M.Sc. Mathematics Degree Program

ELIGIBILITY

Candidates for admission to the first year programme leading to the Degree of M.Sc.Mathematics will be required to possess a Pass in B.Sc Mathematics.

AIM

This Programme is a high quality degree program which ensures that students will be able to integrate theory and practice, recognize the importance of abstraction and appreciate the value of efficient design created to meet clearly developed requirements.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1	Run renowned Educational institutions to serve the society.
PEO2	Have the ability to pursue interdepartmental research in Universities in India and abroad.
PEO3	Have the caliber to work in foreign Universities.
PEO4	Shine in higher level of administration like IAS, IPS officers and officers in Nationalized Banks, LIC, and etc,.

PROGRAMME OUTCOMES (POs)

PO1	Graduates are prepared to be creators of new knowledge leading to innovation and entrepreneurship employable in various sectors such as private, government, and research organizations.
PO2	Graduates are trained to evolve new technologies in their own discipline.
PO3	Graduates are framed to design and conduct experiments /demos/create models to analyze and interpret data.
PO4	Graduates ought to have the ability of effectively communicating the findings of Biological sciences incorporating with existing knowledge.
PO5	Graduates are groomed to engage in lifelong learning process by exploring their knowledge independently.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO1	Analytic skills and Numerical Ability.
PSO2	Computational and Data Analysis skills.
PSO3	Aptitude skills that will help to take up research in pure and applied Mathematics.
PSO4	Reasoning skills required to learn advanced Mathematics.
PSO5	Probing attitude and a search for deeper knowledge in science.
PSO6	The relevance and applications of Mathematics in scientific phenomenon.
PSO7	Positive approach towards Higher Education in Mathematics.
PSO8	Employability Skills that will enable the students to explore career in Teaching and Research in Mathematics.

NATIONAL COLLEGE(AUTONOMOUS), TIRUCHIRAPPALLI-1

COURSE PATTERN FOR M.Sc. MATHEMATICS - 2022 ONWARDS

SL. NO.	SEM	CODE	COURSE	COURSE TITLE	Exam Hrs.	Hrs.	Credits	Internal Exam	External Exam	Total Marks
				I SEMESTER						
1	I	P22MS1	CORE I	LINEAR ALGEBRA	3	6	5	25	75	**100**
2	I	P22MS2	CORE II	REAL ANALYSIS	3	6	5	25	75	**100**
3	I	P22MS3	CORE III	ORDINARY DIFFERENTIAL EQUATIONS	3	6	5	25	75	**100**
4	I	P22MS4	CORE IV	NUMERICAL ANALYSIS	3	6	5	25	75	**100**
5	I	P22MS5E	CBE I	CLASSICAL DYNAMICS	3	6	3	25	75	**100**
				TOTAL		**30**	**23**	**125**	**375**	**500**
SL. NO.	**SEM**	**CODE**	**COURSE**	**COURSE TITLE**	**Exam Hrs.**	**Hrs.**	**Credits**	**Internal Exam**	**External Exam**	**Total Marks**
				II SEMESTER						
6	II	P22MS6	CORE V	ALGEBRA	3	6	5	25	75	**100**
7	II	P22MS7	CORE VI	ADVANCED REAL ANALYSIS	3	6	5	25	75	**100**
8	II	P22MS8	CORE VII	PARTIAL DIFFERENTIAL EQUATIONS	3	6	5	25	75	**100**
9	II	P22MS9	CORE VIII	INTEGRAL EQUATIONS AND CALCULUS OF VARIATIONS	3	6	5	25	75	**100**
10	II	P22MS10E	CBE II	PROBABILITY AND STATISTICS WITH QUEUEING THEORY	3	6	3	25	75	**100**
				TOTAL		**30**	**23**	**125**	**375**	**500**

SL. NO.	SEM	CODE	COURSE	COURSE TITLE	Exam Hrs.	Hrs.	Credits	Internal Exam	External Exam	Total Marks
III SEMESTER										
11	III	P22MS11	CORE IX	COMPLEX ANALYSIS	3	6	5	25	75	**100**
12	III	P22MS12	CORE X	MEASURE THEORY AND INTEGRATION	3	6	5	25	75	**100**
13	III	P22MS13	CORE XI	TOPOLOGY	3	6	5	25	75	**100**
14	III	P22MS14E	CBE III	STOCHASTIC PROCESSES	3	6	3	25	75	**100**
15	III	P22MS15E	CBE IV	APPLIED STATISTICS	3	6	3	25	75	**100**
				TOTAL		**30**	**21**	**125**	**375**	**500**
SL. NO.	**SEM**	**CODE**	**COURSE**	**COURSE TITLE**	**Exam Hrs.**	**Hrs.**	**Credits**	**Internal Exam**	**External Exam**	**Total Marks**
IV SEMESTER										
16	IV	P22MS16	CORE XIII	FUNCTIONAL ANALYSIS	3	6	5	25	75	**100**
17	IV	P22MS17	CORE XIV	OPTIMIZATION TECHNIQUES	3	6	5	25	75	**100**
18	IV	P22MS18	CORE XV	DIFFERENTIAL GEOMETRY	3	6	5	25	75	**100**
19	IV	P22MS19E	CBE V	MATHEMATICAL MODELLING	3	6	3	25	75	**100**
20	IV	P22MSP20	PROJECT	PROJECT WORK		6	5	75	25	**100**
				TOTAL		**30**	**23**	**175**	**325**	**500**
				GRAND TOTAL		**120**	**90**	**550**	**1450**	**2000**

CHOICE BASED ELECTIVES

1.Classical Dynamics

2. Probability and Statistics.

3.Stochastic Processes

4. Applied Statistics.

5. Mathematical Modelling.

6.Tensor Analysis and Spectral Theory of Relativity

7. Numerical Methods Using Mat lab.

8. Theory of Numbers.

9. Operator Theory.

10. Design and Analysis of algorithms.

11. Automata Theory.

12. Graph Theory.

13. Fuzzy Analysis.

CIA	
Scholastic	20
Non Scholastic	5
	25

The levels of CIA Assessment based on Revised Bloom's Taxonomy are: K1-Remember,K2-Understand,K3-Apply,K4-Analyse

EVALUATION PATTERN

SCHOLASTIC				NON-SCHOLASTIC	MARKS		
C1	C2	C3	C4	C4	CIA	ESE	Total
5	6	4	5	5	25	75	100

PG CIA Components

	No.s	MARKS
C1- TEST-I(CIA I)	1	5
C2- TEST -II (CIA II)	1	6
C3- ASSIGNEMNT	2	4
C4- SEMINAR	1	5
C5- ATTENDENCE		5

SEMESTER - I LINEAR ALGEBRA

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/ WEEK	CREDITS
	P22MS1	**LINEAR ALGEBRA**	**Lecture**	**6**	**5**

COURSE DESCRIPTION

Linear Algebra is ubiquitous in Mathematics and therefore a strong foundation has to be laid in studying the abstract algebraic concepts intertwining geometric ideas. This course aims to teach the fundamental notions of vector spaces viz linear dependence, basis and dimension and linear transformations on these spaces have to be studied thoroughly. The students have to learn how the subject encompasses the isomorphic theory of matrices and comprehend the key ideas involved in the study of the structure theory of linear maps.

COURSE OBJECTIVES

1. To give the students a thorough knowledge of the various aspects of Linear Transformations.
2. Understanding Relation between Matrices and Linear Transformation
3. Polynomials of Matrices
4. To train the students in problem-solving as a preparatory to NET/SET.
5. Advance concepts in Linear Algebra and to gain the knowledge of Matrix theory Techniques of diagonalization and triangulation

UNIT – I : LINEAR TRANSFORMATIONS (18 HRS)

Linear transformations – The algebra of linear transformations – Isomorphism – Representation of transformations by Matrices.

UNIT – II : LINEAR FUNCTIONALS (18 HRS)

Linear functionals – The Double Dual– The Transpose of a linear Transformation.

UNIT – III : ALGEBRA OF POLYNOMIALS (18 HRS)

Algebras - The algebra of polynomials – Lagrange Interpolation – Polynomial Ideals -The prime factorization of a polynomial.

UNIT – IV : ELEMENTARY CANONICAL FORM (18 HRS)

Introduction - Characteristic values – Annihilating polynomials - Invariant subspaces –Simultaneous triangulation and simultaneous Diagonalization.

UNIT – V : DIRECT SUMS (18 HRS)

Direct-sum Decompositions –Invariant Direct sums – The Primary Decomposition Theorem –Cyclic subspaces and annihilators – the Jordan form.

TEXT BOOK:

Kenneth Hoffman and Ray Kunze, Linear Algebra, Second Edition, Prentice-Hall of India Private Limited, New Delhi 2014.

