples	K1, K2, K3
CO2	Predict the notions and their connections of Galois theory	K3
CO3	Examine the proof of solvability by Galois theory	K4
CO4	Evaluate clear cut idea in Galois theory extensions and illustrate through examples	K5
CO5	Learn and conclude Galois theory correspondence theorem of algebra	K5

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	2	3	2	2	2	2
CO2	3	3	3	2	2	3	3	3	2	2
CO3	3	3	3	3	3	3	3	2	3	3
CO4	2	2	3	3	3	2	2	3	3	3
CO5	2	2	3	3	3	2	3	2	3	3

"1" – Slight (Low) Correlation ¬ "2" – Moderate (Medium) Correlation ¬
"3" – Substantial (High) Correlation ¬ "-" indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	Prime Ideals and Maximal Ideals - Irreducible Polynomials.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
II	Classical Formulas - Splitting Fields.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	The Galois Group - Roots of Unity - Solvability by Radicals.	18	CO1, CO2, CO3,	K1, K2, K3,

			CO4, CO5	K4, K5
IV	Independence of Characters - Galois Extensions.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
V	The Fundamental Theorem of Galois Theory – Applications – Galois's Great Theorem.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
VI	**Self-Study for Enrichment** **(Not included for End Semester Examinations)** Rings - Domains and Fields - Homomorphism and Ideals - Quotients Rings- Polynomial Rings over Fields.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

Text Book

Joseph Rotman (2006), *Galois Theory*, 2nd Edition, Springer Verlag.

Chapters and Pages

UNIT I Pages 31- 43
UNIT II Pages 44-58
UNIT III Pages 59-75
UNIT IV Pages 76-82
UNIT V Pages 83-95

Reference Books

1. David S. Dummit and Richard M. Foote (Reprint 2017), *Abstract Algebra*, Wiley and Sons, Third Edition
2. John B. Fraleigh (2018), *A First Course in Abstract Algebra*, Narosa Publishing House, Seventh edition
3. I. N. Herstein (2006), *Topics in Algebra*, John Wiley, Second Edition

Web References

1. **https://nrich.maths.org/1422**
2. **https://www.math3ma.com/blog/what-is-galois-theory-anyway**
3. **https://people.math.harvard.edu/~elkies/M250.01/galois_topix.html**
4. **https://www.maths.ed.ac.uk/~tl/gt/gt.pdf**
5. **https://mathoverflow.net/questions/34125/is-galois-theory-necessary-in-a-basic-graduate-algebra-course**

Pedagogy

Power point presentations, Group Discussions, Seminar, Quiz, Assignment.

Course Designer

Dr. K. Kalaiarasi

Semester II	Internal Marks: 25		External Marks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs /Week**	**CREDITS**
22PMA2CC6	**REAL ANALYSIS**	**CORE**	**6**	**5**

Course Objectives

- **Identify** the elements and importance of real numbers.
- **Provide** students with the specialist knowledge necessary for basic concepts in Real Analysis.
- **Apply** the proof techniques in analysis to be well prepared for the advanced courses.

Prerequisite

Basic set theory and Calculus

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Describe fundamental properties of the real numbers that lead to the formal development of real analysis.	K2
CO2	Construct the important concepts of real analysis.	K3
CO3	Ascertain the concepts of basic topology, continuity, differentiation, The Riemann-Stieltjes Integral, sequences and series of functions, functions of several variables.	K4
CO4	Explain various mathematical proofs of basic results in real analysis.	K5
CO5	Develop the abstract ideas and various methods in mathematical analysis that can be applied to important practical problems.	K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3	3	2	2	2	3
CO2	3	2	3	3	3	3	2	3	2	3
CO3	3	3	3	3	3	3	2	3	3	3
CO4	3	2	3	3	2	3	2	2	2	3
CO5	3	3	3	3	2	3	2	3	3	3

"1" – Slight (Low) Correlation ¬ "2" – Moderate (Medium) Correlation ¬

"3" – Substantial (High) Correlation ¬ "-" indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Basis Topology:** Finite, Countable and Uncountable Sets – Metric Spaces – Compact Sets – Connected Sets.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5, K6
II	**Continuity and Differentiation:** Limits of Functions – Continuous Functions – Continuity and Compactness – Continuity and	18	CO1, CO2, CO3,	K2, K3, K4,

	Connectedness – Discontinuities – Monotonic Functions – The Derivative of a Real Function – Mean value Theorems – The Continuity of Derivatives – L' Hospital's Rule – Derivatives of Higher Order – Taylor's Theorem.		CO4, CO5	K5, K6
III	**The Riemann-Stieltjes Integral:** Definition and Existence of the Integral – Properties of the Integral – Integration and Differentiation.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5, K6
IV	**Sequences and Series of Functions:** Discussion of Main Problem – Uniform Convergence – Uniform Convergence and Continuity – Uniform Convergence and Integration – Uniform Convergence and Differentiation – The Stone-Weierstrass Theorem.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5, K6
V	**Functions of Several Variables** Differentiation – The Contraction Principle – The Inverse Function Theorem _ The Implicit Function Theorem.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5, K6
VI	**Self Study for Enrichment:** **(Not included for End Semester Examinations)** Perfect Sets – Infinite Limits and Limits at Infinity – Integration of Vector-valued Functions – Equicontinuous Families of Functions - Linear Transformations.	-	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5, K6

Text Books

Walter Rudin (1986). *Principles of Mathematical Analysis (Third Edition)*. McGraw-Hill Book Company.

Chapters and Sections

UNIT-I Chapter 2: Sections 2.1 – 2.42, 2.45 – 2.47

UNIT-II Chapter 4: Sections 4.1 – 4.31

Chapter 5: Sections 5.1 – 5.15

UNIT-III Chapter 6: Sections 6.1 – 6.22

UNIT- IV Chapter 7: Sections 7.1 – 7.18, 7.26 – 7.33

UNIT- V Chapter 9: Sections 9.10 – 9.29

Reference Books

1. Robert G. Bartle and Donald R. Sherbert. (2019). *Introduction to Real Analysis (Fourth Edition)*. Wiley India Pvt. Limited.
2. Tom M. Apostol. (2002). *Mathematical Analysis (Second Edition)*. Narosa Publishing House.
3. H.L. Royden. (2003). *Real Analysis (Third Edition, Ninth Reprint)*. PHI Learning Private Limited, New Delhi.

Web References

1. **https://youtu.be/mfoVRabIpQI**
2. **https://tinyurl.com/c756hc6k**
3. **https://youtu.be/6mNGn8dTnJw**
4. **https://youtu.be/xIwg_w2quRE**
5. **https://youtu.be/yLbgdL9HAeg**
6. **https://tinyurl.com/mux7d53w**
7. **https://youtu.be/8VTG6EsyJh4**

Pedagogy

Power Point Presentations, Group Discussions, Seminar, Quiz, Assignment.

Course Designer

Dr. S. Vidhya

Semester II	Internal Marks: 25	External Marks: 75		
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs /Week**	**CREDITS**
22PMA2CC7	**LINEAR ALGEBRA**	**CORE**	**6**	**5**

Course Objectives

- **Acquire** knowledge related to basic concepts.
- **Develop** rational thinking patterns in terms of problem solving in competitive exam.
- **Emphasis** knowledge of the various aspects of Linear Algebra.

Prerequisite

Basic Knowledge of algebra and vector space.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Remember and recall the basic concepts of vector space	**K1**
CO2	Illustrate the various techniques of problem solving in respective stream	**K2**
CO3	Apply different terminologies of linear algebra	**K3**
CO4	Classify the various properties in transformation	**K4**
CO5	Interpret the problems involved in vector spaces	**K5**

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	2	3	2	3	2	3	3
CO2	3	3	3	3	3	3	3	3	3	3
CO3	2	2	3	2	3	3	3	2	2	3
CO4	2	2	2	2	3	2	2	2	2	3
CO5	3	3	3	3	3	3	3	3	2	3

"1" – Slight (Low) Correlation ¬ "2" – Moderate (Medium) Correlation ¬
"3" – Substantial (High) Correlation ¬ "-" indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Matrices:** Systems of Linear Equations – Matrices and Elementary Row Operations – Row reduced Echelon Matrices – Invertible Matrices – Bases and Dimension.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
II	**Linear Transformations:** Linear Transformations - The Algebra of Linear Transformations – Isomorphism of Vector Spaces – Representation of Transformations by Matrices – Linear	18	CO1, CO2, CO3, CO4,	K1, K2, K3, K4,

	Functionals – The Transpose of a Linear Transformation.		CO5	K5
III	**Polynomials:** Algebras - The Algebra of Polynomials –Polynomial Ideals – The Prime Factorization of a Polynomial . **Determinants:** Commutative rings – Determinant functions.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	**Determinants:** Permutations and the Uniqueness of Determinants — Introduction - Characteristic values – Annihilating Polynomials.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
V	**Elementary Canonical Forms:** Invariant Subspaces –Direct – Sum Decompositions – Invariant Direct Sums – The Primary Decomposition Theorem.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
VI	**Self -Study for Enrichment:** **(Not included for End Semester Examination)** Matrix Multiplication - The Double Dual - Lagrange Interpolation - Additional Properties of Determinants - Simultaneous Triangulation and Simultaneous Diagonalization.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

Text Book

Kenneth Hoffman and Ray Alden Kunze (1975). *Linear Algebra*, Second Edition, Prentice Hall of India Private Limited, New Delhi.

Chapters and Sections

UNIT-I	Chapter 1:	Sections 1.2 – 1.4, 1.6
	Chapter 2:	Sections 2.3
UNIT-II	Chapter 3:	Sections 3.1 – 3.5, 3.7
UNIT-III	Chapter 4:	Sections 4.1, 4.2, 4.4, 4.5
	Chapter 5:	Sections 5.1 – 5.2
UNIT- IV	Chapter 5:	Sections 5.3
	Chapter 6:	Sections 6.1 – 6.3
UNIT- V	Chapter 6:	Sections 6.4, 6.6 – 6.8

Reference Books

1. Kumaresan S(2004). *Linear Algebra: A Geometric Approach*, Prentice – Hall of India Ltd.
2. Rao A. R, Bhimashankaram P(2000). *Linear Algebra, Second Edition*, Tata McGraw Hill.
3. Edgar Goodaire G(2014). *Linear Algebra*, Pure & Applied World Scientific, Cambridge University Press India Ltd.

Web References

1. https://youtu.be/Pc2dWW3aSrk
2. https://youtu.be/shs8lWDOBHO
3. https://youtu.be/nPOooyrM5is
4. https://youtu.be/uJNQPgYjlQc
5. https://youtu.be/6PEKr7vWsrw
6. https://ksuweb.kennesaw.edu

Pedagogy

Power Point Presentations, Group Discussions, Seminar, Quiz, Assignment.

Course Designer

Dr. P.Shalini

Semester II	Internal Marks: 25		ExternalMarks:75	
COURSE CODE	COURSE TITLE	CATEGORY	Hrs /Week	CREDITS
22PMA2CCC1A	PARTIAL DIFFERENTIAL EQUATIONS	CORE CHOICE	6	4

Course Objectives

- **Recognize** certain basic types of first and second order PDEs and an in-depth knowledge of solving them by various methods.
- **Analyze** the Characteristics and Compatibility of PDE's.
- **Qualitative Analysis** of the solutions of Boundary value Problems.

.Prerequisite

Fundamental knowledge of Partial differential equations in UG.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	**Interpret** the solutions of hyperbolic, linear and second order partial differential equations, Exterior, Interior and boundary value problems using various Methods.	K2
CO2	**Develop** the various type of first and second order equations, Interior and Exterior value problems and **Determine** the higher order equations in physics, **C**haracteristics of Equations in Three Variables, Linear Hyperbolic Equations and Elementary Solutions of Laplace's Equation.	K3
CO3	**Diagnose** the orthogonally, compatibility and characteristics of the partial differential equations with constant and variable coefficients, method of Integral transforms and Families of Equipotential Surfaces.	K3
CO4	**Discriminate** the solutions of first, second order and hyperbolic equations, Integral Surfaces Passing through a Given Curve, Surfaces Orthogonal to a Given System of Surfaces, **C**haracteristics of Equations in Three Variables, The Solution of Linear Hyperbolic Equations, Separation of Variables	K4
CO5	**Ascertain** the concepts of Laplace equation to find the solution of boundary value problems, Special Types of First-Order Equations, Linear Partial Differential Equations with Constant Coefficients, Equations with Variable Coefficients,the Method of Integral Transforms, Families of Equipotential Surfaces.	K4

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3	3	3	2	2	1
CO2	3	2	3	3	3	3	3	3	2	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	2	3	3	2	2	3
CO5	3	2	3	3	2	3	3	3	3	2

"1" – Slight (Low) Correlation ¬ "2" – Moderate (Medium) Correlation ¬ "3" – Substantial (High) Correlation ¬ "-" indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Partial Differential Equations of The First Order:** Partial Differential Equations - Origins of First-order Partial Differential Equations - Cauchy's Problem for First-order Equations - Linear Equations of the First Order - Integral Surfaces Passing through a Given Curve - Surfaces Orthogonal to a Given System of Surfaces.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4
II	**Partial Differential Equations of The First Order:** Cauchy's Method of Characteristics - Compatible Systems of First-order Equations – Charpit's Method - Special Types of First-Order Equations - Jacobi's Method.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4
III	**Partial Differential Equations of the Second Order:** The Origin of Second-order Equations – Second-order Equations in Physics – Higher-order Equations in Physics - Linear Partial Differential Equations with Constant Coefficients - Equations with Variable Coefficients.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4
IV	**Partial Differential Equations of the Second Order:** **C**haracteristics of Equations in Three Variables - The Solution of Linear Hyperbolic Equations - Separation of Variables - The Method of Integral Transforms.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4
V	**Laplace's Equation:** Elementary Solutions of Laplace's Equation - Families of Equipotential Surfaces - Boundary Value Problems - Separation of Variables.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4
VI	**Self Study for Enrichment:** **(Not included for End Semester Examinations)** Nonlinear Partial Differential Equations of the First Order - Solutions Satisfying Given Conditions - Characteristic Curves of Second-Order Equations – Nonlinear Equations of the Second Order– Problems with Axial Symmetry.	-	CO1, CO2, CO3, CO4, CO5	K2, K3, K4

Text Book

Ian N. Sneddon (2006), *Elements of Partial Differential Equations,* Dover Publication – INC. Mineola, Newyork.

Chapters and Sections

UNIT- I	Chapter 2:	Sections 1 to 6
UNIT- II	Chapter 2:	Sections 8 to 11, 13
UNIT- III	Chapter 3:	Sections 1 to 5
UNIT- IV	Chapter 3:	Sections 7 to 10
UNIT- V	Chapter 4:	Sections 2 to 5

Reference Books

1. M.D.Raisinghania (2001), *Advanced Differential Equations*, Eighth Edition, S.Chand and Company Ltd., NewDelhi.
2. T.Amarnath (2003), *Elementary Course in Partial Differential Equations*, Second Edition, Narosa Publishing House, New Delhi.
3. Sauvigny, Friedrich (2006), *A Partial Differential Equations 2: Functional Analytic Methods*, Springer, Arizona.

Web References

1. https://people.bath.ac.uk/mir20/images/odenotes.pdf
2. https://pages.pomona.edu/~ajr04747/Spring2014/Math182/Notes/Math182Spring2014Notes.pdf/
3. https://www.youtube.com/watch?v=VBn1diQCykQ/
4. https://www.youtube.com/watch?v=f0FeWyloHrs/
5. https://nptel.ac.in/courses/111106139/

Pedagogy

Power Point Presentations, Group Discussions, Seminar, Quiz, Assignment.

Course Designer

Dr. G. Janaki

Semester II	Internal Marks: 25		External Marks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs /Week**	**CREDITS**
22PMA2CCC1B	**MATHEMATICAL PROGRAMMING**	**CORE CHOICE**	**6**	**4**

Course Objectives

- Ability to **Understand** and **Analyze** managerial problems in industry so that they are able to use resources (capitals, materials, staffing, and machines) more effectively.
- **Knowledge** of formulating mathematical models for quantitative analysis of managerial problems in industry.
- **Allows** a quantitative technique or a scientific approach for making better decisions for operations under the control.

Prerequisite

Basic Knowledge of Operations Research.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Recognize the importance and value of Operations Research and mathematical modeling in solving practical problems in industry	K1, K2
CO2	Know how to use variables for formulating complex mathematical models in management science, industrial engineering and Transportation science and in real life.	K3
CO3	Analyze a managerial decision problem and formulate into a mathematical model	K4
CO4	To design, improve and operate complex systems in the best possible way	K4, K5
CO5	Determine the solution of NonLinear Programming based on Various Method.	K5

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	3	3	3	3	2	3
CO2	3	3	3	3	3	3	3	3	2	3
CO3	3	2	3	3	3	3	3	3	3	3
CO4	3	3	3	2	3	3	3	3	3	3
CO5	3	3	2	3	3	3	2	3	3	3

"1" – Slight (Low) Correlation ¬ "2" – Moderate (Medium) Correlation ¬
"3" – Substantial (High) Correlation ¬ "-" indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Advanced Linear Programming**: From Extreme Points to Basic Solutions - Generalized Simplex Tableau in Matrix form - Development of the Optimality and Feasibility Conditions - Revised Simplex Algorithm.	17	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
II	**Integer Linear Programming**: Integer Programming Algorithms – Cutting Plane Algorithm. **DeterministicDynamic Programming:** Recursive Nature of Dynamic Programming(DP) Computations.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	**Simulation Modeling :** Monte Carlo Simulation – Types of Simulation – Sampling from ProbabilityDistribution.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	**Classical Optimization Theory**: Unconstrained Problems – Necessary and Sufficient Conditions – The Newton – Raphson Method – Constrained Problems – Equality Constraints (Jacobi Method).	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
V	**Non Linear Programming Algorithms:** Unconstrained Algorithms – Direct Search Method – Gradient Method - Constrained Algorithms – Quadratic Programming.	19	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
VI	**Self -Study for Enrichment:** **(Not included for End Semester Examinations)** Duality – Matrix Definition of the Dual Problem – Optimal Dual Solution – Forward and Backward Recursion – Generation of Random Numbers – Equality Constraints (Lagrangean Method) – Chance-Constrained Programming.		CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

Text Book

Hamdy A.Taha, Nineth Edition, (2014), *Operations Research*, Dorling Kindersley (India) Pvt. Ltd.

Chapters and Sections

UNIT-I	Chapter 7:	Sections 1.1, 1.2, 2.1 - 2.2 (Page No. 299 - 313)
UNIT-II	Chapter 8:	Sections 2, 2.2 (Page No. 355, 364 - 373),
	Chapter 11:	Sections1 (Page No. 461 - 464)
UNIT-III	Chapter 17:	Sections 1, 2, 3.2 (Page No. 681 – 686, 688 - 694)
UNIT- IV	Chapter 18:	Sections 1, 1.1, 1.2, 2, 2.1(Page No. 713 - 726)
UNIT- V	Chapter 19:	Sections 1, 1.1, 1.2, 2, 2.2 (Page No. 737 – 744, 753 – 758)

Reference Books

1. KantiSwarup, P.K. Gupta, ManMohan, Nineteenth Edition (2017), *Operations Research*, Sultan Chand and Sons Publishers.
2. J.K. Sharma, Fourth Edition (2009), *Operations Research Theory and Applications*, Macmillan India Limited.
3. S.S. Rao, Second Edition (1985), *Optimization Theory and Applications*, New Age International Ltd.

Web References

1. https://www.youtube.com/watch?v=ii_oSKROeRI
2. https://www.youtube.com/watch?v=NSrIb7mKtwg
3. https://faculty.ksu.edu.sa/sites/default/files/index.pdf
4. https://www.youtube.com/watch?v=eo2tOPV3AoE
5. https://www.youtube.com/watch?v=9ESUw4azhKE

Pedagogy

Power point presentations, Group Discussions, Seminar, Quiz, Assignment.

Course Designer

Dr. E. Litta.

Semester II	Internal Marks: 25		ExternalMarks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS /WEEK**	**CREDITS**
22PMA2CCC1C	**DIFFERENCE EQUATIONS**	**CORE CHOICE**	**6**	**4**

Course Objectives

- **Analyze** the linear difference equations of higher order.
- **Understand** the implementation of nonlinear difference equations..
- **Summarize** the results of oscillation for linear difference equations with systems of variables..

Prerequisite

Classification of linear difference equations.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Recall and Classify the models through linear difference equations of high- order..	K1, K2
CO2	Interpret the systems of two or more dependent variables for various models.	K2
CO3	Solve the Planetary motions through the study of a linear difference or differential equations to examination of an associated complex function..	K3
CO4	Analyze the basic concepts of Difference equations.	K4
CO5	Determine various types of models through the solutions oscillate around zero or eventually positive or eventually negative and also oscillation theory for self-adjoint equations	K5

Mapping of CO with POs and PSOs

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	3	3	2	2	2	3
CO2	2	3	3	2	2	2	3	2	2	3
CO3	2	2	3	3	3	3	3	2	3	3
CO4	3	3	2	2	3	3	3	3	2	2
CO5	2	2	3	3	2	3	2	2	2	3

"1" – Slight (Low) Correlation ¬ "2" – Moderate (Medium) Correlation ¬
"3" – Substantial (High) Correlation ¬ "-" indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Linear Difference Equations of Higher Order** Difference Calculus: The power Shift, Factorial Polynomials and The Antidifference Operator - General Theory of Linear Difference Equations - Linear Homogeneous Equations with Constant Coefficients **Nonhomogeneous Equations:** Method of Undetermined coefficients : The Method of Variation of Constants (Parameters)	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
II	**System of Linear Difference Equations** Autonomous (Time –Invariant) Systems : The Discrete Analogue of the Putzer Algorithm, The Development of the Algorithm for A^n – the Basic Theory **The Jordan form:** Autonomous (Time –Invariant) Systems Revisited **:** Diagonalizable Matrices, The Jordan Form and Block-Diagonal Matrices.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	**The Z-Transform Method and Volterra Difference Equations** Definition and Examples : Properties of the Z-Transform – The Inverse Z-transform and Solutions of Difference Equations : The Power Series Method, The Partial Fractions Method and The Inversion Integral Method **Volterra Difference Equations of convolution types:** The Scalar Case.	20	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	**Oscillation Theory** Three-Term Difference Equations – Self-Adjoint Second- Order Equations.	17	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
V	**Asymptotic Behavior of Difference Equations** Tools and Approximation – Poincare's theorem : Infinite Products and Perron's Example – Asymptotically Diagonal Systems – High- Order Difference Equations	17	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
VI	**Self Study for Enrichment: (Not included for End Semester Examination)** Limiting behavior of solutions – Linear Periodic System - Volterra Systems - Nonlinear Difference Equations - Second-Order Difference Equations : A Generalization of the Poincare Perron Theorem.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

Text Books

Saber N Elaydi, Third Edition, (2004), *An Introduction to Difference Equations*, Springer Verlag, New York.

Chapters and Sections

UNIT-I	Chapter 2	Section 2.1 - 2.4
UNIT-II	Chapter 3	Sections 3.1 - 3.3
UNIT-III	Chapter 6	Sections 6.1 - 6.3
UNIT- IV	Chapter 7	Sections 7.1 & 7.2 (Page No. 313 – 320)
UNIT- V	Chapter 8	Sections 8.1 - 8.4

Reference Books

1. Ravi P.Agarwal and Kanishka Perera, Reprint, (2006), *Proceedings of the Conference on Differential and Difference Equations and Applications*, Hindawi Publishing Corporation.

2. Ravi P.Agarwal, Second Edition, (2000), *Difference Eqations and Inequalites*, Marcel Dekker, Inc., New York.

3. Klaus Neusser, Reprint, (2021), *Difference Equations for Economists* RePEc/ IDEAS.

Web References

1. **https://www.youtube.com/watch?v=zw8xM5GHvZQ**
2. **https://www.youtube.com/watch?v=MtHpbGUIGaA**
3. **https://www.youtube.com/watch?v=ESKx8PEJCB4**
4. **https://www.youtube.com/watch?v=_Xub0zCmlXk**
5. **https://www.youtube.com/watch?v=IKtROKsWVR4**
6. **https://eprints.kfupm.edu.sa/id/eprint/9906/1/9906.pdf**

Pedagogy

Power point Presentations, Group Discussions, Seminar, Quiz, Assignment and Smart Classroom.

Course Designer

Dr R. Buvaneswari.

Semester II	Internal Marks: 40		ExternalMarks:60	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs /Week**	**CREDITS**
22PMA2DSE2AP	**COMPUTATIONAL MATHEMATICS USING MATLAB(P)**	**DISCIPLINE SPECIFIC ELECTIVE**	**6**	**3**

Course Objectives

- To Provide Software that can be used to explore and experiment with Mathematical Constructions.
- Flexible for users to solve the various system of equations.
- To attain a high level of user support.

Prerequisite

- Basic knowledge of Higher Mathematics

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Remember the concepts of Algebra, Geometry, Numerical Analysis, Calculus, etc.	K1
CO2	Understand the calculation by reading documented source code	K2
CO3	Relate the mathematical thinking that is applicable to daily life	K3
CO4	Associate technological tools for graphical visualization	K4
CO5	Develop skills with core elements of MATLAB and gain an appreciation of social scientific work	K6

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	2	3	3	2	2	2
CO2	3	3	3	2	2	2	3	2	2	3
CO3	2	2	2	2	2	2	2	2	2	2
CO4	2	3	2	3	2	3	2	3	2	2
CO5	2	2	2	2	2	2	2	2	2	2

“1” – Slight (Low) Correlation ¬ “2” – Moderate (Medium) Correlation ¬

“3” – Substantial (High) Correlation ¬ “-” indicates there is no correlation.

LIST OF PROGRAMS

1. Mathematical operations
2. Finding GCD and LCM
3. Finding roots and solving the system of equations
4. Matrix Operations
5. Decision Making
6. Loop Types
7. Vector Operations
8. Working with Arrays
9. Plotting 2D Graphs
10. Plotting 3D Graphs
11. Importing and Exporting data in Excel
12. Integration
13. Differentiation and Finding Maxima and Minima
14. Manipulating strings
15. Laplace Transform and Fourier Transform

Web References

1. **https://www.mathworks.com/products/matlab.html**
2. **https://www.mathworks.com/help/matlab/ref/plot.html**
3. **https://www.mathworks.com/help/stateflow/ug/operations-for-vectors-and-matrices.html**
4. **https://www.tutorialspoint.com/matlab/matlab_matrics.htm**
5. **https://www.javatpoint.com/matlab-numerical-integration**

Pedagogy

Power point presentations and Assignment.