Unit I : Chapter 3: 3.1 to 3.4
Unit II : Chapter 3: 3.5 to 3.7
Unit III : Chapter 4: 4.1 to 4.5
Unit IV : Chapter 6: 6.1 to 6.5
Unit V : Chapter 6: 6.6 to 6.8 & Chapter 7: 7.1 and 7.3

REFERENCES:

1. I.N.Herstein, Topics in Algebra, Wiley Eastern Limited, New Delhi.
2. N.Jacobson, Basic Algebra, Vols.I & II, Freeman, 1980 (also published by Hindustan Publishing Company)

DIGITAL OPEN EDUCATIONAL RESOURCES:

https://www.khanacademy.org/math/linear-algebra

http://linear.ups.edu/

COURSE OUTCOMES

Levels	C1	C2	C3	C4	Total scholastic marks	Non Scholastic Marks C6	CIA Total	% of Assessment
	T1 5 Mks	T2 6 Mks	Assignment 4 Mks	Seminar 5 Mks	20 Mks	5 Mks	25 Mks	
K1	2	2	-	1	5			20%
K2	1	2	1	1	5			20%
K3	1	1	2	2	6			24%
K4	1	1	1	1	4			16%
Non Scholastic	-	-	-	-	-	5	5	20%
Total	5	6	4	5	20	5	25	100%

NO	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
1	Understand the representation of linear transformation by a matrix	K1,K2	PSO1, PSO3
2	Acquire knowledge about linear functional and Transpose of a linear Transformation	K2, K3	PSO4
3	Learn about algebra of polynomials	K1,K2,K3	PSO4, PSO6
4	Evaluate the Characteristic values and polynomials and recognize the Invariant subspaces	K3,K4	PSO4, PSO5
5	Investigate Direct-sum Decompositions –Invariant Direct sums – The Primary Decomposition	K2,K3,K4	PSO4, PSO7

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	3	3	2	3	3	3
CO2	3	2	3	3	2	3	3	3
CO3	3	2	2	3	3	2	3	3
CO4	3	2	3	2	3	3	3	2
CO5	3	2	2	3	2	3	3	3

Mapping COs Consistency with POs

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	2
CO2	3	3	3	3	2
C03	3	3	3	3	3
C04	3	2	3	2	2
C05	2	2	2	3	3

Note:
Strongly Correlated-3
Moderately Correlated-2
Weakly Correlated-1

SEMESTER - I REAL ANALYSIS

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/ WEEK	CREDITS
	P22MS2	REAL ANALYSIS	Lecture	6	5

COURSE DESCRIPTION

This course aims to teach the basics of Real Analysis that traces on many branches of pure mathematics and applied mathematics. The aim of this courses to cover the fundamentals of mathematical analysis: convergence of sequences and series, continuity, differentiability, Riemann integral, sequences and series of functions, uniformity, and the interchange of limit operations. It shows the utility of abstract concepts and teaches an understanding and construction of proofs. The main goal of this course is to make the students to pursue advanced studies in mathematics and related fields to lay a solid foundation in mathematical analysis.

COURSE OBJECTIVES

1. To learn the basic quantitative concepts of real analysis and the complex number system.

2. To comprehend the qualitative aspects of real analysis in the setting of Metric spaces. The intrinsic geometric ideas in the basic notions of metric spaces viz., open sets, closed sets, limit points, cluster points, connectedness and compactness have to be brought out

3. To exhibit an elaborate analysis Sequences of real numbers, monotone sequences, convergence, subsequences, the Bolzanno-Weierstrass property and compactness.

4. To learn briefly about Limits; Continuous functions and their properties, intermediate and extreme value theorems, uniform continuity, monotone functions and inverses.

5. To give a detailed study of Differentiation the chain rule, Rolle's theorem and the Mean Value Theorem and L'Hospital's rule.

UNITS

UNIT-I The real and complex number systems (20 HRS)

The real and complex number systems: ordered sets – fields – the real field – the extended real number system - the complex field – Euclidean spaces.

UNIT-II Basic Topology (20 HRS)

Basic Topology: finite, countable and uncountable sets – metric spaces – compact sets –perfect sets – connected sets.

UNIT- III Numerical sequences and series (15 HRS)

Numerical sequences and series: convergent sequences – subsequences – Cauchy sequences – upper & lower limits – some special sequences – series – series of non-negative terms – the number – the root and ratio tests – power series.

UNIT-IV Continuity (20 HRS)

Continuity: limits of functions – continuous functions – continuity and compactness –continuity and connectedness – discontinuities.

UNIT-V Differentiation (15 HRS)

Differentiation: The derivative of a real function – mean value theorems – the continuity of derivatives – L' Hospital's rule – derivatives of higher order.

TEXT BOOK:

[1] Walter Rudin, Principles of Mathematical Analysis Third Edition, McGraw Hill,1976.

UNIT I : Chapter 1 – Sections 1.1 – 1.38

UNIT II : Chapter 2 – Sections 2.1 – 2.47

UNIT III : Chapter 3 – Sections 3.1 – 3.40

UNIT IV : Chapter 4 – Sections 4.1 – 4.27

UNIT V : Chapter 5 – Sections 5.1 – 5.15

REFERENCES:

Simmons G.F, Topology and Modern Analysis, McGraw Hill Co. 1998.

Apostol, Analysis Vol. II, Mac Millan 1976.

A.T. White, Real Analysis : An Introduction, Addison Wesley Publishing Co.,Inc.1968.

DIGITAL OPEN EDUCATIONAL RESOURCES:

https://web.math.ucsb.edu/~agboola/teaching/2021/winter/122A/rudin.pdf

Levels	C1	C2	C3	C4	Total scholastic marks	Non Scholastic Marks C5	CIA Total	% of Assessment
	T1 5 Mks	T2 6 Mks	Assignment 4 Mks	Seminar 5 Mks	20 Mks	5 Mks	25 Mks	
K1	2	2	-	1	5	-	5	20%
K2	1	2	1	1	5	-	5	20%
K3	1	1	2	2	6	-	6	24%
K4	1	1	1	1	4	-	4	16%
Non Scholastic	-	-	-	-	-	5	5	20%
Total	5	6	4	5	20	5	25	100%

COURSE OUTCOMES

NO	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
1	Gain knowledge about Construction of Real Numbers	**K1,K2**	**PSO1,PSO7**
2	Analyse the Fundamentals of Pure Mathematics.	**K1,K2,K3**	**PSO3**
3	Inherit the knowledge of Set Theoretic approach.	**K1,K2,K4**	**PSO4**
4	Evaluate theTechniques in sequences	**K1,K2,K4**	**PSO6**
5	Sufficient conditions for convergence of series.	**K3,K4**	**PSO8 ,PSO6**
6	Basic Knowledge of Topology	**K1**	**PSO6**
7	Understand the Properties of Real valued continuous functions	**K2,K3**	**PSO8**

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	**3**	**2**	**3**	**2**	**2**	**3**	**3**	**2**
CO2	**3**	**2**	**3**	**2**	**2**	**3**	**3**	**3**
CO3	**3**	**2**	**3**	**2**	**2**	**3**	**3**	**2**
CO4	**3**	**2**	**3**	**2**	**2**	**3**	**3**	**2**
CO5	**3**	**2**	**3**	**3**	**2**	**3**	**3**	**3**
CO6	**3**	**2**	**3**	**3**	**2**	**3**	**3**	**3**
CO7	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**2**

Mapping COs Consistency with POs

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	3
CO2	3	2	3	2	3
C03	3	2	3	3	2
C04	3	2	3	3	3
C05	3	3	3	3	3
CO6	3	3	3	2	3
CO7	3	3	3	3	3

Note:

- **Strongly Correlated-3**
- **Moderately Correlated-2**
- **Weakly Correlated-1**

SEMESTER - I ORDINARY DIFFERENTIAL EQUATIONS

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/ WEEK	CREDITS
	P22MS3	ORDINARY DIFFERENTIAL EQUATIONS	Lecture	6	5

COURSE DESCRIPTION

This course is intended for postgraduate students to provide with the theoretical aspects of ordinary differential equations. Special equations like Legendre and Bessel were dealt with and many of its properties. Applications in oscillation theory and boundary value problems were also dealt with. . Ordinary differential equations arise as a natural mathematical model of many physical situations and hence the concepts involved in solving them are rudiments and vital for the course. The main objective is to give elementary, thorough, systematic approach for the subject.

COURSE OBJECTIVES

1. To understand the system of general solutions of homogeneous equations.
2. The existence and uniqueness of solutions for first order differential equations are studied in detail. Qualitative properties of solutions are carried out elaborately.
3. To study the concepts on Gauss's hyper geometric equation, Legendre Polynomials , Bessel functions.
4. To study the boundary value problems, strum comparison theorem
5. To study the Non linear equations and Autonomous Systems

UNITS

UNIT – I (18 Hrs)

The general solution of the homogeneous equation – The use of one known solution to find another – The method of variation of parameters power Series solutions. A review of Power series – Series solutions of first order equations second order linear equations: Ordinary points.

UNIT – II (18 Hrs)

Regular Singular points- Gauss's hyper geometric equation – The point at infinity-Legendre Polynomials – Bessel functions – Properties of Legendre Polynomials and Bessel functions.

UNIT – III (18 Hrs)

Linear Systems of First Order Equations – Homogeneous Equations with Constant Coefficients – The Existence and Uniqueness of Solutions of Initial value problem for First Order Ordinary Differential Equations – The Method of Solutions of Successive Approximations and Picard's Theorem.

UNIT – IV (18 Hrs)

Oscillation Theory and Boundary value problems – Qualitative Properties of Solutions – Sturm comparison Theorems – Eigen values, Eigen functions and the vibrating string.

UNIT – V **(18 Hrs)**

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.

Text Book (s)

G.F.Simmons, Differential Equations with Applications and Historical Notes, TMH ,New Delhi, 1994.

Unit I : Chapter 3: Sections 15, 16,19 and Chapter 5: Sections 25 to 27.
Unit II : Chapter 5: Sections 28 to 31 and Chapter 6: Sections 32 to 35
Unit III : Chapter 7: Sections 37,38 and Chapter 11: Sections 55,56
Unit IV : Chapter 4: Sections 22 to 24
Unit V : Chapter 8: Sections 42 to 44.

Reference(s)

1. W.T.Rcid, Ordinary Differential Equations, John Wilcy& Sons, New York, 1971.
2. E.A.Coddington and N.Levinson, Theory of Ordinary Differential Equations, McGrawHill Publishing Company, New York, 1955.

E – links:

1. https://users.math.msu.edu/users/gnagy/teaching/ode.pdf
2. https://www.math.uni-bielefeld.de/~grigor/odelec2008.pdf

DIGITAL OPEN EDUCATIONAL RESOURCES:

Levels	C1	C2	C3	C4	C5	Total scholastic marks	Non Scholastic Marks C6	CIA Total	% of Assessment
	T1 5 Mks	T2 6 Mks	Assignment 4 Mks	Seminar 5 Mks	Atttendence 5 MkS	20 Mks	5 Mks	25 Mks	
K1	1	1	1	1	-	4		4	16%
K2	1	1	1	1	-	4		4	16%
K3	1	2	1	1	-	5		5	20%
K4	2	2	1	2	-	7		7	28%
Non Scholastic	-	-	-	-	5		5	5	20%
Total	4	6	4	5	5	20	5	25	100%

COURSE OUTCOMES

On the successful completion of the course, students will be able to

No.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	To understand the method of solving Bessel's and Legendre differential equations.	K 2	PSO2
CO 2	To examinethe stability of a solution of ODE.	K 4	PSO4
CO 3	To know about the oscillation theory and Boundary value problems.	K 1	PSO1
CO 4	To use Problem solving techniques in Differential equations	K 3	PSO5
CO 5	Apply power series in solving differential equations	K 4	PSO5 & PSO8

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	2	3	2
CO2	2	2	3	2	3
CO3	3	2	2	2	3
CO4	2	2	3	2	2
CO5	3	2	2	3	2

Mapping COs Consistency with POs

CO/PO	PO1	PO2	PO3	PO4
CO1	2	2	3	3
CO2	3	2	2	2
C03	3	2	2	3
C04	3	3	2	3
C05	2	3	2	2

Note:
Strongly Correlated-3
Moderately Correlated-2
Weakly Correlated-1

SEMESTER - I NUMERICAL ANALYSIS

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	Hrs/ WEEK	CREDITS
	P22MS4	NUMERICAL ANALYSIS	LECTURE	6	5

COURSE DESCRIPTION

To understand and analyse about the system of linear algebraic & Ordinary differential equations. Interpolation and approximation formulae and also to find differentiation & integration using numerical methods.

COURSE OBJECTIVES

1. To introduce the field of numerical analysis as the design and analysis of techniques to give approximate solutions to difficult problems.
2. To understand the numerical problems differentiation and integration.
3. Various numerical methods are used to solve algebraic equations and differential equations.
4. To acquire a knowledge of Transcendental and polynomial equations .
5. To attain a knowledge of solving numerical problems for various real life situations.

UNITS

UNIT-I (Transcendental and polynomial equations**) (18 Hrs)**

Muller method , Chebyshev method –Multipoint iteration method - Rate of convergence - Iteration methods. Polynomial equations: Birge-Vieta method, Bairstow's method, Graeffe's root squaring method only.

UNIT-II (System of Linear Algebraic equations and Eigen Value Problems**) (18 Hrs)**

Decomposition method, Partition method - Error Analysis of direct and iteration methods – Finding eigen values and eigen vectors – Jacobi and Power methods

UNIT- III (Interpolation and Approximation**) (18 Hrs)**

Hermite Interpolations – Piecewise and Spline Interpolation – Bivariate Interpolation- Approximation – Least square approximation.

UNIT-IV (Differentiation and Integration**) (18 Hrs)**

Numerical Differentiation - Optimum choice of Step length – Extrapolation methods – Partial Differentiation – Methods based on undetermined coefficients – GaussLegendre integration method and Lobatto, Radau,Gauss – Chebyshev integration methods only – Double integration.

UNIT-V (Ordinary differential equations**) (18 Hrs)**

Introduction, Euler, Backward Euler, Mid-point, Taylor series method – Runge - Kutta methods

TEXT BOOK:

M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, III Edition, New Age International (P) Ltd Publishers,1993

Unit I: Chapter 2 – 2.4(P 32- 34), 2.5, 2.6, 2.8
Unit II: Chapter 3 – 3.2(P 90-93, 95-99), 3.3, 3.4, 3.5
Unit III: Chapter 4 – 4.5 to 4.7, 4.9(upto P 199)
Unit IV: Chapter 5 – 5.2 to 5.5, 5.8(upto P 262) and 5.11
Unit V: Chapter 6 – 6.1,6.2, 6.3, 6.6

REFERENCES:

1. C.F.Gerald and P.O.Wheatley , Applied Numerical Analysis, Fifth Edition, Addison Wesley, (1998).
2. Samuel D.Conte, Carl. De Boor, Elementary Numerical Analysis, Mc Graw Hill International Edition 1983.
3. M.KJain, Numerical Solutions of Differential Equations, Second Edition, New Age International (P) Ltd., 1983.

DIGITAL OPEN EDUCATIONAL RESOURCES:

https://nptel.ac.in/courses/111106101

https://academic.oup.com/imajna

Levels	C1	C2	C3	C4	Total scholastic marks	Non Scholastic Marks C5	CIA Total	% of Assessment
	T1 5 Mks	T2 6 Mks	Assignment 4 Mks	Seminar 5 Mks	20 Mks	5 Mks	25 Mks	
K1	2	2	1	1	6	-	6	24%
K2	1	2	1	1	5	-	5	20%
K3	1	1	1	2	5	-	5	20%
K4	1	1	1	1	4	-	4	16%
Non Scholastic	-	-	-	-	-	5	5	20%
Total	5	6	4	5	20	5	25	100%

COURSE OUTCOMES

NO	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	To attain a knowledge of solving numerical problems for various real life situations.	K3 & K4	PSO 1 & PSO 2
CO 2	To learn about Interpolation and approximation problems.	K2	PSO 2
CO 3	To understand the numerical problems differentiation and integration.	K1 & K2	PSO 1 & PSO 5
CO 4	To acquire a knowledge of Transcendental and polynomial equations .	K2 & K3	PSO 4
CO 5	To solve the system of algebraic equations and eigen value problems.	K2 & K3	PSO 3& PSO 2

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	2
CO2	2	3	2	2	2
CO3	3	2	2	2	3
CO4	2	2	2	3	2
CO5	2	3	2	2	2

Mapping COs Consistency with POs

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	2	2	3	2	2
CO2	2	2	2	3	2
CO3	2	3	2	2	2
CO4	3	2	2	2	3
CO5	2	2	3	3	2

Note:
Strongly Correlated-3
Moderately Correlated-2
Weakly Correlated-1

SEMESTER - I CLASSICAL DYNAMICS

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/ WEEK	CREDITS
	P22MS5E	CLASSICAL DYNAMICS	Lecture	6	3

COURSE DESCRIPTION

This course is a presentation of Newtonian mechanics at the post graduate level. Topics include dynamics of particles and rigid bodies, rotating reference frames, conservation laws, gravitational fields and potentials, planetary motion, Lagrangian and Hamiltonian equations.

COURSE OBJECTIVES:

1. To give a detailed knowledge about the mechanical system of particles and virtual work.
2. To develop familiarity with the dynamical concepts of Lagrange.
3. To develop skills in formulating and solving physics problems using Lagrange's method.
4. To emphasize that the subject is a amalgamation of ideas from Hamilton's Principle.
5. To solve many problem using Hamilton Jacobi principal.

UNIT – I (INTRODUCTORY CONCEPTS) (18hrs)

Introductory concepts: The mechanical system – Generalized Coordinates –constraints – virtual work – Energy and momentum.

UNIT – II (LAGRANGE'S EQUATIONS) (18hrs)

Lagrange's equations: Derivation of Lagrange's equation and examples – Integrals of the Motion .

UNIT – III (SPECIAL APPLICATIONS OF LAGRANGE'S EQUATIONS) (18hrs)

Special Applications of Lagrange's Equations: Rayleigh's dissipation function –impulsive motion – Gyroscopic systems – velocity dependent potentials.

UNIT – IV(HAMILTON'S EQUATIONS) (18hrs)

Hamilton's equations: Hamilton's Principle – Hamilton's equations – Other variational principles – phase space.

UNIT – V(HAMILTON – JACOBI THEORY) (18hrs)

Hamilton – Jacobi Theory: Hamilton's Principal Function – The Hamilton – Jacobi equation – Separability.

Text Book (s)

Classical Dynamics, Donald T. Greenwood , Prentice Hall of India Pvt. Ltd., New Delhi-1985.

Unit I : Chapter 1: Sections 1.1 to 1.5
Unit II : Chapter 2: Sections 2.1 to 2.3
Unit III : Chapter 3: Sections 3.1 to 3.4
Unit IV : Chapter 4: Sections 4.1 to 4.4
Unit V : Chapter 5: Sections 5.1 to 5

Reference (s)

1. Herbert Goldstein, classical Mechanics, (2nd edition), Narosa Publishing House, New Delhi.

2. Narayan Chandra Rana & Prmod Sharad Chandra Joag, Classical Mechanics, Tata McGraw Hill, 1991.

DIGITAL OPEN EDUCATIONAL RESOURCES:

1. https://youtu.be/tVYocJlvhi4

2. https://youtu.be/noiMhovKXdM

Levels	C1	C2	C3	C4	C5	Total scholastic marks	Non Scholastic Marks C6	CIA Total	% of Assessment
	T1 5 Mks	T2 6 Mks	Assignment 4 Mks	Seminar 5 Mks	Atttendence 5 MkS	20 Mks	5 Mks	25 Mks	
K1	1	1	1	1	-	4	-	4	16%
K2	1	1	1	1	-	4	-	4	16%
K3	1	2	1	1	-	5	-	5	20%
K4	2	2	1	2	-	7	-	7	28%
Non Scholastic	-	-	-	-	5	-	5	5	20%
Total	5	6	4	5	5	20	5	25	100%

COURSE OUTCOMES

NO	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO1	To give a detailed knowledge about the mechanical system of particles.	K1&K2	PSO1, PSO2
CO2	To develop familiarity with the dynamical concepts of Lagrange.	K3	PSO4
CO3	To study the applications of Lagrange's equations	K4	PSO2
CO4	Hamilton's equations as well as Integrals of Motion.	K3&K4	PSO4
CO5	To understand the theory of Hamilton-Jacobi Theory and its application.	K3	PSO2

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	3	2	2	2	2	2	2
CO2	2	2	2	3	2	2	2	2
CO3	2	3	2	2	2	2	2	2
CO4	2	2	2	3	2	2	2	2
CO5	2	3	2	2	2	2	2	2

Mapping COs Consistency with POs

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	2	3
CO2	3	3	2	3	3
C03	2	3	3	3	3
C04	2	2	2	2	2
C05	3	2	2	2	3

Note:

- **Strongly Correlated-3**
- **Moderately Correlated-2**
- **Weakly Correlated-1**

SEMESTER - II ALGEBRA

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/ WEEK	CREDITS
	P22MS6	**ALGEBRA**	**Lecture**	**6**	**5**

COURSE DESCRIPTION

This course aims to teach the advanced algebraic concepts such as counting Principles, Direct Products, Sylow's theorems, ideals, Quotient rings, Euclidean rings , polynomial rings, dual Spaces , inner Product Space and Modules. It enables the students to use the mathematical knowledge in Roots of Polynomials, field extension and Galois theory.