Course Designers

1. Dr. S. Sasikala
2. Ms. R. Soundaria.

Semester II	Internal Marks: 40	ExternalMarks:60		
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS / WEEK**	**CREDITS**
22PMA2DSE2BP	**MATHEMATICAL MODELLING USING MATLAB(P)**	**DISCIPLINE SPECIFIC ELECTIVE**	**6**	**3**

Course Objectives

- **Analyze** the concepts and use the necessary to the real-life problems using MATLAB.
- **Apply** the technical knowledge to **interpret** and **solve** the problems using MATLAB.
- **Explore** the ideas of MATLAB in Mathematical modelling.

Prerequisite

Basic knowledge of Mathematical Modelling and MATLAB.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Understand the importance of Mathematical Modelling in the real world using MATLAB.	K2
CO2	Apply Mathematical concepts to identify the appropriate mathematics to realize a solution using MATLAB.	K3
CO3	Make use of formulas, familiar with memory and file management in MATLAB.	K4
CO4	Determine various types of models through Difference equation .	K5
CO5	Formulate, Analyse and simulate mathematical models using MATLAB.	K6

Mapping of CO with PO and PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	3	3	3	2	2	2
CO2	3	2	3	3	3	3	3	2	2	2
CO3	3	2	3	3	3	3	3	2	2	2
CO4	3	2	3	3	3	3	3	2	2	2
CO5	3	2	3	3	3	3	3	2	2	2

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation

"3" – Substantial (High) Correlation "-" indicates there is no correlation.

LIST OF PROGRAMS

1) Lagrange 's Formula for Area of a Rectangle.
2) Simple interest and Compound interest.
3) Integral equations.
4) Calculus of variations in functionals involving two and three independent variables.
5) Difference Equation of a System.
6) MATLAB programming in dynamic programming.
7) Delay differential equations.
8) Linear programming in MATLAB.
9) Mixed-Integer linear programming.

10) Application of Non-linear programming.

11) Simulating simple circuit.

12) Programming a simple markov model.

13) Design Optimization.

14) MATLAB solution of a diffusion equation.

15) Commodities trading with MATLAB.

Web References

1. **https://www.youtube.com/watch?v=Y93V9wOWETs**
2. **https://www.youtube.com/watch?v=ryxh5CoihwE**
3. **https://www.youtube.com/watch?v=K6yjDI4hzKo**
4. **https://www.youtube.com/watch?v=LpVv306NSnE**
5. **https://www.youtube.com/watch?v=z4aMBaTPW3I**
6. **https://www.youtube.com/watch?v=TCWrD3cZG9s**
7. **https://www.youtube.com/watch?v=bJy_QJTQxQA**
8. **https://www.mathworks.com/videos/mixed-integer-linear-programming-in-matlab-91541.html**
9. **https://www.youtube.com/watch?v=qTJDNXRfcsc**
10. **https://www.youtube.com/watch?v=yLlQ1dzAsl8**
11. **https://www.youtube.com/watch?v=wr35tzLMMfw**
12. **https://www.mathworks.com/videos/design-optimization-with-matlab-1601644975662.html**
13. **https://www.youtube.com/watch?v=S3DXGvrdx1w**
14. **https://www.youtube.com/watch?v=m6bkXNEKE7E**
15. **https://www.mathworks.com/videos/modeling-an-insulin-infusion-pump-87684.html**

Pedagogy

Power point presentations, Live Demo, Hands on training.

Course Designer

Dr. C. Saranya

Semester II	Internal Marks:40	External Marks:60		
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HOURS / WEEK**	**CREDITS**
22PMA2DSE2CP	**ORDINARY DIFFERENTIAL EQUATIONS AND PARTIAL DIFFERENTIAL EQUATIONS USING MATLAB (P)**	**DISCIPLINE SPECIFIC ELECTIVE**	**6**	**3**

Course Objectives

- To identify different ordinary and partial differential equation problems and reformulate them in a way that is appropriate for using MATLAB.
- Use functions from the programming language library for efficient calculations and visualization.
- Solve problems systematically and implement the solution in MATLAB.

Prerequisite

Fundamental knowledge of ordinary and partial differential equations.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Describe the use of fundamental data structures	**K3**
CO2	Apply MATLAB effectively to analyze and visualize data	**K4**
CO3	Solve scientific and mathematical problems	**K4**
CO4	Apply basic functions for ordinary and partial differential equations	**K3**
CO5	Compute programs in MATLAB	**K5**

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	2	2	2	3	2	2	3
CO2	3	2	3	2	3	2	3	3	3	3
CO3	3	3	3	2	3	2	3	3	3	2
CO4	3	3	2	3	3	3	2	3	3	3
CO5	3	3	2	3	3	3	2	3	3	3

"1"–Slight (Low)Correlation "2"–Moderate (Medium)Correlation

"3"– Substantial (High)Correlation "-" indicates there is no correlation.

LIST OF PROGRAMS

1. Computing the solutions of First Order Differential Equations.
2. Determine the solutions to Initial Value Problems.
3. Plotting the solutions of First Order Differential Equations.
4. Plotting the solution of the second-order equations.
5. Computing the Solutions of the heat equations.
6. Finding the solutions of the Poisson equations.
7. Determine the solutions of Laplace Equations by Direct Method.
8. Computing the solutions of Laplace Equations by Iterative Method.
9. Solving the nonlinear system of Partial Differential Equations.
10. Plotting for the single Partial Differential Equations with the initial conditions.

Web References

1. **https://in.mathworks.com/help/matlab/math/partial-differential-equations.html**
2. https://www.math.tamu.edu/reu/comp/matode.pdf
3. https://www.math.tamu.edu/~phoward/m401/pdemat.pdf
4. https://www.youtube.com/watch?v=-DmTK868J4A
5. https://www.youtube.com/watch?v=rwC7YU2WUf4

Pedagogy

Power point presentations, Live Demo, Hands on training.

Course Designers

1. Dr. G. Janaki
2. Ms. A. Gowri Shankari.

Semester III	Internal Marks: 25		External Marks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs /Week**	**CREDITS**
22PMA3CC8	**TOPOLOGY**	**CORE**	**6**	**5**

Course Objectives

- **Define** the notion of topological spaces and characterize the properties of convergence, continuity, connectedness and compactness of the spaces.
- **Explore** the fundamental concepts of Product topology and box topology.
- **Apply** the idea of construction of the continuous real valued functions on normal spaces.
-

Prerequisite

Basic Knowledge of Real Analysis

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Describe the basic concepts of topological spaces, continuous functions, connectedness, compactness, countability and separation axioms.	K2
CO2	Apply the topological concepts in various fields.	K3
CO3	Ascertain the notions of topological concepts, continuous functions, connectedness, compactness, countability and separation axioms.	K4
CO4	Evaluate the concepts of topological spaces, continuous functions, connectedness, compactness, countability and separation axioms.	K5
CO5	Develop the ideas involving topological spaces, continuous functions, connected ness, compactness, countability and separations axioms in different proofs.	K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3	3	3	2	3	3
CO2	3	3	3	3	3	3	2	2	3	3
CO3	3	3	3	3	3	3	2	2	3	3
CO4	3	3	3	3	3	3	2	2	3	3
CO5	3	3	3	3	3	3	2	2	3	3

"1" – Slight (Low) Correlation ¬ "2" – Moderate (Medium) Correlation ¬

"3" – Substantial (High) Correlation ¬ "-" indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Topological Spaces:** Topological Spaces - Basis for a Topology - The Order Topology - The Product Topology on X x Y - The Subspace Topology - Closed Sets and Limit Points.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5, K6
II	**Continuous Functions:** Continuous Functions - The Product Topology - The Metric Topology – The Metric Topology (continued).	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5, K6
III	**Connectedness:** Connected Spaces - Connected Subspaces of the Real Line - Components and Local Connectedness.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5, K6
IV	**Compactness:** Compact Spaces - Compact Subspaces of the Real Line - Limit Point Compactness.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5, K6
V	**Countability and Separation Axioms:** The Countability Axioms - The Separation Axioms - Normal Spaces - The Urysohn Lemma - The Urysohn Metrization Theorem - The Tietze Extension Theorem – The Tychonoff Theorem.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5, K6
VI	**Self Study for Enrichment:** **(Not included for End Semester Examinations)** Topological Groups – The Quotient Topology – Nets - Local Compactness – Imbeddings of Manifolds.	-	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5, K6

Text Book

James R. Munkres (2013). *Topology (Second Edition)*. PHI Learning Private Limited, New Delhi.

Chapters and Sections

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 - 28
UNIT- V	Chapter 4:	Sections 30 – 35
	Chapter 5:	Section 37

Reference Books

1. Mangesh G. Murdeshwar. (1999). *General Topology (Second Edition)*. New Age International (P) Limited, New Delhi.
2. George F. Simmons. (2016). *Introduction to Topology and Modern Analysis (26th Reprint)*. McGraw Hill Education (India) Private Limited, New Delhi.
3. Stephen Willard. (1998). *General Topology*. Dover Publications, INC, Mineola, New York.

Web References

1. **https://youtu.be/jHQ7qEPkKkw**
2. **https://youtu.be/6-J75PtYC5E**
3. **https://tinyurl.com/yk65k76h**
4. **https://youtu.be/VDifg7aTXzg**
5. **https://youtu.be/bAkevWcBsxs**
6. **https://youtu.be/CGADr19iWSo**
7. **https://tinyurl.com/32cbv45m**

Pedagogy

Power Point Presentations, Group Discussions, Seminar, Quiz, Assignment.

Course Designer

Dr. S. Vidhya

Semester - III	Internal Marks: 25		ExternalMarks:75	
COURSECODE	**COURSETITLE**	**CATEGORY**	**Hours / Week**	**CREDITS**
22PMA3CC9	**DISCRETE MATHEMATICS**	**CORE**	**6**	**5**

Course Objectives

- **Develop** the mathematical concepts and technique which should serve as a preparation for more advanced quantitative courses.
- **Analyze** the method of logical reasoning to solve variety of problems.
- **Apply** mathematically correct terminology and notation.

Prerequisites

- Familiarity of concepts of statements logic and truth tables, sets, functions and relations.
- Counting principles, permutations and combinations.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Understand basic concepts in formal languages and computability, permutations, combinations,relations and functions, finite state machines, Boolean algebras.	**K2**
CO2	Classify algorithms based on the concepts of discrete Mathematics.	**K3**
CO3	Ascertain the notions of discrete Mathematics.	**K4**
CO4	Evaluate the conceptsof discrete mathematics in problem solving.	**K5**
CO5	Deduce mathematical ideas in computability, permutations, combinations,relations and functions, finite state machines, Boolean algebras.	**K5**

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	2	3	3
CO5	3	3	3	3	3	3	3	3	3	3

"1" – Slight (Low) Correlation ¬
"2" – Moderate (Medium) Correlation ¬
"3" – Substantial (High) Correlation ¬
"-" indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**COMPUTABILITY AND FORMAL LANGUAGES:** Introduction-Russell's Paradox and Non computability-Languages-Phrase Structure Grammars- Types of Grammars and Languages.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

II	**PERMUTATIONS, COMBINATIONS AND DISCRETE PROBABILITY:** Introduction- The Rules of Sum and Product – Permutations – Combinations – Generations of Permutations and Combinations - Discrete Probability – Conditional Probability.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	**RELATIONS AND FUNCTIONS:** Introduction – Relational Model for Data Bases – Properties of Binary Relations – Equivalence Relations and Partitions – Partial Ordering Relations and Lattices – Chains and Antichains- A job - Scheduling Problem.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	**FINITE STATE MACHINES:** Introduction – Finite State Machines – Finite State Machines as Models of Physical Systems – Equivalent Machines – Finite State Machines as Language Recognizers.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
V	**BOOLEAN ALGEBRAS:** Lattices and Algebraic System – Principle of Duality – Basic properties of Algebraic Systems defined by Lattices – Distributive and Complimented Lattices- Boolean Lattices and Boolean Algebras- Uniqueness of Finite Boolean Algebras - Boolean Functions and Boolean Expressions.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
VI	**Self Study for Enrichment:** **(Not included for End Semester Examinations)** Ordered sets - Information and Mutual Information - Functions and the Pigeonhole Principle - Finite State Languages and Type-3 Languages - Propositional Calculus	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

Text Book

C.L.Liu, (2000), *Elements of Discrete Mathematics(Second Edition)*, Tata McGraw-Hill Publishing Company Limited.

Chapters and Sections

UNIT-I Chapter 2: Sections 2.1, 2.2, 2.4-2.6.

UNIT-II Chapter 3: Sections 3.1-3.7

UNIT-III Chapter 4: Sections 4.1- 4.7

UNIT-IV Chapter 7: Sections 7.1 – 7.5

UNIT-V Chapter 12: Sections 12.1-12.7

Reference Books

1. J.P.Tremblay,R.Manohar,(2011),*Discrete Mathematical, Structures with Applications to Computer Science*, Tata McGraw Hill.
2. Ralph P. Grimaldi, B. V. Ramana(2006), *Discrete and Combinatorial Mathematics*, Pearson Education,.
3. Kenneth H. Rosen, (2008), *Discrete Mathematics & its Applications with combinatorics and graph theory*, Tata McGraw Hill Company Limited, New Delhi.

Web References

1. https://gyires.inf.unideb.hu/GyBITT/14/ch02s03.html
2. https://www.youtube.com/watch?v=_rSBC86Tdkw
3. https://www.youtube.com/watch?v=0HiMb-yf-nI
4. https://www.youtube.com/watch?v=XJnIdRXUi7A
5. https://www.youtube.com/watch?v=wbBY2tTqXDA
6. https://www.youtube.com/watch?v=Qa6csfkK7_I
7. https://plato.stanford.edu/entries/russell-paradox/
8. https://youtu.be/WW-NPtIzHwk

Pedagogy

Power point presentations, Group Discussions, Seminar, Quiz, Assignment.