COURSE OBJECTIVES

1. To utilize the class equation and Sylow's theorem to solve different relative problems.
2. To study in detail the advanced concepts of Rings such as Ring homomorphisms, polynomial rings and Euclidean rings.
3. To exhibit an elaborate analysis of Dual Spaces , inner Product Spaces and Modules **.**
4. To give a detailed study of Extension fields , Roots of Polynomials .
5. To demonstrate capacity of illustration for mathematical reasoning through analyzing and proving the concepts of field extension and Galois theory.

UNITS

UNIT I GROUP THEORY (18 HRS)

A Counting Principle – Permutation Groups – Another Counting Principle – Sylow's theorem - Direct Products.

UNIT II RING THEORY (18 HRS)

More Ideals and Quotient Rings – Euclidean Rings – Polynomial Rings – Polynomials over the Rational Field .

UNIT III VECTOR SPACES AND MODULES (18 HRS)

Dual Spaces - Inner Product Spaces – Modules.

UNIT IV FIELDS (18 HRS)

Extension fields – Roots of Polynomials – More about Roots.

UNIT V GALOIS THEORY (18 HRS)

The Elements of Galois Theory – Solvability by Radicals – Finite Fields.

TEXT BOOK:

I.N. Herstein, Topics in Algebra, Second Edition, Wiley Eastern Limited, New Delhi .

UNIT I : Chapter 2 – Sections 2.5, 2.10, 2.11, 2.12, and 2.13
UNIT II : Chapter 3 – Sections 3.5, 3.7, 3.9, 3.10
UNIT III : Chapter 4 – Sections 4.3, 4.4, 4.5
UNIT IV : Chapter 5 - Sections 5.1, 5.3, 5.5
UNIT V : Chapter 5 – Section 5.6, 5.7
Chapter 7 – Section 7.1

REFERENCE BOOK(S)

1. P.B. Bhattacharya. S.K. Jain and S.R. Nagpul, Second Edition, Cambridge University Press, 2005.
2. Vijay, K. Khanna, and S.K. Bhambri, A Course in Abstract Algebra, Vikas Publishing House Pvt Limited, 1993.
3. John, B. Fraleigh, A First Course in Abstract Algebra, Addison-Wesley Publishing company.

DIGITAL OPEN EDUCATIONAL RESOURCES:

https://marinazahara22.files.wordpress.com/2013/10/i-n-herstein-topics-in-algebra-2nd-edition-1975-wiley-international-editions-john-wiley-and-sons-wie-1975.pdf

http://www.unishivaji.ac.in/uploads/distedu/M.Sc.%20I%20MT%20101%20Algebra-1%20All%20PDF.PDF

Levels	C1	C2	C3	C4	Total scholastic marks	Non Scholastic Marks C5	CIA Total	% of Assessment
	T1 5 Mks	T2 6 Mks	Assignment 4 Mks	Seminar 5 Mks	20 Mks	5 Mks	25 Mks	
K1	2	2	-	1	5	-	5	20%
K2	1	2	1	1	5	-	5	20%
K3	1	1	2	2	6	-	6	24%
K4	1	1	1	1	4	-	4	16%
Non Scholastic	-	-	-	-	-	5	5	20%
Total	5	6	4	5	20	5	25	100%

COURSE OUTCOMES

NO	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
1	Understanding the concepts of permutation groups and Sylows theorem	K1,K2,K3	PSO1,PSO7
2	To study polynomial rings and Euclidean rings	K1,K2,K4	PSO4 ,PSO7
3	Analyzing dual space and modules	K2,K3	PSO3, PSO8
4	Exhibit the extension fields, root of the polynomials.	K1,K2	PSO4
5	illustration for Galois theory and finite fields	K3,K4	PSO6 ,PSO7,PSO8

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	3	2	2	3	3	2
CO2	3	3	3	2	3	3	3	3
CO3	3	2	3	2	3	3	3	2
CO4	3	2	3	2	2	3	3	2
CO5	3	3	3	3	2	3	3	3

Mapping COs Consistency with POs

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	2	3
CO2	3	2	3	3	3
C03	3	2	3	3	2
C04	3	2	3	2	2
C05	3	3	3	2	3

Note:
Strongly Correlated-3
Moderately Correlated-2
Weakly Correlated-1

SEMESTER - II ADVANCED REAL ANALYSIS

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/ WEEK	CREDITS
	P22MS7	**ADVANCED REAL ANALYSIS**	**Lecture**	**6**	**5**

COURSE DESCRIPTION

To enable the students to appreciate various aspects of Metric spaces and understand continuous functions, Riemann Stieltjes integral, sequences and series of functions in detail.

COURSE OBJECTIVES

1. To perceive the basic idea of Riemann Stieltjes Integral and its properties.
2. To study the concept of convergence of sequences and series of functions
3. To analyse the concept of some special functions.
4. To learn more about functions of several variables and linear transformation
5. To understand higher order derivatives ,derivatives of integrals and some theorems.

UNITS

UNIT-I THE RIEMANN – STIELTJES INTEGRAL (18 HRS)

Definition and Existence of the integral – Properties of the integral – Integration and Differentiation – Integration of Vector valued functions – rectifiable curves.

UNIT-II SEQUENCES AND SERIES OF FUNCTIONS (18 HRS)

Uniform convergence – Uniform convergence and continuity – Uniform convergence and integration – Uniform convergence and differentiation – Equicontinuous families of functions – The Stone - Weierstrass Theorem.

UNIT- III SOME SPECIAL FUNCTIONS (18 HRS)

Power series – The Exponential and Logarithmic Functions – The Trigonometric functions – The algebraic completeness of the complex field – Fourier series – The Gamma function.

UNIT-IV FUNCTIONS OF SEVERAL VARIABLES (18 HRS)

Linear Transformations – Differentiation – The Contraction Principle – The inverse function theorem.

UNIT-V FUNCTIONS OF SEVERAL VARIABLES CONTINUED (18 HRS)

The implicit function theorem – The rank Theorem – Determinants – Derivatives of Higher order – differentiation of integrals

TEXT BOOK:

Walter Rudin, Principles of Mathematical Analysis Third Edition, McGraw Hill, 1976
Unit I: Chapter 6 – Sections 6.1 – 6.27
Unit II: Chapter 7 – Sections 7.1– 7.33
Unit III: Chapter 8 – Sections 8.1– 8.22
Unit IV: Chapter 9 – Sections 9.1– 9.25
Unit V: Chapter 9 – Sections 9.26 – 9.43

REFERENCES:

[1] Simmons G.F, Topology and Modern Analysis, McGraw Hill Co. 1998.
[2] Apostol, Analysis Vol. II, Mac Millan 1976.
[3] A.T. White, Real Analysis: An Introduction, Addison Wesley Publishing Co., Inc.1968.

DIGITAL OPEN EDUCATIONAL RESOURCES:

http://www.classicalrealanalysis.info/com/Elementary-Real-Analysis.php
https://pdxscholar.library.pdx.edu/pdxopen/12/

Levels	C1	C2	C3	C4	Total scholastic marks	Non Scholastic Marks C5	CIA Total	% of Assessment
	T1 5 Mks	T2 6 Mks	Assignment 4 Mks	Seminar 5 Mks	20 Mks	5 Mks	25 Mks	
K1	1	2	1	2	6		6	24
K2	1	1	1	1	4		4	16
K3	2	2	1	1	6		6	24
K4	1	1	1	1	4		4	16
Non Scholastic						5	5	20
Total	5	6	4	5	20	5	25	100

COURSE OUTCOMES

NO	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
1	To perceive the basic idea of Riemann Stieltjes Integral and its properties.	K1	PSO1
2	To study the concept of convergence of sequences and series of functions	K1&K2	PSO2
3	To analyse the concept of some special functions.	K3	PSO3
4	To learn more about functions of several variables and linear transformation	K4	PSO4
5	To understand higher order derivatives ,derivatives of integrals and some theorems.	K3&K4	PSO5

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	2	3	2	3	2	2	2	2
CO2	2	2	3	3	2	2	2	2
CO3	3	2	3	2	3	3	3	3
CO4	2	2	2	2	3	3	3	3
CO5	2	3	2	3	2	2	2	2

Mapping COs Consistency with POs

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	2	2
CO2	2	3	2	3	3
C03	3	2	3	2	2
C04	2	3	3	2	3
C05	2	3	2	2	2

Note:
Strongly Correlated-3
Moderately Correlated-2
Weakly Correlated-1

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/ WEEK	CREDITS
	P22MS8	PARTIAL DIFFERENTIAL EQUATIONS	Lecture	6	5

COURSE DESCRIPTION

This course aims to teach the basics of Partial differential equations (PDEs), a subject that touches on many branches of pure mathematics, applied mathematics, as well applied science. Partial differential equations are a very rich subject at a research level and most workers in the field specialize in one of the many sub-fields. The aim of this course is both to give an overview of the subject as much as possible, and introduce some tools that are used throughout. Emphasis is placed on separation of variables, special functions, transform methods, and numerical techniques. This should prepare students adequately for the many more advanced courses in PDEs that are offered in the department.

COURSE OBJECTIVES

1. The main objective is to equip students to classify partial differential equations and solve linear Partial Differential equations using different methods.
2. To demonstrate the ability to solve initial boundary value problems express and explain the physical interpretations of common forms of P.D.Es.
3. To give a detailed study of Linear Equations and Non-Linear First order P.D.E.
4. To exhibit an elaborate analysis of Laplace's Equation and Boundary value Problems.
5. To understand how partial differential equations arise in the mathematical description of heat flow and vibration using Heat equation and Wave equation.
6. To be acquainted with applications of partial differential equations in various disciplines of study.

UNITS

UNIT-I First Order P.D.E (20 HRS)

First order P.D.E.- Curves and Surfaces – Genesis of First Order P.D.E. – Classification of Integrals – Linear Equations of the first order – Pfaffian Differential Equations – Compatible systems – Charpit's Method – Jacobi's Method.

UNIT-II Linear and Non-Linear P.D.E (15 HRS)

Integral Surfaces Through a given Curve – Quasi – Linear Equations – Non-Linear First order P.D.E.

UNIT- III Second Order P.D.E (20 HRS)

Second order P.D.E: Genesis of second order P.D.E. – Classification of Second order P.D.E. One – Dimensional Wave equation – Vibrations of an infinite string – Vibrations of Semi-infinite string – Vibrations of a String of Finite Length (Method of Separation of variables)

UNIT-IV Laplace's Equation (20 HRS)

Laplace's Equation: Boundary value Problems – Maximum and Minimum Principles –The Cauchy Problem – The Dirichlet problem for the Upper Half Plane – The Neumann Problem for the Upper Half Plane – The Dirichlet Interior Problem for a circle – The Dirichlet Exterior for a circle – The

Neumann Problem for a circle – The Dirichlet Problem for a Rectangle – Harnack's Theorem – Laplace's Equation – Green's Function.

UNIT-V Heat Conduction Problem **(15 HRS)**

Heat Conduction problem – Heat Conduction – Infinite Rod case - Heat Conduction Finite Rod case – Duhamel's Principle – Wave Equation – Heat Conduction Equation.

TEXT BOOK:

T. Amarnath, An Elementary course in Partial Differential Equations, Narosa Publishing house Pvt.Ltd. Second Edition Fourth Reprint 2009.

Unit I: Chapter 1: Sections 1.1 to 1.8
Unit II: Chapter 1: Sections 1.9 to 1.11.
Unit III: Chapter 2: Sections 2.1 to 2.3.5(omit section 2.3.4.)
Unit IV: Chapter 2: Sections 2.4 to 2.4.11
Unit V: Chapter 2: Sections 2.5 to 2.6.2.

REFERENCES:

1. I.C.Evans, Partial Differential Equations, Graduate Studies in Mathematics, Vol 19 AMS, 1998.
2. I.N.Snedden, Elements of Partial Differential Equations.
3. F.John , P.Prasad, , Partial Differential Equations.

DIGITAL OPEN EDUCATIONAL RESOURCES:

www.t.me/join_appliedmathematics.com

Levels	C1	C2	C3	C4	Total scholastic marks	Non Scholastic Marks C5	CIA Total	% of Assessment
	T1 5 Mks	T2 6 Mks	Assignment 4 Mks	Seminar 5 Mks	20 Mks	5 Mks	25 Mks	
K1	2	2	-	1	5	-	5	20%
K2	1	2	1	1	5	-	5	20%
K3	1	1	2	2	6	-	6	24%
K4	1	1	1	1	4	-	4	16%
Non Scholastic	-	-	-	-	-	5	5	20%
Total	5	6	4	5	20	5	25	100%

COURSE OUTCOMES

NO	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
1	Understanding the origin of partial differential equations	**K1,K2**	**PSO1,PSO7**
2	Understanding nonlinear partial differential equations	**K1,K2**	**PSO4**
3	Understanding the Integral surfaces passing through a given curve.	**K1,K2**	**PSO3**
4	Understanding different methods of solving the Problems.	**K1,K2**	**PSO4**
5	Applying higher order equations in physics	**K3**	**PSO8 ,PSO6**
6	Analyzing Linear Hyperbolic equations	**K4**	**PSO6**
7	Understanding Laplace equations and its applications.	**K3**	**PSO3, PSO8**

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	**3**	**1**	**3**	**2**	**1**	**3**	**3**	**2**
CO2	**3**	**1**	**3**	**2**	**1**	**3**	**3**	**3**
CO3	**3**	**1**	**3**	**2**	**1**	**3**	**3**	**2**
CO4	**3**	**1**	**3**	**2**	**1**	**3**	**3**	**1**
CO5	**3**	**1**	**3**	**3**	**2**	**3**	**3**	**3**
CO6	**3**	**1**	**3**	**3**	**2**	**3**	**3**	**3**

Mapping COs Consistency with POs

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	**3**	**2**	**3**	**1**	**3**
CO2	**3**	**2**	**3**	**1**	**3**
C03	**3**	**2**	**3**	**1**	**2**
C04	**3**	**2**	**3**	**1**	**1**
C05	**3**	**3**	**3**	**1**	**3**
CO6	**3**	**3**	**3**	**1**	**3**

Note:
Strongly Correlated-3
Moderately Correlated-2
Weakly Correlated-1

SEMESTER - II

INTEGRAL EQUATIONS AND CALCULUS OF VARIATIONS

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/ WEEK	CREDITS
	P22MS9	INTEGRAL EQUATIONS AND CALCULUS OF VARIATIONS	Lecture	6	5

COURSE DESCRIPTION

The course is aimed to lay a broad foundation for an understanding of the problems of calculus of variations and its many methods and techniques and to prepare students for the study of integral equations. To make the students familiar with methods of solving integral equations.

COURSE OBJECTIVES:

1. To obtain thorough analysis of various aspects of Fredholm's integral equations.
2. To acquire the knowledge of solving problems in the fields of Volterra Integral equations.
3. To make a decision to study Classical Fredholm Theory.
4. To have much better and deeper understanding of the fundamental concepts of Calculus of Variations.
5. To obtain thorough analysis of various aspects of Lagrange's multipliers

UNIT – I(LINEAR INTEGRAL EQUATIONS) (18hrs)

Definition- Regularity conditions – special kind of kernels – Eigen values and eigen functions – Convolution Integral – The inner and scalar product Of two functions.

Integral equations with seperable Kernels: Reduction to a system Examples – Fredholm alternative – examples – an approximate method.

UNIT – II(METHOD OF SUCCESSIVE APPROXIMATION) (18hrs)

Iterative scheme – examples- Volterra Integral equation – examples – some results about the resolvent kernel.

UNIT – III(CLASSICAL FREDHOLM THEORY) (18hrs)

The method of solution of Fredholm – Fredholm's first theorem –Examples- Fredholm's second theorem – Fredholm's third theorem(statement only).**Applications to ordinary Differential Equations:** Initial value problems-Boundary value problems-Examples. **singular integral equations:** Abel integral equation-Examples.

UNIT – IV(CALCULUS OF VARIATION) (18hrs)

Calculus of variation – Maxima and Minima – The simplest case – Natural boundary Conditions and transition conditions. The Variational notation.

UNIT – V(MORE GENERAL CASE) (18hrs)

The more general case with illustrative equations – Constraints and Lagrange's multipliers – Variables end points – Sturm – Liouville Problems.

Text Book(S)

1. **Ram.P.Kanwal-Linear Integral Equations Theory and Practise, Academic Press 1971.**
2. **F.B.Hildebrand, Mehtods of Applied Mathematics II ed. PHI, ND 1972.**

Unit – I – Chapter 1: section 1.1 to 1.6. [1], Chapter 2: section 2.1 to 2.5.[1]
Unit – II – Chapter 3: section 3.1 to 3.5. [1]
Unit – III – Chapter 4: section 4.1 to 4.5 [1], Chapter 5: section 5.1 to 5.3[1], Chapter 8: section 8.1, 8.2[1]
Unit – IV – Chapter 2: Section 2.1 to 2.4[2],
Unit –V- Chapter 2: Section 2.5 to 2.9[2]

REFERENCE(S)

[1] S.J.Mikhlin, Linear Integral Equations (translated from Russian), Hindustan Book Agency, 1960.

[2] I.N.Snedden, Mixed Boundary value Problems in Potential Theory, North Holland,1966.