Course Designer

Dr. P. Saranya.

Semester III	Internal Marks:25		External Marks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs/Week**	**CREDITS**
22PMA3CC10	**MEASURE AND INTEGRATION**	**CORE**	**6**	**5**

Course Objectives

- Gain the knowledge to construct Lebesgue measure and its properties.
- Compute Lebesgue integrals by convergence theorems and Fubini's theorem.
- Familiarize the concepts of Measure theory.

Prerequisite

Basic knowledge in Real Analysis

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Describe fundamental concepts of Measure and Integration through examples.	**K2**
CO2	Predict the important notions and their connections of Measure theory.	**K3**
CO3	Ascertain the concepts of Measure in real line, abstract spaces, product spaces, integration of functions of a real variables and convergence	**K4**
CO4	Evaluate mathematical proofs of results in Measure and Integration.	**K5**
CO5	Examine the methods of analysis that can be applied to real world problems.	**K5**

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	3	3	3	3	2	3
CO2	3	2	3	3	3	3	3	3	3	2
CO3	3	2	3	3	3	3	3	3	2	2
CO4	3	2	2	3	3	3	3	3	3	2
CO5	3	2	3	3	3	3	3	3	2	2

"1" – Slight (Low) Correlation ¬ "2" – Moderate (Medium) Correlation ¬

"3" – Substantial (High) Correlation ¬ "-" indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Measure On the Real Line :** Lebesgue Outer Measure – Measurable Sets – Regularity – Measurable Functions – Borel and Lebesgue Measurability	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5
II	**Integration of Functions of a Real variable :** Integration of Non-negative Functions – The General Integral – Riemann and Lebesgue Integrals.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5
III	**Abstract Measure Spaces :** Measures and outer measures – Extension of a Measure – Uniqueness of the Extension – Completion of a Measure	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5
IV	**Inequalities and the L^p spaces :** The L^p Spaces – Convex Functions. **Convergence :** Convergence in Measure – Almost Uniform Convergence.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5
V	**Signed Measures and their Derivatives :** Signed Measures and the Hahn Decomposition – The Jordan decomposition **Measure and Integration in a Product Space :** Measurability in a Product Space – The product measure and Fubini's theorem.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5
VI	**Self-Study for Enrichment (Not included for End Semester Examination)** Hausdorff Measures on the Real line – Integration of Series – Measure spaces – Integration with respect to a Measure – The Radon-Nikodym theorem – Lebesgue Measure in Euclidean space.	-	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5

Text Book

G.De Barra, (2003). Measure Theory and Integration, New Age International (P) Limited.

Chapters and Sections

UNIT–I	Chapter 2:	Sections 2.1 to 2.5
UNIT II	Chapter 3:	Sections 3.1, 3.2 and 3.4
UNIT-III	Chapter 5:	Sections 5.1 to 5.4
UNIT-IV	Chapter 6:	Sections 6.1, 6.2
	Chapter 7:	Sections 7.1, 7.2
UNIT-V	Chapter 8:	Sections 8.1, 8.2
	Chapter 10:	Sections 10.1, 10.2

Reference Books

1. Munroe. M.K. (1971). *Measure and Integration*, Addison - Wesley Publishing Company.
2. Jain, P.K, Gupta, V.P. (2003). *Lebesgue Measure and Integration*, New Age International Pvt Limited Publishers New Delhi.
3. Richard L. Wheeden and Antoni Zygmund (1977). *Measure and Integral: An Introduction to Real Analysis* , Marcel Dekker Inc.
4. Inder, K. Rana (1997). *An Introduction to Measure and Integration*, Narosa Publishing House, New Delhi.

Web References

1. https://www.youtube.com/watch?v=TG67nsccqeQ
2. https://www.youtube.com/watch?v=PGPZ0P1PJfw
3. https://www.youtube.com/watch?v=qAYX9Koo87o
4. https://www.youtube.com/watch?v=eu-6_wpTE-A
5. https://link.springer.com/book/10.1007/978-3-540-34514-5
6. **http://www.math.chalmers.se/~borell/MeasureTheory.pdf**

Pedagogy

Assignment, Seminar, Lecture, Quiz, Group discussion, Brain storming, e-content.

Course Designer

Dr. V. Geetha

Semester : III	Internal Marks:25		External Marks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
22PGCS3CCC2A	**CYBER SECURITY**	**CORE CHOICE**	**3(T) + 2(P)**	**4**

Course Objectives

- To develop skills in students that can help them plan, implement, and monitor cyber securitymechanisms to ensure the protection of information technology assets.
- To expose students to governance, regulatory, legal, economic, environmental, social, and ethicalcontexts of cyber security.
- To expose students to the responsible use of online social media networks.
- To systematically educate the necessity to understand the impact of cyber-crimes and threats withsolutions in a global and societal context.
- To select suitable ethical principles, commit to professional responsibilities and human values,and contribute value and wealth for the benefit of society

Prerequisite

Basic Knowledge of Cyber Security

Course Outcomes and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Understand the cyber security threat landscape	K1,K2
CO2	Develop a deeper understanding and familiarity with various types, cyber crimes, vulnerabilities, and remediesthereto.	K2, K3
CO3	Analyse and evaluate existing legal frameworks and laws on cyber security.	K4, k5
CO4	Analyse and evaluate the digital payment system security and remedial measures.	K4, K5
CO5	Analyse and evaluate the cyber security risks, plan suitable security controls	K4, K5

Mapping of CO with PO and PSO

COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	P0 1	PO 2	PO 3	PO 4	PO 5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	2	3	3	3	3	2
CO4	3	3	3	3	2	3	3	3	3	2
CO5	3	3	3	3	2	3	3	3	3	2

"1" – Slight (Low) Correlation "2" – Moderate (Medium)Correlation
"3" – Substantial (High) Correlation "-" indicates there is no correlation

SyllabusTheory

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	Overview of Cyber Security: Cyber security increasing threat landscape, -Cyberspace, attack, attack vector, attack surface, threat, risk, vulnerability, exploit, exploitation, hacker., Non-state actors, Cyber terrorism, Protection of end user machine, Critical IT and National Critical Infrastructure, Cyber warfare, Case Studies.	9	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
II	Cyber Crimes: Cyber Crimes targeting Computer systems and Mobiles- data diddling attacks, spyware, logic bombs, DoS, DDoS, APTs, virus, Trojans, ransomware, data breach., Online scams and frauds- email scams, Phishing, Vishing, Smishing, Online job fraud, Online sextortion, Debit/credit card fraud, Online payment fraud, Cyberbullying, website defacement, Cyber-squatting, Pharming, Cyber espionage, Cryptojacking, Darknet-illegal trades, drug trafficking, human trafficking., Social Media Scams & Frauds- impersonation, identity theft, job scams, misinformation, fake news cyber crime against persons –cyber grooming, child pornography, cyber stalking., Social Engineering attacks, Cyber Police stations, Crime reporting procedure, Case studies.	9	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	Cyber Law: Cyber Crime and legal landscape around the world, IT Act, 2000 and its amendments. Limitations of IT Act, 2000. Cyber Crime and punishments, Cyber Laws and Legal and ethical aspects related to new technologies- AI/ML, IoT, Blockchain, Darknet and Social media, Cyber Laws of other countries, Case Studies.	9	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	Data Privacy and Data Security: Defining data, meta-data, big data, non-personal data. Data protection, Data privacy and data security, Personal Data Protection Bill and its compliance, Data protection principles, Big data security issues and challenges, Data protection regulations of other countries- General Data Protection Regulations(GDPR),2016 Personal Information Protection and Electronic Documents Act (PIPEDA). Social media-data privacy and security issues.	9	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
V	Cyber security Management, Compliance and Governance: Cyber security Plan-cyber security policy, cyber crises management plan., Business continuity, Risk assessment, Types of security controls and their goals, Cyber security audit and compliance, National cyber security policy and strategy.	9	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

VI	**Self Study for Enrichment** **(Not included for End Semester Examinations)** **Case Studies**: Largest Cyber Attacks : Yahoo Data Breach, Equifax Data Breach, WannaCry Malware Attack, Simple Locker.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

Reference Books

1. Vivek Sood, (2017). *Cyber Law Simplified*. McGraw Hill Education
2. Sumit Belapure and Nina Godbole, (2011). *Computer Forensics and Legal Perspectives*. Wiley India Pvt. Ltd.
3. Dorothy F. Denning, (1998). *Information Warfare and Security*. Addison Wesley.
4. Henry A. Oliver, (2015). *Security in the Digital Age: Social Media Security Threats and Vulnerabilities*.Create Space Independent Publishing Platform.
5. Natraj Venkataramanan and Ashwin Shriram, (2016). *Data Privacy Principles and Practice.* 1st Edition, CRC Press.
6. W.Krag Brothy, (2008). *Information Security Governance, Guidance for Information Security Managers*. 1st Edition, Wiley Publication.
7. Martin Weiss, Michael G.Solomon, (2015). *Auditing IT Infrastructures for Compliance*. 2nd Edition, Jones & Bartlett Learning.

Web References

1. https://www.tutorialspoint.com/principles-of-information-system-security
2. https://www.geeksforgeeks.org/principle-or-information-system-secutiry/
3. https://www.techtarget.com/searchsecurity/definition/cybersecurity
4. https://www.ukessays.com/essays/computer-science/analysis-of-the-yahoo-data-breaches.php
5. https://www.csoonline.com/article/3444488/equifax-data-breach-faq-what-happened-who-was-affected-what-was-the-impact.html
6. https://www.techtarget.com/searchsecurity/definition/WannaCry-ransomware
7. https://www.cloudflare.com/learning/ddos/syn-flood-ddos-attack/

Practicals:

List of Exercises *(Not included for End Semester Examinations)*

1. Platforms for reporting cyber crimes.
2. Checklist for reporting cyber crimes online
3. Setting privacy settings on social media platforms.
4. Do's and Don'ts for posting content on Social media platforms.
5. Registering complaints on a Social media platform.
6. Prepare password policy for computer and mobile device.
7. List out security controls for computer and implement technical security controls in the personal computer.
8. List out security controls for mobile phone and implement technical security controls in the personal mobile phone.
9. Log into computer system as an administrator and check the security policies in the system.

Web References

1. https://cybercrime.gov.in/
2. https://cybercrime.gov.in/webform/crime_onlinesafetytips.aspx
3. https://www.digitalvidya.com/blog/social-media-dos-and-donts/
4. https://www.medianama.com/2023/02/223-platform-grievance-appellate-committees-social- media/
5. https://www.ibm.com/topics/security-controls
6. https://docs.oracle.com/cd/E19683-01/817-0365/concept-2/index.html

Pedagogy

Chalk and Talk, Group discussion, Seminar & Assignment.

Course Designer

From UGC SYLLABUS

Semester III	Internal Marks: 25		External Marks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs / Week**	**CREDITS**
22PMA3CCC2B	**INTRODUCTION TO CODING THEORY**	**CORE CHOICE**	**5**	**4**

Course Objectives

- **Apply** the coding theory to code an information using linear codes and cyclic codes.
- **Acquire** the knowledge of decoding the codes received and retrieve the original information.
- **Find** various bounds for various types of codes.

Prerequisite

Basic Knowledge in Algebra.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Explain the concept of coding.	K2
CO2	Classify the Communication Channels and give the datas in a required format.	K3
CO3	Determine the bounds on various coding.	K4
CO4	Examine some methodologies for the coding and decoding in an effective manner.	K4
CO5	Compare the notions of distinct codes and represent the data in a easy way.	K5

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	2	3	2	2	3	2	2	2	3
CO2	2	2	3	2	2	2	2	2	2	3
CO3	3	2	3	2	2	3	2	2	3	3
CO4	3	2	2	2	2	2	2	2	2	2
CO5	2	2	2	3	3	2	3	3	2	2

"1" – Slight (Low) Correlation ¬ "2" – Moderate (Medium) Correlation ¬

"3" – Substantial (High) Correlation ¬ "-" indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Error detection, correction and decoding:-** Communication Channels- Maximum likelihood decoding- Hamming distance –Nearest neighbor/minimum distance decoding .	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
II	**Finite Fields:** Fields- Polynomial rings–Structure of finite fields-Minimal Polynomials. **Linear Codes:** Vector spaces over finite fields- Linear codes-Hamming weight-bases for linear codes.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	**Linear Codes:** Equivalence of linear codes-Encoding with linear code-**Decoding of linear codes**: Cosets-Nearest neighbor decoding for linear codes. **Bounds in coding theory:** The main coding theory problem– Lower bounds-Hamming bound and perfect codes.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	**Bounds in coding theory:** Singleton bound and MDS codes-Plotkin bound-Nonlinear codes-griesmer bound.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
V	**Construction of cyclic codes:** Definition-Generator polynomials-generator and parity check matrices-Decoding of cyclic codes.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
VI	**Self Study for Enrichment:** **(Not included for End Semester Examination)** Distance of a Code – Generator Matrix and parity-check matrix- Syndrome decoding- Linear Programming bound – Brust-error-correcting codes.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

Text Book

San Ling Chaoping Xing.(2004), *Coding Theory: A First Course*, The Cambridge University Press, United States of America.

Chapters and Sections

UNIT-I	Chapter 2	Sections 2.1-2.4
UNIT-II	Chapter 3	Sections 3.1-3.4
	Chapter 4	Sections 4.1-4.4
UNIT-III	Chapter 4	Sections 4.5- 4.8
	Chapter 5	Sections 5.1- 5.3
UNIT- IV	Chapter 5	Sections 5.4 – 5.7
UNIT- V	Chapter 7	Sections 7.1 to 7.4.

Reference Books

1. Lint Van J. H (2004).A *Introduction to Coding Theory,* Springer- Verlag, Berlin.
2. Mary J Jones and Gareth A Jones(2004). *The Information and Coding Theory,* Springer- Verlag, Berlin.
3. Woungang I, Misra S & Misra S. C(2010). *Selected Topics in Information and Coding Theory,* Prentice Hall of India, New Delhi.

Web References

1. **https://www.youtube.com/watch?v=5wDVsXrDFoQ**
2. **https://www.youtube.com/watch?v=NULv-dp-UzQ**
3. **https://www.youtube.com/watch?v=_cdSLHfRN_o**
4. **https://u.cs.biu.ac.il/~lindell/89-662/coding_theory-lecture-notes.pdf**
5. **https://users.math.msu.edu/users/halljo/classes/codenotes/Topstuff.pdf**

Pedagogy

Chalk and talk, PPT, Discussion, Assignment, Quiz, Seminar.

Course Designer

Dr. S. Saridha

Semester III	Internal Marks: 25		External Marks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs /Week**	**CREDITS**
22PMA3CCC2C	**MECHANICS**	**CORE CHOICE**	**5**	**4**

Course Objectives

- **State** the basic concepts of Lagrangian and Hamiltonian approaches to classical mechanics.
- **Explore** different applications of these concepts in mechanics.
- **Analyze** the methods of solving central force problems.

Prerequisite

Mechanics and differential equations at UG level.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Describe the fundamental concepts of Mechanics.	K2
CO2	Interpret and illustrate the knowledge of core principles in mechanics.	K3
CO3	Ascertain the analytical techniques for solving some partial differential equations that frequently occur in applications.	K4
CO4	Test for the importance of concepts such as generalized coordinates and constrained motion.	K4
CO5	Build up an understanding of kinetic and potential energies of a system, the Lagrangian and Hamiltonian functions of systems will be set up in order to arrive at the equations of motion and to realize the reduction of a two-body problem to a one-body problem in a central force system.	K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3	3	3	2	3	3
CO2	3	3	3	3	3	3	2	2	3	3
CO3	3	3	3	3	3	3	2	2	3	3
CO4	3	3	3	3	3	3	2	2	3	3
CO5	3	3	3	3	3	3	2	2	3	3

“1” – Slight (Low) Correlation ¬ “2” – Moderate (Medium) Correlation ¬

“3” – Substantial (High) Correlation ¬ “-” indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
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.	15	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K6
II	**VARIATIONAL PRINCIPLES AND LAGRANGE'S EQUATIONS** Hamilton's Principle – Some Techniques of the Calculus of Variations – Derivation of Lagrange's Equations from Hamilton's Principle – Advantages of a Variational Principle Formulation – Conservation Theorems and Symmetry Properties – Energy Function and the Conservation of Energy.	15	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K6
III	**THE 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.	15	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K6
IV	**THE CENTRAL FORCE PROBLEM** The Differential Equation for the Orbit and Integrable Power-Law Potentials – Conditions for Closed Orbits (Bertrand's Theorem) – The Kepler Problem: Inverse Square Law of Force – The Motion in Time in the Kepler Problem – The Laplace-Runge-Lenz vector.	15	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K6
V	**THE HAMILTON EQUATIONS OF MOTION** Legendre Transformations and the Hamilton Equations of Motion– Cyclic Coordinates and the Conservation Theorems – Routh's Procedure – Derivation of Hamilton's Equations from a Variational Principle – The Principle of Least Action.	15	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K6
VI	**Self Study for Enrichment:** **(Not included for End Semester Examinations)** Simple Applications of the Lagrangian Formulation– Extending Hamilton's Principle to systems with constraints– Scattering in a Central Force Field– Transformation of the Scattering Problem to Laboratory Coordinates – The Hamiltonian Formulation of Relativistic Mechanics.	-	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K6

Text Book

Herbert Goldstein, Charles P.Poole, John Safko (2011). *Classical Mechanics (Third Edition)*. Darling Kindersley, India.

Chapters and Sections

UNIT-I	Chapter 1	Sections 1.1 – 1.5
UNIT-II	Chapter 2	Sections 2.1 – 2.3, 2.5 – 2.7
UNIT-III	Chapter 3	Sections 3.1 – 3.4
UNIT- IV	Chapter 3	Sections 3.5 – 3.9
UNIT- V	Chapter 8	Sections 8.1 – 8.3, 8.5, 8.6

Reference Books

1. S.K.Sinha (2009). *Classical Mechanics*. Narosa Publishing House, New Delhi.
2. J.C.Upadhaya (2003). *Classical Mechanics*. Himalaya Publishing House, New Delhi.
3. D.Greenwood(1985). *Classical Dynamics*. Prentice hall of India, New Delhi.

Web References

1. **https://youtu.be/-9g3bqbZHCI**
2. **https://youtu.be/ONese_4PSeM**
3. **https://youtu.be/OWTaGzLeRpE**
4. **https://youtu.be/Wrr4d2De5IE**
5. **https://youtu.be/wejAz4hIVUI**
6. **https://youtu.be/2DvvSvUj_Qg**
7. **https://sites.astro.caltech.edu/~golwala/ph106ab/ph106ab_notes.pdf**

Pedagogy

Power Point Presentations, Group Discussions, Seminar, Quiz, Assignment.

Course Designer

Dr. C.Saranya

Semester III	Internal Marks: -		ExternalMarks:100	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs / Week**	**CREDITS**
22PMA3DSE3A	**ANALYTICAL SKILLS FOR COMPETITIVE EXAMINATIONS**	**DISCIPLINE SPECIFIC ELECTIVE**	**4**	**3**

Course Objectives

- **Analyse** the concepts concerned with linear and algebraic properties that are preserved under continuous deformations of objects.
- **Enhance** the students to develop analytical thinking and the study of continuity and connectivity
- **Motivate** the advance treatment of theory at a fairly understandable level.

Prerequisite

Basic Knowledge of algebra and vector spaces.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO 1	Remember the basic concepts and objective of algebra and vector spaces.	K1
CO 2	Illustrate the properties of algebra and vector spaces to find the solution.	K2
CO 3	Apply different terminologies of algebra and linear algebra	K3
CO 4	Classify the various properties in algebra and transformation	K4
CO 5	Interpret the problems involved in algebra and vector spaces	K5

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3	3	3	2	2	3
CO2	3	2	3	3	3	3	3	3	2	3
CO3	3	3	2	3	3	3	3	3	3	3
CO4	3	2	3	3	2	3	3	2	2	3
CO5	3	2	3	3	2	3	3	3	3	2

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation

"3" – Substantial (High) Correlation "-" indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	Permutations – Combinations - Pigeon-hole Principle - Inclusion-Exclusion Principle – Derangements - Fundamental Theorem of Arithmetic - Divisibility in Z – Congruences - Chinese Remainder Theorem - Euler's Ø- Function - Primitive Roots.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
II	Vector Spaces – Subspaces – Linear dependence – Basis – Dimension – Algebra of linear transformations.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

III	Algebra of matrices – Rank and Determinant of matrices – Linear equations - Eigenvalues - Eigenvectors – Cayley –Hamilton theorem.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	Matrix representation of linear transformations – Change of basis - Canonical forms – Diagonal forms – Triangular forms –Jordan forms.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
V	Inner product spaces – Ortho normal basis – Quadratic forms –Reduction and Classification of Quadratic forms.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
VI	**Self-Study for Enrichment: (Not included for End Semester Examinations)** The Double Dual - Lagrange Interpolation – Modules – Direct-Sum Decomposition Theorem – Operators on Inner Product Spaces.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

Text Books

[1] Joseph A. Gallian, (1999), Contemporary Abstract Algebra, Narosa Publishing House, Fourth Edition.

[2] David M. Burton (2012), Elementary Number Theory (Sixth Edition), Tata McGraw Hill Education Private Limited, New Delhi.

[3] Kumaresan.S (2000), Linear Algebra: A Geometric Approach , Prentice hall.

[4] Seymour Lipschutz (2001), Marc Lipson, Schaum's outlines- Linear Algebra ,Mcgraw Hill Education, Third Edition.

[5] Krishnamurthy, Mainra V P and Arora JL (1976), Introduction to linear Algebra, East West Press, New Delhi.

[6] Vasistha. A. R, Linear Algebra (2006), Krishna Prakashan media (P).

[7] Stephen. H, Friedberg (2004) , Linear Algebra, Prentice Hall of India Pvt Ltd.

Reference Books

[1] Telang S. G. (2005), Number Theory (Reprint 2001),Tata McGraw Hill Education Private Limited, New Delhi.

[2] David S. Dummit and Richard M. Foote, (2004), Abstract Algebra, Wiley and Sons, Third Edition.

[3] Kenneth Hoffman and R. Kunze (1984): Linear Algebra, Phi Learning Private Limited, 2nd Edition.

Web References

1. https://www.google.com/search?q=csir+net+mathematical+science+solved+question+papers&tbm=vid&ei=FeE0ZI7uILqOseMP_oSWyAw&start=10&sa=N&ved=2ahUKEwjOzIv8_aDAhU6R2wGHX6CBckQ8tMDegQIFhAE&biw=1366&bih=600&dpr=1#fpstate=ive&vld=cid:ee12b87c,vid:6iCmTnhgM0Y.
2. https://www.google.com/search?q=csir+net+mathematical+science+solved+linear+algebra+question+papers&biw=1366&bih=600&tbm=vid&ei=UeI0ZOmOLuWcseMP_IXwA4&ved=0ahUKEwipS_6DAhVlTmwGHfzHBeg4FBDh1QMIDQ&uact=5&oq=csir+net+mathematical+science+solved+linear+algebra+question+papers&gs_lcp=Cg1nd3Mtd2l6LXZpZGVvEAM6BAgAEB46CAgAEIoFEIYDOgYIABAeEA06CgghEKABEMMEEAo6CAghEKABEMMEOgQIIRAKULwGWM0tYLY6aABwAHgAgAGAA4gBsheSAQgwLjEyLjIuMpgBAKABAcABAQ&sclient=gws-wiz-video#fpstate=ive&vld=cid:dffaef48,vid:ItF4GBWtdwQ
3. https://www.google.com/search?q=csir+net+mathematical+science+solved+linear+algebra+question+papers&biw=1366&bih=600&tbm=vid&ei=UeI0ZOmOLuWcseMP_IXwA4&ved=0ahUKEwipS_6DAhVlTmwGHfzHBeg4FBDh1QMIDQ&uact=5&oq=csir+net+mathematical+science+solved+linear+algebra+question+papers&gs_lcp=Cg1nd3Mtd2l6LXZpZGVvEAM6BAgAEB46CAgAEIoFEIYDOgYIABAeEA06CgghEKABEMMEEAo6CAghEKABEMMEOgQIIRAKULwGWM0tYLY6aABwAHgAgAGAA4gBsheSAQgwLjEyLjIuMpgBAKABAcABAQ&sclient=gws-wiz-video#fpstate=ive&vld=cid:20257e30,vid:okGkqdNAyuQ
4. https://www.youtube.com/watch?v=bbQ0uPTLZzo
5. https://www.youtube.com/watch?v=3KqG8Mc6C40
6. https://www.youtube.com/watch?v=RoYIu6LbSnI
7. https://www.youtube.com/watch?v=rgxyxcTwvuo
8. https://www.youtube.com/watch?v=y_57UcnWHfU
9. https://www.cuemath.com/numbers/the-fundamental-theorem-of-arithmetic/
10. https://www.khanacademy.org/computing/computer-science/cryptography/modern-crypt/v/euler-s-totient-function-phi-function

Pedagogy

Power Point Presentations, Group Discussions, Seminar, Quiz, Assignments.

Course Designer

Ms. V. ManiMozhi

Semester III	Internal Marks:25		External Marks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs/Week**	**CREDITS**
22PMA3DSE3B	**STOCHASTIC PROCESSES**	**DISCIPLINE SPECIFIC ELECTIVE**	**4**	**3**

Course Objectives

- **Acquire** the basic concepts of stochastic processes and their applications.
- **Understand** the fundamental of renewal processes.
- **Explore** fundamental concepts in queuing theory.