DIGITAL OPEN EDUCATIONAL RESOURCES:

1. **Integral Equations books.google.com**
2. **Calculus of Equations books.google.co.in**

Levels	**C1**	**C2**	**C3**	**C4**	**C5**	**Total scholastic marks**	**Non Scholastic Marks C6**	**CIA Total**	**% of Assessment**
	T1 5 Mks	**T2 6 Mks**	**Assignment 4 Mks**	**Seminar 5 Mks**	**Atttendence 5 MkS**	**20 Mks**	**5 Mks**	**25 Mks**	
K1	**1**	**1**	**1**	**1**	**-**	**4**	**-**	**4**	**16%**
K2	**1**	**1**	**1**	**1**	**-**	**4**	**-**	**4**	**16%**
K3	**1**	**2**	**1**	**1**	**-**	**5**	**-**	**5**	**20%**
K4	**2**	**2**	**1**	**2**	**-**	**7**	**-**	**7**	**28%**
Non Scholastic	**-**	**-**	**-**	**-**	**5**	**-**	**5**	**5**	**20%**
Total	**5**	**6**	**4**	**5**	**5**	**20**	**5**	**25**	**100%**

COURSE OUTCOMES

NO	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TOREVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO1	Knowing about different types of Kernals and types of Fredholm's equations.	K1 & K2	PSO1,PSO2
CO2	To understand the Fredholm integral theorem	K3	PSO4
CO3	Know different integrals equations and methods of solving them.	K4	PSO2
CO4	Be able to understand variational methods for solving differential equations.	K3&K4	PSO4
CO5	To know the concepts of Maxima and minima ,Natural boundary conditions	K3	PSO2

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	3	2	2	2	2	2	2
CO2	2	2	2	3	2	2	2	2
CO3	2	3	2	2	2	2	2	2
CO4	2	2	2	3	2	2	2	2
CO5	2	3	2	2	2	2	2	2

Mapping COs Consistency with POs

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	2	3
CO2	3	3	2	3	3
C03	2	3	3	3	3
C04	2	2	2	2	2
C05	3	2	2	2	3

Note:

- **Strongly Correlated-3**
- **Moderately Correlated-2**
- **Weakly Correlated-1**

SEMESTER -II

PROBABILITY AND STATISTICS WITH QUEUEING THEORY

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/ WEEK	CREDITS
	P22MS10E	**Probability And Statistics With Queueing Theory**	Lecture	**6**	**3**

COURSE DESCRIPTION

To get the basic knowledge in probability axioms , random variables, and distribution functions based on the we apply the concepts in queuing theory. To learn the advanced theory of probability and some statistical Techniques.

COURSE OBJECTIVES

1. To provide mathematical foundation for statistics
2. To study the discrete and continuous random variables, statistical parameters
3. on probability distributions and central limit theorems.
4. To understand the limiting process of distribution and solve related problems
5. Identify situations where queuing Models and solve related Problems
6. Computing Probabilities based on practical using binomial, normal distribution

UNITS

UNIT-I (Probability**)** **(18 HRS)**

Axiomatic of probability –Conditional probability – Baye's theorem – Probability mass function – continuous random variable –cumulative distribution function- Probability density function- -Two dimensional random variables- Properties.

UNIT-II (Distributions**)** **(18 HRS)**

Geometric, Hyper Geometric, Negative Binomial, Uniform, exponential, Gamma and weibull distributions –Moment generating functions - Properties .

UNIT- III (Probability**)** **(18 HRS)**

Two dimensional random variables – Joint distribution – Marginal and Conditional distributions – Functions of random variables – Central limit theorem.

UNIT-IV (Queueing theory**)** **(18 HRS)**

Characteristics of a queueing model –(M/M/1):(∞/FIFO) ;(M/M/S):(∞/FIFO); (M/M/1):(K/FIFO); (M/M/S):(K/FIFO)- Problems.

UNIT-V (Advanced Queue model**)** **(18 HRS)**

Non-Markovian Queueing Model((M/G/1):(∞/GD)- Pollaczek- Khintchine formula – Special cases.

TEXT BOOK:

T.Veerarajan "Probability, Statistics and Random Process with Queuing theory and Queuing Networks"- ,Third edition - McGraw Hill Education.

UNIT I: Chapter 1 – sec 1.1- 1.19 , Chapter 2 - sec 2.1- 2.23

UNIT II : Chapter 4 – sec 4.48 - 4.62(MGF only for the related distribution)
Chapter 5 – sec 5.9-5.12 5.36 - 5.43, 5.54 - 5.68,
UNIT III : Chapter 2 - sec 2.23 - 2.46 , Chapter 3 – sec 3.1 - 3.27,
Chapter 4 – sec 4.73 - 4.79
UNIT IV: Chapter 8 – sec 8.1 – 8.18
UNIT V: Chapter 8 – sec 8.21-8.23

REFERENCES:

1. Kishore S. Trivedi, "Probability & Statistics with Reliability, Queueing and Computer Applications", Prentice Hall of India, 1999.

DIGITAL OPEN EDUCATIONAL RESOURCES:

1. **https://www.britannica.com/science/probability**
2. **https://www.khanacademy.org/math/statistics-probability**
3. **https://www.investopedia.com/terms/q/queuing-theory.asp#:~:text=Queuing%20theory%20is%20the%20study,cost%2Deffective%20services%20and%20systems.**
4. **https://www.youtube.com/watch?v=Yo7LG_JeJos**

Levels	C1	C2	C3	C4	C5	Total scholastic marks	Non Scholastic Marks C6	CIA Total	% of Assessment
	T1 5 Mks	T2 6 Mks	Assignment 4 Mks	Seminar 5 Mks	Atttendence 5 MkS	20 Mks	5 Mks	25 Mks	
K1	1	1	1	1		4		4	16
K2	1	1	1	1		4		4	16
K3	2	2	1	1		6		6	24
K4	1	2	1	2		6		6	24
Non Scholastic					5		5	5	20
Total	5	6	4	5	5	20		25	100

COURSE OUTCOMES

NO	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
1	Understanding the basic concepts in Probability	K2	PSO4
2	Understanding the Concepts of continuous Distribution.	K2	PSO5 & PSO
3	Understanding the Moment Generating Concepts for continuous Distributions	K1&k3	PSO6
4	Understanding Concepts of two dimensional random variable.	K3	PSO3
5	Understanding the concepts Transformation of random variables.	K4	PSO7

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	3	2	2	3	3	2
CO2	2	2	3	2	3	2	2	3
CO3	3	3	2	3	2	2	3	2
CO4	2	2	2	3	3	2	2	3
CO5	3	2	3	2	3	3	3	3

Mapping COs Consistency with POs

CO/PO	PO1	PO2	PO3	PO4
CO1	2	3	3	2
CO2	3	3	2	3
C03	3	2	3	2
C04	2	2	2	3
C05	3	3	2	3

Note:
Strongly Correlated-3
Moderately Correlated-2
Weakly Correlated-1

SEMESTER - III **COMPLEX ANALYSIS**

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/ WEEK	CREDITS
	P22MS11	**COMPLEX ANALYSIS**	**Lecture method**	**6**	**5**

COURSE DESCRIPTION

This course is designed to get Knowledge in Complex Integration, Power series Expansion, Partial fraction and factorization and Entire functions.

COURSE OBJECTIVES

1. To study about Cauchy's integral formula.

2. To introduce analytic functions which are locally a power series and to study the profound Cauchy theory which says analytic functions are complex differentiable (holomorphic) functions on an open set.

3. To understand the concept of Calculus of Residues

4. To study about Harmonic functions

5. To Get deep Knowledge in Entire functions

UNITS

UNIT-I (Fundamental Theorems & Cauchy's Integral formula) (18 Hrs)

Fundamental theorems: Line Integrals- Rectifiable Arcs –Line Integrals as Functions of Arcs-Cauchy's Theorem for a Rectangle-Cauchy's Theorem in a Disk. **Cauchy's Integral formula:** The Index of a point with Respect to a closed curve-The Integral Formula – Higher Derivatives.

UNIT-II (Local properties of Analytical Functions) (18Hrs)

Removable Singularities – Taylor's Theorem -Zeros and Poles - The Local Mapping - The Maximum Principle.

UNIT- III (The General Form of Cauchy's Theorem&The Calculus of residues) (18Hrs)

The General Form of Cauchy's Theorem : Chains and Cycles Simple Connectivity-Homology The General Statement of Cauchy's Theorem - Proof of Cauchy's Theorem-Locally Exact Differentials.

The Calculus of residues: The Residue Theorem- The Argument Principle-Evaluation of Definite Integrals.

UNIT-IV (Harmonic Functions &Power series expansions) (18Hrs)

Harmonic Functions and: Definition and Basic Properties-The Mean value Property-Poisson's Formula-Schwarz's Theorem-The Reflection Principle .**Power series expansions:**Weierstrass's Theorem-The Taylor Series-The Laurent Series.

UNIT-V (Partial fractions and factorization & Entire Functions) (18Hrs)

Partial fractions and factorization: Partial fractions – Infinite products - Canonical products – The Gamma function. **Entire Functions:** Jensen's formula - Hadamard's theorem.

TEXT BOOK:

Lars.V.Ahlfors,Complex Analysis McGraw Hill Company,Third Edition 1979

Unit I: Chapter 4: 1.1-1.5, 2.1 – 2.3

Unit II: Chapter 4: 3.1,3.2,3.3,3.4

Unit III: Chapter 4: 4.1-4.6,5.1-5.3

Unit IV: Chapter 4: 6.1-6.5 and
Chapter 5: 1.1-1.3

Unit V: Chapter 5: 2.1 to 2.4 :3.1, 3.2

REFERENCES:

[1] Serge Lang, Complex Analysis,Addisn Wesley, 1977

[2] S.Ponnisamy, Foundations of Complecx Analysis, Narosa Publishing House, New Delhi 1997.

[3] V.Karunakaran, Complex Analysis

DIGITAL OPEN EDUCATIONAL RESOURCES:

1. **https://archive.nptel.ac.in/courses/111106141/**
2. **https://mathworld.wolfram.com**
3. **https://www.degruyter.com/document/doi/101515/9783110417241/html**
4. **http://www.sosmath.com**

Levels	C1	C2	C3	C4	C5	Total scholastic marks	Non Scholastic Marks C6	CIA Total	% of Assessment
	T1 5 Mks	T2 6 Mks	Assignment 4 Mks	Seminar 5 Mks	Atttendence 5 MkS	20 Mks	5 Mks	25 Mks	
K1	1	1	1	1	-	4	-	4	16%
K2	1	1	1	1	-	4	-	4	16%
K3	1	2	1	1	-	5	-	5	20%
K4	2	2	1	2	-	7	-	7	28%
Non Scholastic	-	-	-	-	5	-	5	5	20%
Total	5	6	4	5	5		5	25	100%

COURSE OUTCOMES

NO	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	To be familiar with Cauchy's Integral Formula to apply Contour Integration.	K1 & K2	PSO1, PSO2
CO 2	To study the concept of Analyticity, Complex Integration.	K3	PSO4
CO 3	To be familiar with the concept of Complex Integration so as to apply Cauchy's Theorem and Knowledge of Residues	K4	PSO2
CO 4	Advance concepts in complex analysis	K3 & K4	PSO4
CO 5	Knowledge of Infinite Products	K3	PSO2

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	3	2	2	2	2	2	2
CO2	2	2	2	3	2	2	2	2
CO3	2	3	2	2	2	2	2	2
CO4	2	2	2	3	2	2	2	2
CO5	2	3	2	2	2	2	2	2

Mapping COs Consistency with POs

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	2	3
CO2	3	3	2	3	3
CO3	2	3	3	3	3
CO4	2	2	2	2	2
CO5	3	2	2	2	3

Note:
Strongly Correlated-3
Moderately Correlated-2
Weakly Correlated-1

SEMESTER - III MEASURE THEORY AND INTEGRATION

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/ WEEK	CREDITS
	P22MS12	Measure Theory and Integration	Lecture	6	5

COURSE DESCRIPTION

This course presents the fundamental concepts and techniques of measure theory. It includes measures, measurable sets, functions, integrals as measures, modes of convergence and product measure.

COURSE OBJECTIVES

1. To provide a concrete setting of Lebesgue measure and Lebesgue integral via the classical concepts of Jordan measure and the Riemann integration.
2. To give an expert and thorough study on abstract measures and the modern integration theory including the standard convergence theorems.
3. To introduce product measure and study the Fubini's theorem.

UNITS

UNIT-I MEASURE ON THE REAL LINE (20 HRS)

Lebesgue outer measure – Measurable sets – Regularity – Measurable functions – Borel and Lebesgue measurability.

UNIT-II INTEGRATION OF FUNCTIONS OF A REAL VARIABLE (20 HRS)

Integration of non-negative functions – The General Integral – Integration of series – Riemann and Lebesgue integrals.

UNIT- III ABSTRACT MEASURE SPACES (15 HRS)

Measures and outer measures – Extension of a measure –uniqueness of the Extension-Completion of a Measure.

UNIT-IV COVERGENCE AND SIGNED MEASURES (20 HRS)

Convergence in Measure – Almost uniform convergence – Signed Measures and the Hahn Decomposition – The Jordan Decomposition.

UNIT-V MEASURE AND INTEGRATION IN A PRODUCT SPACE (15 HRS)

Measurability in a product space – The Product Measure and Fubini's Theorem.

TEXT BOOK:

G.De Barra , Measure Theory and Integration, New Age International (P) Ltd, First Edition Reprint-2010.

Unit I : Chapter 2 Section 2.1 to 2.5
Unit II : Chapter 3 Section 3.1 to 3.4
Unit III : Chapter 4 Section 5.1 to 5.4
Unit IV : Chapter 7 Section 7.1 and 7.2
Chapter 8 Section 8.1 and 8.2
Unit V : Chapter 10 Section 10.1 and 10.2

REFERENCES:

1. M.E.Munroe, Measure and Integration, Addison – Wesley Publishing Company,Second Edition, 1971.
2. P.K.Jain, V.P.Gupta, Lebesgue Measure and Integration, New Age International Pvt Ltd Publishers, New Delhi,1986. (Reprint 2000).
3. Richard L.Wheeden and Antoni Zygmund, Measure and Integral: An Introduction to Real Analysis, Marcel Dekker Inc.1977.

DIGITAL OPEN EDUCATIONAL RESOURCES:

https://www.mathcity.org/msc/notes/measure_theory_by_anwar_khan
https://ocw.mit.edu/courses/18-125-measure-and-integration-fall-2003/pages/lecture-notes/
https://huynhcam.files.wordpress.com/2013/07/anhquangle-measure-and-integration-full-www-mathvn-com.pdf

Levels	C1	C2	C3	C4	Total scholastic marks	Non Scholastic Marks C4	CIA Total	% of Assessment
	T1 5 Mks	T2 6 Mks	Assignment 4 Mks	Seminar 5 Mks	20 Mks	5 Mks	25 Mks	
K1	2	2	-	1	5		5	20%
K2	1	2	-	-	3		3	12%
K3	1	1	2	2	6		6	24%
K4	1	1	2	2	6		6	24%
Non Scholastic						5	5	20%
Total	5	6	4	5	20	5	25	100%

COURSE OUTCOMES

NO.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO1	Explain Lebesgue measurable sets and measurability	K1	PSO5
CO2	Classify Riemann and Lebesgue Integrals	K2	PSO1
CO3	Describe abstract measure spaces and complete measures	K3	PSO5
CO4	Learn convergence in measure, Signed measures and decomposition theorems	K4	PSO4

CO5	**Explain the concept of measurability in product space**	**K2**	**PSO5**

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	2	-	2	3	3	3	3	3
CO2	3	-	2	3	3	3	3	3
CO3	2	-	2	3	3	3	3	3
CO4	3	-	3	3	3	3	3	3
CO5	2	-	2	3	3	3	3	3

Mapping COs Consistency with POs

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	2
CO2	3	3	3	2	2
CO3	3	3	3	2	2
CO4	3	3	3	2	2
CO5	3	3	3	2	2

Note:
Strongly Correlated-3
Moderately Correlated-2
Weakly Correlated-1

SEMESTER - III **TOPOLOGY**

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/ WEEK	CREDITS
	P22MS13	**Topology**	**Lecture**	**6**	**5**

COURSE DESCRIPTION

This course generalize the concept of Real Analysis to Topological spaces and introduces the notion of topological basis which provides foundation for many other branches of Mathematics.

COURSE OBJECTIVES

1. To introduce the notion of topological spaces ,basis and different types of topologies.
2. To characterize the properties of continuity of functions and details about metric topology.
3. To understand compactness and connectedness of the spaces.
4. Emphasize is to bring out the ideas on countability and separation axioms.
5. To study important theorems related to metrizability.

UNITS

UNIT-I TOPOLOGICAL SPACES (18 HRS)

Topological spaces-Basis for a topology – The order topology – The product topology on X x Y – The subspace topology – closed sets and limit points.

UNIT-II CONTINUOUS FUNCTIONS (18HRS)

Continuous functions – the product topology – The metric Topology,The metric topology (Continued)

UNIT- III CONNECTEDNESS AND COMPACTNESS (18 HRS)

Connected spaces – connected subspaces of the real line - Compact spaces – Compact subspaces of the Real line – Limit point Compactness – Local Compactness.

UNIT-IV COUNTABILITY AND SEPARATION AXIOMS (18 HRS)

The countability Axioms – The separation Axioms – Normal spaces.

UNIT-V THE URYSOHN LEMMA (18 HRS)

The Urysohn Lemma- The Urysohn metrization Theorem - The Tietz extension Theorem-The Tychonoff Theorem.

TEXT BOOK:

James R. Munkres, Topology , Pearson Education Pvt. Ltd.,New Delhi,Second Edition,9th Indian Reprint -2005.

Unit I: Chapter 2: Sections 12 to 17

Unit II: Chapter 2: Sections 18 to 21

Unit III: Chapter 3: Sections 23,24, 26 to 29(Omit Section 25)

Unit IV: Chapter 4: Sections 30 to 32

Unit V: Chapter 4: Sections 33 to 35. Chapter 5: Sections 37

REFERENCES:

[1] J. Dugundji, Topology, Prentice Hall of India, New Delhi, 1975.

[2] George F.Simmons, Introduction to Topology and Modern Analysis, McGraw HillBook Co., 1963.

[3] J.L.Kelly, General Topology, Van Nostrand, Reinhold Co., New York.

[4] L.Steen and J.Seeback, Counter examples in Topology, Holt, Rinehart and Winston,New York, 1970.

DIGITAL OPEN EDUCATIONAL RESOURCES:

1. **https://www.uni-frankfurt.de/64271720/TopNotes_Spring10.pdf**

2. **https://brilliant.org/wiki/topology/**

Levels	C1	C2	C3	C4	Total scholastic marks	Non Scholastic Marks C6	CIA Total	% of Assess Ment
	T1 5 Mks	T2 6 Mks	Assignment 4 Mks	Seminar 5 Mks	20 Mks	5 Mks	25 Mks	
K1	1	1	1	2	5		5	20
K2	2	1	1	1	5		5	20
K3	1	2	1	1	5		5	20
K4	1	2	1	1	5		5	20
Non Scholastic						5	5	20
Total	5	6	4	5	20	5	25	100

COURSE OUTCOMES

NO	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
1	To introduce the notion of topological spaces ,basis and different types of topologies.	K1	**PSO1 & PSO 2**
2	To characterize the properties of continuity of functions and details about metric topology.	K2	**PSO3**
3	To understand compactness and connectedness of the spaces.	K2	**PSO4**
4	Emphasize is to bring out the ideas on countability and separation axioms.	K3	**PSO5**
5	To study important theorems related to metrizability.	K2 & K4	**PSO6**

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	2	3	2	3	2	2	2	2
CO2	2	2	3	3	2	2	2	2
CO3	3	2	3	2	3	3	3	3
CO4	2	2	2	2	3	3	3	3
CO5	2	3	2	3	2	2	2	2

Mapping COs Consistency with POs

CO/PO	PO1	PO2	PO3	PO4	PO5

CO1	**2**	**3**	**3**	**2**	**2**
CO2	**2**	**3**	**2**	**3**	**3**
C03	**3**	**2**	**3**	**2**	**2**
C04	**2**	**3**	**3**	**2**	**3**
C05	**2**	**3**	**2**	**2**	**2**

Note:
Strongly Correlated-3
Moderately Correlated-2
Weakly Correlated-1

SEMESTER - III STOCHASTIC PROCESSES

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/ WEEK	CREDI
	P22MS14E	STOCHASTIC PROCESSES	Lecture	6	3

Course Description: This course deals with the methods and ideas associated with Markov chain. A special emphasis is given for Markov processes with discrete state space. Also this course enable a student to understand renewal processes in continuous time.