Prerequisite

Basic knowledge in Probability

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Remember and recall the basic concept of probability	**K1**
CO2	Interpret the various states space and chains of the Stochastic Processes.	**K2**
CO3	Analyze the different techniques of Stochastic Processes.	**K3**
CO4	Classify the solution of mathematical problems using various techniques	**K4**
CO5	Examine the solution of various state space.	**K4**

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	3	3	3	3	2	3
CO2	3	3	3	3	3	3	3	3	3	2
CO3	3	2	3	3	3	3	3	3	2	2
CO4	3	2	2	3	3	3	3	3	3	2
CO5	3	2	3	3	3	3	3	3	2	2

"1" – Slight (Low) Correlation ¬ "2" – Moderate (Medium) Correlation ¬

"3" – Substantial (High) Correlation ¬ "-" indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Stochastic Processes: Some Notions** : Introduction-Specification of Stochastic processes – Stationary processes **Markov Chains**: Definitions and examples – Higher Transition Probabilities – Generalization of Independent Bernoulli Trials: Sequence of Chain – Dependent Trials.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4

II	**Markov chains:** 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- Reducible Chains – Markov Chains with Continuous State Space.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
III	**Markov Processes with Discrete State Space** : **Poisson Process and its Extensions** – Poisson Process -Poisson Process and Related Distributions – Generalisations of Poisson Process- Birth and Death Process	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
IV	**Renewal processes and Theory**: Renewal Process – Renewal Processes in Continuous Time – Renewal Equation – Stopping time: Wald's Equation – Renewal Theorems.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
V	**Stochastic Processes in Queueing and Reliability** – Queueing Systems: General Concepts – The Queueing Model M/M/1: Steady State Behaviour – Transient Behaviour of M/M/1 Model – Non-Markovian Queueing Models.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
VI	**Self-Study for Enrichment** **(Not included for End Semester Examination)** Martingales – Non-Homogeneous chain– Markov Processes with Discrete State Space (Continuous Time Markov Chains) – Delayed and Equilibrium Renewal Processes – The Model GI/M/1.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4

Text Book

J. Medhi (1984), Stochastic Processes, New Age International (P) Limited, Publishers, New Delhi– Second Edition.

Chapters and Sections

UNIT I Chapter 2: Section 2.1 – 2.3
Chapter 3: Section 3.1 – 3.3
UNIT II Chapter 3: Section 3.4 – 3.9 and 3.11
UNIT III Chapter 4: Section 4.1 – 4.4
UNIT IV Chapter 6: Section 6.1 – 6.5
UNIT V Chapter 10: Section 10.1– 10.3 and 10.7

Reference Books

1. B.R.Bhat, Stochastic Models Analysis and Applications ,New Age International(P) Limited Publishers, New Delhi,2004
2. Biswas, Suddhendu , Stochastic Processes in Demography and Applications, New Central Book Agency Calcutta, 2006.
3. T.Veerarajan, Probability, Statistics and Random Processes, Tata McGraw Hill Education Private Limited, New Delhi,2010 .

Web References

1. **https://www.google.com/url?q=https%3A%2F%2Fmpaldridge.github.io%2Fmath2750%2FP04.html&sa=D&sntz=1&usg=AOvVaw1alFxYapjLEFq-K2MNhQjT**
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3. https://www.google.com/url?q=https%3A%2F%2For.stackexchange.com%2Fquestions%2F4882%2Fhow-do-derive-the-steady-state-probabilities-m-m-1-k-queueing-system&sa=D&sntz=1&usg=AOvVaw3OpFUoK7nMmoVMCKeClnlU
4. **https://youtu.be/i3AkTO9HLXo**
5. **https://youtu.be/sb4jo4P4ZLI**
6. **https://youtu.be/L1fK3p5U4x0**
7. **https://youtu.be/xGkpXk-AnWU**
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Pedagogy

Assignment, Seminar, Group discussion, Brain storming, e-content.

Course Designer

Dr. S. Sasikala

Semester III	Internal Marks: 25		ExternalMarks:75	
COURSE CODE	**COURSETITLE**	**CATEGORY**	**Hrs /WEEk**	**CREDITS**
22PMA3DSE3C	**FUZZY SETS AND THEIR APPLICATIONS**	**Discipline Specific Elective Course**	**4**	**3**

Course Objectives

- **Introduce** the concept of fuzzy set theory and study its application in real problems.
- **Acquire** knowledge of the uncertainty environment through the fuzzy logic that incorporates imprecision and subjectivity.
- **Provide** a good outline of a model formulation and solution process.

Prerequisite

Basic Knowledge of Algebra, Logic and Graph Theory**.**

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Identify and Explain the basic concepts of Fuzzy sets and its properties	K1,K2
CO2	Classify the operations on Fuzzy sets	K3,K4
CO3	Explain and Relate Fuzzy sets and its Graphs	K3,K4
CO4	Distinguish clear and accurate results to assess the concepts of Fuzzy inference systems	K4,K5,K6
CO5	Develop and Define Fuzzy concepts to compute Design procedure for Fuzzy expert systems	K5,K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	1	1	3	3	2	2	1
CO2	3	3	2	2	1	3	3	2	2	2
CO3	2	3	3	3	2	3	3	3	2	2
CO4	1	2	2	3	3	3	3	2	3	3
CO5	1	2	3	3	3	3	3	2	2	3

"1" – Slight (Low) Correlation ¬ "2" – Moderate (Medium) Correlation ¬

"3" – Substantial (High) Correlation ¬ "-" indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**FUZZY SETS :** Sets - Operation of Sets - Characteristics of Crisp Set -Definition of Fuzzy Set -Expanding Concepts of Fuzzy Set - Standard Operation of Fuzzy Set **THE OPERATION OF FUZZY SET** : Standard Operations of Fuzzy Set -- Fuzzy Complement -	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

	Fuzzy Union - Fuzzy Intersection - Other Operations In Fuzzy Set - T-norms and T-conorms			
II	**FUZZY RELATION AND COMPOSITION** : Crisp Relation -Properties of Relation on a Single Set - Fuzzy Relation - Extension of Fuzzy Set **FUZZY GRAPH AND RELATION:** Fuzzy Graph -Characteristics of Fuzzy Relation -Classification of Fuzzy Relation -Other Fuzzy Relations	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
III	**FUZZY NUMBER:** Concept of Fuzzy Number - Operation of Fuzzy Number -Triangular Fuzzy Number -Other Types of Fuzzy Number **FUZZY FUNCTION:** Kinds of Fuzzy Function - Fuzzy Extrema of Function -Integration and Differentiation of Fuzzy Function	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
IV	**PROBABILITY AND UNCERTAINTY :** Probability and Possibility -Fuzzy Event -Uncertainty -Measure of Fuzziness **FUZZY LOGIC** : Classical Logic -Fuzzy Logic - Linguistic Variable - Fuzzy Truth Qualifier - Representation of Fuzzy Rule	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	**FUZZY INFERENCE:** Composition of Rules - Fuzzy Rules and Implication - Inference Mechanism - Inference Methods **FUZZY CONTROL AND FUZZY EXPERT SYSTEMS** -Fuzzy Logic Controller -Fuzzification Interface Component - Knowledge Base Component - Inference (Decision Making Logic) - Defuzzification -Design Procedure of Fuzzy Logic Controller - Application Example of FLC Design - Fuzzy Expert Systems	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	**Self Study for Enrichment:** **(Not included for End Semester Examination)** Fusion of fuzzy system and neural networks - Neural Networks - Fusion With Neural Networks -Fusion of fuzzy system and genetic algorithms - Genetic Algorithms -Fusion With Genetic Algorithms	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

Text Book

Kwang H. Lee (2005), *First Course on Fuzzy Theory and Applications,* Springer

Chapters and Sections

UNIT-I	Chapter I & II	Sections: 1.1 – 1.6 & 2.1 – 2.6
UNIT-II	Chapter III & IV	Sections: 3.1 – 3.4 & 4.1 – 4.4
UNIT-III	Chapter V & VI	Sections: 5.1 – 5.4 & 6.1 & 6.3
UNIT- IV	Chapter VII & VIII	Sections: 7.1 – 7.4 & 8.1 – 8.5
UNIT- V	Chapter IX & X	Sections: 9.1 – 9.4 & 10.1 – 10.8

Reference Books

1. Zimmermann H.J. (2006). *Fuzzy Set Theory and its Applications.* Fourth Edition. Springer(India) Private Limited.
2. Klir G. J. and Yuan B. (1995). *Fuzzy Sets and Fuzzy Logic*. Prentice-Hall of India.
3. Ganesh M. (2006). *Introduction to Fuzzy Sets and Fuzzy Logic*. Prentice-Hall of India.

Web References

1. https://www.tutorialspoint.com/fuzzy_logic/fuzzy_logic_introduction.htm
2. https://nitsri.ac.in/Department/Computer%20Science%20&%20Engineering/FuzzyLogic.pdf
3. http://site.iugaza.edu.ps/mahir/files/2010/02/chap5-FuzzyNumbers.pdf
4. https://codecrucks.com/fuzzy-inference-system-concepts-foundation/
5. http://fuzzy.cs.ovgu.de/wiki/uploads/Lehre.FS0910/fs0910lecture07.pdf

Pedagogy

Power point presentations, Group Discussions, Seminar, Quiz, Assignment.

Course Designer

Dr. K. Kalaiarasi

Semester III	Internal Marks: 25		ExternalMarks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs / Week**	**CREDITS**
22PMA3GEC1	**FOUNDATION FOR LOGICAL THINKING**	**GENERIC ELECTIVE**	**3**	**2**

Course Objectives

- **Explain** many short tricks to solve mathematical problems easily.
- **Apply** the knowledge to **interpret** and **solve** the problems.
- **Predict** elite knowledge in verbal reasoning.

Prerequisite

Knowledge of basic mathematics

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Explain the knowledge of the various techniques of quantitative aptitude and reasoning.	K1, K2
CO2	Apply the concepts in solving mathematical problems to succeed in various competitive examinations.	K3
CO3	Examine various types of Problems using arithmetic and reasoning test.	K3
CO4	Apply the concept obtained in the course to solve the problems.	K3
CO5	Analyse real-life problems and find solutions.	K4

Mapping of CO with PO and PSO

COs	PSO1	PSO2	SO3	SO4	SO5	D1	D2	D3	D4	D5
CO1	3	3	3	2	3	3	3	2	2	3
CO2	3	2	3	3	3	3	3	3	2	3
CO3	3	3	2	3	3	3	3	3	3	3
CO4	3	2	3	3	2	3	3	2	2	3
CO5	3	2	3	3	2	3	3	3	3	2

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation

"3" – Substantial (High) Correlation "-" indicates there is no Correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Arithmetical Ability:** Surds and indices - Logarithms – Alligation or Mixture	9	CO1, CO2, CO3, CO4, CO5	K1 K2, K3, K4
II	Probability – Heights and Distances – Odd Man Out and Series	9	CO1, CO2, CO3, CO4, CO5	K1 K2, K3, K4
III	**Data Interpretation:** Bar Graphs - Pie Chart - Line Graphs.	9	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
IV	**Reasoning Test:** Relationship –Direction Sense Test - Problems based on Alphabet.	9	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
V	Logical Reasoning	9	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
VI	**Self-Study for Enrichment: (Not included for End Semester Examinations)** Arithmetical Ability: Permutation and Combination- Clocks – Calendar. Verbal Reasoning: Analogy- Classification.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4

Text Books

1. R.S.Aggarwal (Reprint 2017), *Quantitative Aptitude for Competitive Examinations (Fully Solved)*, S.Chand and Company Ltd., New Delhi.
2. Dr. Lal, Jain and Dr. K. C. Vashisthu (2018), *UGC NET/JRF/ SET Teaching & Research Aptitude*, Upkar Prakashan, Agra.

Chapters and Sections

UNIT-I Section I (9, 10, 21) **[1]**

UNIT-II Section I (31, 34, 35) **[1]**

UNIT-III Section II (37, 38, 39) **[1]**

UNIT- IV Section I (1, 5, 7) **[2]**

UNIT- V Section II **[2]**

Reference Books

1. Dinesh Khattar (2016), *Pearson Guide to Quantitative Aptitude for Competitive Examinations*, Pearson Publication, 3rd Edition.
2. Lal, Jain and Vashisthu .K .C (2018), *UGC NET/JRF/SET Teaching Research Aptitude.*
3. Abhijit Guha (2014), *Quantitative Aptitude for Competitive Examinations*, Mcgraw Hill Education Private Limited, New Delhi, 5th Edition.

Web References

1. https://www.indiabix.com/aptitude/questions-and-answers/
2. https://www.youtube.com/watch?v=lFHjNbSmsCE
3. https://www.sawaal.com/aptitude-reasoning/quantitative-aptitude-arithmetic-ability-questions-and-answers.html
4. https://www.youtube.com/watch?v=xRLNYich5Ls
5. https://www.youtube.com/watch?v=qwHJtfEUCgE
6. https://www.youtube.com/watch?v=g0_1ZhueCcE
7. https://www.indiabix.com/logical-reasoning/questions-and-answers/
8. https://byjus.com/govt-exams/logical-reasoning/

Pedagogy

Power Point Presentations, Group Discussions, Seminar, Quiz and Assignment.

Course Designer

Ms. V. ManiMozhi

Semester IV	Internal Marks: 25	External Marks:75		
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs /Week**	**CREDITS**
22PMA4CC11	**COMPLEX ANALYSIS**	**CORE**	**6**	**5**

Course Objectives

- **Define** analytic functions, linear transformations, Harmonic functions and power series.
- **Explore** the fundamental concepts of Cauchy's theorem, Cauchy's integral formula and the calculus of residues.
- **Apply** the idea of removable singularities, zeros and poles in various fields.

Prerequisite

Fundamental concepts in Real Analysis

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be ableto	Cognitive Level
CO1	Explain the fundamental concepts of conformality, Analyticfunctions, complex integration and series.	K2
CO2	Apply the various concepts of complex integration in differentfields.	K3
CO3	Ascertain the notion of complex integration, series, conformalityand linear transformations.	K4
CO4	Evaluate the problems in complex integration using variousconcepts.	K5
CO5	Develop the basic concepts of complex integration, conformality,series in various fields.	K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3	3	2	2	3	3
CO2	3	3	3	3	3	2	3	3	2	3
CO3	3	3	3	3	3	2	3	2	3	3
CO4	3	3	3	3	3	3	3	3	2	3
CO5	3	3	3	3	3	3	3	3	3	3

"1" – Slight (Low) Correlation ¬ "2" – Moderate (Medium) Correlation ¬

"3" – Substantial (High) Correlation ¬ "-" indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Conformality and Linear Transformations:** Arcs and closed curves – Analytic Functions in Regions – Conformal Mapping – Length and Area – The Linear Group – The Cross Ratio – Symmetry.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5, K6
II	**Fundamental Theorems and Cauchy's Integral Formula:** Line Integrals – Rectifiable Arcs – Line Integrals as Functions of Arcs – Cauchy's Theorem for a Rectangle – Cauchy's Theorem in a Disk – The Index of a Point with Respect to a Closed Curve – The Integral Formula – Higher Derivatives.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5, K6
III	**Local Properties of Analytical Functions:** Removable Singularities. Taylor's Theorem – Zeros and Poles – The Local Mapping – The Maximum Principle.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5, K6
IV	**The General Form of Cauchy's Theorem and The Calculus of Residues:** Chains and Cycles – Simple Connectivity – Homology – The General Statement of Cauchy's Theorem – Proof of Cauchy's Theorem – Locally Exact Differentials – The Residue Theorem – The Argument Principle – Evaluation of Definite Integrals.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5, K6
V	**Harmonic Functions and Power Series Expansions:** Definition and Basic Properties – The Mean-value Property – Poisson's Formula – Schwarz's Theorem – The Reflection Principle – Weierstrass's Theorem – The Taylor Series – The Laurent Series.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5, K6
VI	**Self Study for Enrichment:** **(Not included for End Semester Examinations)** Elementary Point Set Topology – Oriented Circles – Families of Circles - Multiply Connected Regions.	-	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5, K6

Text Book

Lars V. Ahlfors. (1979). *Complex Analysis* (Third Edition). McGraw-Hill International Editions.

Chapters and Sections

UNIT-I	Chapter 3: Sections 2.1 – 2.4, 3.1 – 3.3
UNIT-II	Chapter 4: Sections 1.1 – 1.5, 2.1 – 2.3
UNIT-III	Chapter 4: Sections 3.1 – 3.4
UNIT- IV	Chapter 4: Sections 4.1 – 4.6, 5.1 – 5.3
UNIT- V	Chapter 4: Sections 6.1 – 6.5
	Chapter 5: Sections 1.1 – 1.3

Reference Books

1. Serge Lang. (2005). *Complex Analysis* (Fourth Edition, First Indian Reprint). Springer International Edition.
2. Ponnusamy S. (2007). *Foundations of Complex Analysis* (Second Edition, First Reprint). Narosa Publishing House Pvt. Ltd.
3. John B. Conway. (2002). *Functions of One Complex Variable* (Second Edition, Sixteenth Reprint). Narosa Publishing House.

Web References

1. **https://youtu.be/3rQjkI9G8TQ**
2. **https://tinyurl.com/45me9mx6**
3. **https://tinyurl.com/yrmka7d9**
4. **https://youtu.be/OCnFnBtlg-c**
5. **https://tinyurl.com/3mthbnsp**
6. **https://tinyurl.com/52y5mmpw**
7. **https://tinyurl.com/58p5c888**

Pedagogy

Power Point Presentations, Group Discussions, Seminar, Quiz, Assignment.

Course Designer

Dr. S. Vidhya

Semester IV	Internal Marks: 25		External Marks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs /Week**	**CREDITS**
22PMA4CC12	**FUNCTIONAL ANALYSIS**	**CORE COURSE**	**6**	**5**

Course Objectives

- **Explore** Banach spaces, Hilbert spaces and their properties.
- **Compose** clear, accurate proof of Hahn Banach Theorem, Open Mapping Theorem usingcontinuous linear transformation and Conjugate of an operator.
- **Analyze** the structure of Commutative Banach Algebras to prove the Gelfand Neumarktheorem.

Prerequisite

Topology and Linear algebra at PG level.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Explain Banach spaces, Hilbert spaces, Banach algebras, commutative banach algebra and interpret their properties with other type of spaces.	K2
CO2	Apply the analytical techniques and theoretical knowledge in Banach spaces, Hilbert spaces, Banach algebras, commutative banach algebras.	K3
CO3	Construct banach algebras, Commutative banach algebra through banach spaces and determine orthonormal sets in Hilbert spaces.	K4
CO4	Analyze the properties of the operators defined on these spaces.	K4
CO5	Attain knowledge and experience of working with many pure mathematical problems.	K5

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3
CO3	2	3	2	2	2	3	2	2	2	3
CO4	2	2	2	2	2	3	2	2	2	3
CO5	3	3	3	3	3	3	3	3	3	3

"1" – Slight (Low) Correlation ¬ "2" – Moderate (Medium) Correlation ¬

"3" – Substantial (High) Correlation ¬ "-" indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
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	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5
II	**HILBERT SPACES** The definition and some simple properties – Orthogonal complements – Orthonormal sets – The conjugate space H*.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5
III	**HILBERT SPACES** The adjoint of an operator – Self-adjoint operators – Normal and unitary operators – Projections.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5
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	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5
V	**THE STRUCTURE OF COMMUTATIVE BANACH ALGEBRAS** The Gelfand mapping – Applications of the formula $r(x) = \lim \|x^n\|^{\frac{1}{n}}$ – Involutions in Banach Algebras – The Gelfand-Neumark theorem.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5
VI	**Self Study for Enrichment: (Not included for End Semester Examinations)** Euclidean and unitary spaces – Weak topologies– Linear spaces – Determinants and the spectrum of an operator – Commutative C*-algebras.	-	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5

Text Book

George F. Simmons (2016). *Introduction to Topology and Modern Analysis(26th reprint)*. Mcgraw Hill Education (India) Private Limited, New Delhi.

Chapters and Sections

UNIT-I	Chapter 9	Sections 46 – 51
UNIT-II	Chapter 10	Sections 52 – 55
UNIT-III	Chapter 10	Sections 56 – 59
UNIT- IV	Chapter 12	Sections 64 – 69
UNIT- V	Chapter 13	Sections 70 – 73

Reference Books

1. Walter Rudin (2008). *Functional Analysis (Fourth Reprint*). Tata Mcgraw-Hill Publishing Company Limited, New Delhi.
2. B.V. Limaye (2002). *Functional Analysis (Second Edition)*. New Age International (P) Limited Publishers, New Delhi.
3. K.Yosida (2005). *Functional Analysis (Second Indian Reprint)*. Springer-Verlag, Newyork.

Web References

1. **https://youtu.be/imYQJOgUx7Y**
2. **https://youtu.be/EGii1lz7XHA**
3. **https://youtu.be/MfZz1k9rlUc**
4. **https://youtu.be/0LnL9kE-6us**
5. **https://youtu.be/zQPEABKzBpc**
6. **https://youtu.be/kiUTXw3_jds**
7. **https://59clc.files.wordpress.com/2012/08/functional-analysis-_-rudin-2th.pdf**
8. **https://people.math.ethz.ch/~salamon/PREPRINTS/funcana.pdf**
9. **https://zlib.pub/book/introduction-to-topology-and-modern-analysis-7jh9srua6920**

Pedagogy

Power Point Presentations, Group Discussions, Seminar, Quiz, Assignment.

Course Designer

Dr. C.Saranya

Semester IV	Internal Marks: 25		ExternalMarks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs / Week**	**CREDITS**
22PMA4CCC3A	**DIFFERENTIAL GEOMETRY**	**CORE CHOICE COURSE**	**6**	**4**

Course Objectives

- **Introduce** space curves and its characterizations.
- **Study** properties of curves on surfaces.
- **Understand** the concepts of Geodesics and canonical Geodesics equations.

Prerequisite

Knowledge of basic concepts of Vectors and Differentiation.

Course Outcomes

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Understand the concepts of a space curve, Geodesics, developables, helihoids and umbilics.	K2
CO2	Compute its curvature and torsion, surface of revolution, Existence theorems and lines of curvature.	K2
CO3	Acquire the knowledge of curves on a surface, Geodesic curvature and lines of curvature	K3
CO4	Determine the second fundamental form and developable associated with curves on surfaces, Hilbert's Lemma and classify differential geometry of several surfaces.	K3
CO5	Interpret the concepts of geodesics and its normal properties, differential geometry of surfaces and also familiar with Gauss Bonnet Theorem.	K4

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	2	3	1	3	3	1	2
CO2	3	3	2	1	3	1	3	3	2	2
CO3	3	3	2	2	3	1	3	3	2	2
CO4	3	3	2	2	3	1	3	3	2	2
CO5	3	3	2	2	3	1	3	3	2	2

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation

"3" – Substantial (High) Correlation "-" indicates there is no Correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**The Theory of Space Curves** Definitions – Arc length – Tangent, normal and binormal – Curvature and torsion of a curve given as the intersection of two surfaces – Contact between curves and surfaces – Tangent surface, involutes and evolutes – Helices.	18	CO1, CO2, CO3, CO4, CO5	K1 K2, K3, K4
II	**The Metric** Definition of a surface – Curves on a surface – Surfaces of revolution – Helicoids – Metric – Direction coefficients – Families of curves – Isometric correspondence.	18	CO1, CO2, CO3, CO4, CO5	K1 K2, K3, K4
III	**Geodesics** Geodesics – Canonical geodesic equations – Normal property of geodesics – Existence theorems – Geodesic parallels – Geodesic curvature – Gauss-Bonnet Theorem	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
IV	**The Second Fundamental Form: Local Non-Intrinsic Properties of a Surface** The Second fundamental form – Principal curvatures – Lines of curvature – Developables – Developables associated with space curves.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
V	**Differential Geometry of surfaces in the large** Compact surfaces whose points are umbilics – Hilbert's Lemma – Compact surfaces of constant Gaussian or mean curvature – Complete surfaces.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
VI	**Self-Study for Enrichment: (Not included for End Semester Examinations)** Intrinsic equations, fundamental existence theorem for space curves – Intrinsic properties - Gaussian curvature – Surfaces of constant curvature - Developables associated with curves on surfaces- Characterization of complete surfaces.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4

Text Books

T.J. Willmore (2017), *An Introduction to Differential Geometry (*21st Impression), Oxford University Press, New Delhi.

Chapters and Sections

UNIT-I	Chapter I:	Sections: 2 - 7 & 9
UNIT-II	Chapter II:	Sections: 1 - 8
UNIT-III	Chapter II:	Sections: 10 - 16
UNIT- IV	Chapter III:	Sections: 1 - 5
UNIT- V	Chapter IV:	Sections: 2 - 5

Reference Books

1. D. Somasundaram (2010*), Differential Geometry*, A First Course (Third Reprint), Narosa Publishing House, New Delhi.
2. Christian Bar (2011), *Elementary Differential Geometry* (First South Asian Edition), Cambridge University Press, New York.
3. J.A. Thorpe (2004), *Elementary Topics in Differential Geometry* (First Indian Reprint), , Springer-Verlag, New York.

Web References

9. https://www.youtube.com/watch?v=4fB0VfKZRXM
10. https://youtu.be/1HUpNAS81PY?list=PLIljB45xT85DWUiFYYGqJVtfnkUFWkKtP
11. https://youtu.be/J-RgiQca6Q8?list=PLIljB45xT85DWUiFYYGqJVtfnkUFWkKtP
12. https://youtu.be/drOldszOT7I?list=PLIljB45xT85DWUiFYYGqJVtfnkUFWkKtP
13. https://youtu.be/QXrqsz5zD2I
14. https://youtu.be/zADj0k0waFY
15. https://people.math.ethz.ch/~salamon/PREPRINTS/diffgeo.pdf

Pedagogy

Power Point Presentations, Group Discussions, Seminar, Quiz and Assignment.

Course Designer

Ms. A. Gowri Shankari

Semester IV	Internal Marks: 25		External Marks: 75	
COURSECODE	**COURSE TITLE**	**CATEGORY**	**HOURS / WEEK**	**CREDITS**
22PMA4CCC3B	**FORMAL LANGUAGE AND AUTOMATA THEORY**	**CORE CHOICE COURSE – III**	**6**	**4**

Course Objectives

- **Explore** the nuances of Automata and Grammar.
- **Analyze** the applications of these techniques in Computer science.
- **Apply** the ideas for constructing the Regular Expressions.

Prerequisite

Familiarity in concepts of Discrete Mathematics.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Explain the basic concepts of automata, regular expressions, regular sets, grammars and compilers.	**K2**
CO2	Interpret the fundamental ideas in formal languages, automata, compilers and regular sets.	**K2**
CO3	Relate the concepts of deterministic and nondeterministic Finite Automata, grammars, regular expressions with pushdown automata, compilers and regular sets.	**K3**
CO4	Determine the implementation of automata languages, regular expressions, regular sets in compilers.	**K4**
CO5	Deduce mathematical notions in computability of regular expressions, automata, grammars, and regular sets and compilers.	**K5**

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	2	3	3
CO5	3	3	3	3	3	3	3	3	3	3

"1" – Slight (Low) Correlation ¬ "2" – Moderate (Medium) Correlation¬

"3" – Substantial (High) Correlation ¬ "-" indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**FINITE AUTOMATA:** Finite state systems – Basic definitions – Nondeterministic finite automata – Finite automata with ε – moves.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5
II	**REGULAR EXPRESSIONS AND CONTEXT-FREE GRAMMARS:** Regular expressions - Motivation and introduction – Context-free grammars – Derivation trees – Chomsky normal form – Greibach normal form.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5
III	**PROPERTIES OF REGULAR SETS:** The pumping lemma for regular sets - Closure properties of regular sets - Decision algorithms for regular sets - The Myhill-Nerode theorem and minimization of finite automata.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5
IV	**PUSHDOWN AUTOMATA:** Informal description - Definitions - Pushdown automata and context-free languages.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5
V	**INTRODUCTION TO COMPILERS:** Compilers and translators – Why we need transtators? - The structure of compiler - Lexical analysis - Syntax analysis - Intermediate code generation – Optimization - Code generation - Book keeping - Error handling - Compiler writing tools - Getting Started.	18	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5
VI	**Self Study for Enrichment:** **(Not included for End Semester Examinations)** Strings, alphabets and languages - Graphs and trees - Applications of finite automata –From regular expression to finite automata - Minimizing the number of states of a DFA.	-	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5

Text Books

1. John E. Hopcroft and Jeffery D. Ullman (1979), *Introduction to Automata theory, Languages and Computation*, Narosa Publishing House Pvt. Ltd
2. Alfred V. Aho and Jeffrey D. Ullman, (2002), *Principles of Compiler Design (Twentyfifth Reprint)*, Narosa Publishing House.

Chapters and Sections

UNIT-I Chapter 2[1]: Sections 2.1 - 2.4

UNIT-II Chapter 2[1]: Sections 2.5

Chapter 4[1]: Sections 4.1 - 4.3, 4.5, 4.6

UNIT-III Chapter 3[1]: Sections 3.1 – 3.4

UNIT-IV Chapter 5[1]: Sections 5.1 – 5.3

UNIT-V Chapter 1[2]: Sections 1.1 – 1.12

Reference Books

1. Iyengar N Ch S. N., Chandrasekaran V.M, Venkatesh K. A, Arunachalam P.S.(2005), *Discrete Mathematics(Third Reprint)*, Vikas Publishing House Pvt Ltd.
2. Dhamdhere (2008),*Compiler Construction*,(*Reprint five time)*, Macmillan India Ltd.
3. Alfred V. Aho Ravi Sethi Jeffrey D. Ullman (2007), *Compilers Principles, Techniques, and Tools*, Pearson Education.

Web References

1. https://www.vssut.ac.in/lecture_notes/lecture1423726104.pdf
2. https://www.iitg.ac.in/dgoswami/Flat-Notes.pdf
3. https://www.youtube.com/watch?v=ntrF_KxHn18&pp=ygUacHVzaGRvd24gYXV0b21hdGEgZXhhbXBsZXM%3D
4. https://www.youtube.com/watch?v=4nx8LEGy9kI&pp=ygUlbGV4aWNhbCBhbmFseXNpcyBkZWZpbml0aW9uICBleGFtcGxlcw%3D%3D
5. https://www.youtube.com/watch?v=H0Mf4FE2wiU&pp=ygUoUmVndWxhciBFeHByZXNzaW9ucyBkZWZpbml0aW9uICBleGFtcGxlcw%3D%3D

Pedagogy

Power point presentations, Group Discussions, Seminar, Quiz, Assignment.

Course Designer

Dr. S. Saridha

Semester IV	Internal Marks: 25		External Marks: 75	
COURSECODE	**COURSE TITLE**	**CATEGORY**	**HOURS / WEEK**	**CREDITS**
22PMA4CCC3C	**FLUID DYNAMICS**	**CORE CHOICE COURSE**	**6**	**4**

Course Objectives

- **Understand** the dynamics of real fluids.
- **Familiarize** with the properties of fluids and the applications of fluid dynamics.
- **Apply** the concept of fluid measurement, types of flows and dimensional analysis.

Prerequisite

Basic concepts in Dynamics.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Understand the measuring techniques of temperature, heat flux, pressure, velocity, force.and flow rate.	**K2**
CO2	Apply governing equations for particular flow fields with applications and analyse potential flows and execute concept of conformal transformation for flow over bodies.	**K3**
CO3	Compute the Navier - Stokes equations of Motion of a Viscous Fluid and analyse the Kinematics of fluids, two dimensional and three-dimensional flows through various techniques	**K3**
CO4	Examine viscous flows through various systems and apply various intrusive and non-intrusive techniques to measure flow and fluid properties.	**K4**
CO5	Evaluate the knowledge of experimental fluid dynamics and analyze of fluid motion.	**K5**

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	2	3	3	3	2	2	3
CO2	3	3	2	1	3	3	3	2	3	2
CO3	3	3	2	2	3	2	3	2	3	2
CO4	3	3	2	2	3	2	2	3	3	3
CO5	3	3	2	2	3	3	3	3	3	2

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation

"3" – Substantial (High) Correlation "-" indicates there is no Correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Kinematics of Fluids in Motion:** Real Fluids and Ideal Fluids – Velocity of a Fluid at a point – Streamlines and Path lines; Steady and Unsteady Flows – The Velocity potential – The Vorticity vector – Local and Particle Rates of Change – The Equation of continuity – Worked examples – Acceleration of a Fluid – Conditions at a rigid boundary **Equations of Motion of a Fluid:** Pressure at a point in a Fluid at Rest – Pressure at a point in a Moving Fluid – Conditions at a Boundary of Two Inviscid Immiscible Fluids – Euler's equations of motion – Bernoulli's equation – Worked examples.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
II	**Equations of Motion of a Fluid:** Discussion of the case of steady motion under conservative body forces – Some potential theorems – Some Flows Involving Axial Symmetry – Some special two-Dimensional Flows – Impulsive Motion **Some Three-Dimensional Flows:** Sources, Sinks and Doublets – Images in a Rigid Infinite Plane – Images in solid spheres – Axi-Symmetric Flows; Stokes's stream function.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	**Some Two-Dimensional Flows:** Meaning of a Two-Dimensional Flow – Use of cylindrical Polar coordinates – The stream function – The Complex Potential for Two-Dimensional, Irrotational, Incompressible Flow – Complex velocity potentials for Standard Two-Dimensional Flows – Some worked examples – Two-Dimensional Image systems – The Milne-Thomson circle theorem – The Theorem of Blasius.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	**Some Two-Dimensional Flows:** The use of conformal Transformation – The Schwarz-Christoffel Transformation	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

	Viscous Flow: Stress components in a Real fluid – Relations between Cartesian components of stress – Translational Motion of Fluid Element – The Rate of Strain Quadric and Principal Stresses – Some Further properties of the Rate of Strain Quadric – Stress Analysis in Fluid Motion – Relations Between stress and rate of strain – The coefficient of viscosity and Laminar Flow			
V	**Viscous Flow:** Some solvable problems in Viscous Flow – Steady Viscous Flow in Tubes of Uniform cross section – Diffusion of Vorticity – Energy Dissipation due to Viscosity – Steady Flow past a Fixed Sphere Dimensional Analysis; Reynolds Number.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
VI	**Self-Study for Enrichment: (Not included for End Semester Examinations)** General analysis of fluid motion –Some Further Aspects of Vortex Motion - Some Special Forms of the Stream Function for Axi-Symmetric Irrotational Motions – Vortex Rows - – The Navier-Stokes equations of Motion of a Viscous Fluid - Prandtl's Boundary Layer.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

Text Book

F. Chorlton (2004), *Text Book of Fluid Dynamics*, CBS Publishers & Distributors Pvt. Ltd., New Delhi.

Chapters and Sections

UNIT-I	Chapter 2:	Sections 2.1 - 2.10
	Chapter 3:	Sections 3.1 - 3.6
UNIT-II	Chapter 3:	Sections 3.7 - 3.11
	Chapter 4:	Sections 4.2 - 4.5 (omit 4.5.1)
UNIT-III	Chapter 5:	Sections 5.1 – 5.9
UNIT-IV	Chapter 5:	Sections 5.10 – 5.11
	Chapter 8:	` Sections 8.1 – 8.8
UNIT-V	Chapter 8:	Sections 8.10 – 8.15

Reference Books

[1] Dr. M.D. Raisinghania (2013), *Fluid Dynamics with Complete Hydrodynamics and Boundary Layer Theory*, S. Chand & Company Pvt. Ltd. (Online PDF)

[2] Hyoung Woo Oh (2012), *Advanced Fluid Dynamics.* (Online PDF)

[3] J.H. Ferziger & M. Peric (2005), *Computational methods for fluid Dynamics* (Third Edition), Springer – Verlag.

Web References

1. **https://www.youtube.com/watch?v=zzdWqBnwkys**
2. **https://tinyurl.com/yunrr3eb**
3. **https://www.youtube.com/watch?v=I4NZANfyzMs&list=PL1UZBJqzzy--lKFA0xRcsgVsdqctF2r2p&index=2**
4. **https://tinyurl.com/bdf2bwv3**
5. **https://www.youtube.com/watch?v=wlPXZrP9vR8&list=PLCoE5wxWtHFYiVGswvsWRaHjv18vxZzE2**
6. **file:///C:/Users/user/Downloads/toaz.info-fluid-dynamics-by-chorlton-pr_5ce01488c289a4a10ce5d30a8198cc16.pdf**

Pedagogy

Power Point Presentations, Group Discussions, Seminar, Quiz, Assignment.

Course Designer

Dr. G. Janaki

Semester IV	Internal Marks: 25		External Marks:75	
COURSE CODE	COURSE TITLE	CATEGORY	Hrs /Week	CREDITS
22PMA4GEC2	OPTIMIZATION TECHNIQUES	GENERIC ELECTIVE	3	2

Course Objectives

- **Understand** the various features of Operations research.
- **Analyze** the optimum solutions using Operations research.
- **Explore** the concepts of Operations research in real life problems**.**

Prerequisite

Basic computational knowledge.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be ableto	Cognitive Level
CO1	Illustrate the various notions in the respective streams.	K2
CO2	Identify the different terminologies of Operations research	K3
CO3	Analyze the solutions of mathematical problem using specific techniques.	K4
CO4	Simplify the optimum solutions of a mathematical problem.	K5
CO5	Construct various mathematical problem of Sequencing.	K6

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	2	3	3	3	2	3
CO2	3	2	3	3	2	3	3	3	3	2
CO3	3	2	3	3	2	3	2	3	2	2
CO4	3	2	2	2	2	3	3	2	3	2
CO5	3	2	3	2	2	3	3	3	2	2

“1” – Slight (Low) Correlation ¬ “2” – Moderate (Medium) Correlation ¬

“3” – Substantial (High) Correlation ¬ “-” indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Linear Programming Problem – Mathematical Formulation** Introduction - Linear Programming Problem - Mathematical Formulation of the Problem - Illustration on Mathematical Formulation of LPPs. **Linear Programming Problem – Graphical Solution and Extension** Introduction - Graphical Solution Method - Some Exceptional Cases	9	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5, K6
II	**Linear Programming Problem – Graphical Solution and Extension** General Linear Programming Problem - Canonical and Standard Forms of LPP. **Linear Programming Problem – Simplex Method** Introduction - Fundamental Propertiesof Solutions - The computational Procedure.	9	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5, K6
III	**Transportation Problem:** The Transportation Table – Solution of a Transportation Problem - Finding an initial basic feasible solution - Transportation algorithm (MODI method) - Some exceptional Cases.	9	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5, K6
IV	**Assignment Problem:** Introduction - Solution methods of assignment problem – Special Cases in Assignment Problem.	9	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5, K6
V	**Sequencing Problem:** Introduction – Problem of Sequencing – Basic Terms Used in Sequencing – Processing *n* Jobs through Two Machines – Processing *n* Jobs through *k* Machines.	9	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5, K6
VI	**Self Study for Enrichment:** **(Not included for End Semester Examinations)** Some Exceptional Cases(Graphical Solution) - Use of Artificial Variables – Degeneracy in Transportation Problem – The Traveling Salesman Problem - Processing 2 Jobs through *k* Machines.	-	CO1, CO2, CO3, CO4, CO5	K2, K3, K4, K5, K6

Text Book

Kanti Swarup, P.K. Gupta, Manmohan. (2008). *Operations research*, Sultan Chand & sons

Chapters and Sections

UNIT-I	Chapter 2: Sections 2.1 – 2.4
	Chapter 3: Sections 3.1 - 3.3.
UNIT-II	Chapter 3: Sections 3.4 - 3.5.
	Chapter 4: Sections 4.1 – 4.3
UNIT- III	Chapter 10: Sections 10.5, 10.8, 10.9, 10.13, 10.15.
UNIT- IV	Chapter 11: Sections 11.1, 11.3, 11.4
UNIT- V	Chapter 12: Sections 12.1 – 12.5.

Reference Books

1. Hamdy A.Taha. (2017). *Operations Research An Introduction* Pearson India Education services PVT Ltd
2. Premkumar Gupta. (2004). *Operations Research*. S.Chand & Company Ltd, New Delhi..
3. Chandrasekhara Rao.K,Shanti Lata Mishra. (2008). *Real Operations Research*, Narosa Publishing House PVT Ltd, New Delhi

Web References

1. https://youtube.com/@introductiontooperationsre4975?si=s4hUaj5nLi331rrz
2. https://youtube.com/@iit?si=X62o-o3CvMdgXQpq
3. https://youtube.com/@introductiontooperationsre4975?si=s4hUaj5nLi331rrz
4. https://youtube.com/@iit?si=X62o-o3CvMdgXQpq
5. https://youtube.com/@kauserwise?si=tdP_lvoCD12LgHos

Pedagogy

Power Point Presentations, Group Discussions, Seminar, Quiz, Assignment.

Course Designer

Dr. E. Litta.