Course Objectives:

1. To understand stochastic processes
2. To study Markov chains, Markov processes with discrete and continuous state space.
3. To study renewal processes in continuous time and Morkovian queuing models.

Unit I

Stochastic Processes: Some notions – Specification of Stochastic processes – Stationary processes - Markov chains – Definitions and examples – Higher Transition probabilities – Generalization of Independent Bernoulli trails – Sequence of chain – Dependent trains.

Unit II

Markov chains: Classification of states and chains – determination of higher transition probabilities – stability of a Markov system – Reducible chains – Markov chains with continuous state space.

Unit III

Markov processes with Discrete state space: Poisson processes and their extensions – Poisson process and related distribution – Generalization of Poisson process – Birth and Death process – Markov system – Reducible chains – Markov chains with continuous state space.

Unit IV

Renewal processes and theory: Renewal processes - Renewal processes in continuous time - Renewal equation.

Unit V

Stopping Time Wald's Edition: Stopping time – Wald's Edition – Renewal theorem-Elementary Renewal theorem – Application of Renewal theorem (Black well's and Smith's)

Text Book

J.Medhi, Stochastic Processes, Howard M. Taylor – Second Edition.

Unit I : Chapter 2 - Sec 2.1 to 2.3, Chapter 3 - Sec 3.1 to 3.3.

Unit II : Chapter 3 - Sec 3.4 to 3.6, 3.8,3.9 and 3.11.

Unit III : Chapter 4 - Sec 4.1 to 4.5.

Unit IV : Chapter 6 – sec 6.1 - 6.3

Unit V : Chapter 6- sec 6.4., 6.5, 6.5.1, 6.5.2 & 6.5.4.

REFERENCE(S)

[1] Sameul Korlin, Howard M. Taylor, A first course in stochastic processes, II Edn.

[2] Narayan Bhat, Elements of Applied Stochastic processes,

[3] Srinivasan and Metha, Stochastic processes, N.V. Prabhu, Macmillan (NY), Stochastic Processes

DIGITAL OPEN EDUCATIONAL RESOURCES:

1. https://ocw.mit.edu/courses/18-445-introduction-to-stochastic-processes-spring-2015
2. https://en.wikipedia.org/wiki/Stochastic_process

Levels	**C1**	**C2**	**C3**	**C4**	**C5**	**Total**	**Non Scholastic**	**CIA Total**	**% of Assessment**
	T1	**T2**	**Assignment**	**Seminar**	**Atttendence**	**scholasticmarks**	**Marks C6**		
	5 Mks	**6 Mks**	**4 Mks**	**5 Mks**	**5 MkS**	**20 Mks**	**5 Mks**	**25 Mks**	

K1	**1**	**1**	**1**	**1**	**-**	**4**		**4**	**16%**
K2	**1**	**1**	**1**	**1**	**-**	**4**		**4**	**16%**
K3	**1**	**2**	**1**	**1**	**-**	**5**		**5**	**20%**
K4	**2**	**2**	**1**	**2**	**-**	**7**		**7**	**28%**
Non Scholastic	**-**	**-**	**-**	**-**	**5**		**5**	**5**	**20%**
Total	**4**	**6**	**4**	**5**	**5**	**20**	**5**	**25**	**100%**

COURSE OUTCOMES

On the successful completion of the course, students will be able to

No.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	To understand the stochastic models for many real life probabilistic situations.	K 2	PSO1
CO 2	To learn the well known models like birth-death processs.	K 2	PSO2
CO 3	To estimate the transition probabilities and its classifications.	K 5	PSO4

CO 4	To apply the random walk in real life situation.	K 3	PSO5
CO 5	To solve the problems related to renewal theory.	K 3	PSO5

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**2**				
CO2				**2**	
CO3			**2**		
CO4		**3**			
CO5					**2**

Mapping COs Consistency with POs

CO/PO	PO1	PO2	PO3	PO4
CO1		**2**		
CO2		**2**		
C03			**2**	
C04				**3**
C05				**2**

Note:

- **Strongly Correlated-3**
- **Moderately Correlated-2**
- **Weakly Correlated-1**

SEMESTER - III APPLIED STATISTICS

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/ WEEK	CREDITS
	P22MS15E	**APPLIED STATISTICS**	**Lecture**	**6**	**3**

COURSE DESCRIPTION

This course gives the broad view on some application of Statistics such as statistical quality control, time series , Index number ,demand analysis and one way and two way ANOVA table.

COURSE OBJECTIVES

1. To introduce the concepts of statistical quality control involved in basic statistics and learn them with plenty of demonstrating examples
2. To introduce about the components of time series, analysis of time series and the method used to solve.
3. To introduce about the index number and the criteria of good index number.
4. To introduce about the price elasticity of demand ,data required and analysis using certain methods.
5. To introduce about the one way and two way classification of ANOVA

UNITS

UNIT-I (STATISTICAL QUALITY CONTROL) (18 Hrs.)

Introduction –Process & Product Control-Control Charts- Control Limits – Tools of S.Q.C –Control chart for attributes- Control chart for number of defects per unit (C-Charts).

UNIT-II (TIME SERIES ANALYSIS) (18 Hrs.)

Introduction- Components of Time series-Analysis of Time Series-
Measurement of Trend –Measurement of Seasonal Fluctuations. (Excluding the moving average mathematical treatment).

UNIT- III (Index number) (18 Hrs.)

Introduction-Problems involved in the construction of index numbers-The criteria of a good index number-Classification of index numbers.

UNIT-IV (Demand Analysis) (18 Hrs.)

Introduction-Price elasticity of demand- Partial elasticities of demand –Types of Data required for estimating elasticities-Engel's law and Engel's curve- Pareto's law of income Distribution-Utility function.

UNIT-V (Analysis of Variance) (18 Hrs.)

Introduction- One-way classification – Two-way classification- Analysis of Two-way classified data with M-observations per cell.

TEXT BOOK:

S. C GUPTA AND V.K. KAPOOR FUNDAMENTALS OF APPLIED STATISTICS, SULTAN CHAND & SONS – THIRD EDITION,

Unit I: chapter 1, section 1.0 - 1 .7
Unit II: chapter 2, section 2.1 - 2.5
Unit III: chapter 3, section 3.1 - 3.4
Unit IV: chapter 4, section4.1 - 4.7
Unit V: chapter 5, section 5.1 - 5.4

REFERENCES:

1. D.R. Caze – APPLIED STATISTICS – Principle and examples
2. B.N. Ashana – APPLIED STATISTICS
3. Marek Fisz Probability Theory and mathematical statistics , Krieger publishing company
4. Pillai RSN , Bhagavathi statistics, S chand publications

DIGITAL OPEN EDUCATIONAL RESOURCES:

1. https://libguides.reading.ac.uk
2. https://projecteuclid.org/
3. https://www.ams.org/

Levels	C1	C2	C3	C4	Total scholastic marks	Non Scholastic Marks C5	CIA Total	% of Assessment
	T1 5 Mks	T2 6 Mks	Assignment 4 Mks	Seminar 5 Mks	20 Mks	5 Mks	25 Mks	
K1	1	1	1	1	4		4	16%
K2	1	1	1	1	4		4	16%
K3	1	2	1	1	5		5	20%
K4	2	2	1	2	7		7	28%
Non Scholastic	-	-	-	-		5	5	20%
Total	5	6	4	5	20	5	25	100%

COURSE OUTCOMES

No.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	To learn about Statistical quality control and control chart	K 1 and K 2	PSO 1
CO 2	Enable to learn about Analysis of time series and measurement of trends	K 1,K 2 and K 3	PSO 1 & PSO 2
CO 3	To know about construction of index number and criteria of index number.	K 1 ,K 2 and K 3	PSO 2 & PSO 3
CO 4	Enable to learn demand analysis and elasticity	K 1 ,K 2,K 3 and K 4	PSO 4,PSO 5, PSO 6
CO 5	Learn about Analysis of Variance, one way and two way classification	K 1,K 2 ,K 3 and K 4	PSO 6, PSO 7,PSO 8

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO 1	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO 2	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**
CO 3	**2**	**3**	**3**	**2**	**2**	**2**	**2**	**2**
CO 4	**2**	**2**	**2**	**3**	**3**	**2**	**2**	**2**
CO 5	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**3**

Mapping COs Consistency with POs

CO/PO	PO1	PO2	PO3	PO4
CO 1	**3**	**2**	**2**	**2**
CO 2	**2**	**3**	**3**	**2**
CO 3	**2**	**2**	**3**	**2**
CO 4	**2**	**2**	**2**	**3**
CO 5	**2**	**2**	**3**	**3**

Note:
Strongly Correlated-3
Moderately Correlated-2
Weakly Correlated-1

SEMESTER - IV FUNCTIONAL ANALYSIS

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/ WEEK	CREDITS
	P22MS16	FUNCTIONAL ANALYSIS	Lecture	6	5

COURSE DESCRIPTION

Functional analysis is the study of infinite dimensional vector spaces of functions and linear operators between them. This class deals with relevant function spaces (normed vector spaces, Banach and Hilbert spaces), bounded linear operators on normed vector spaces, fundamental principles of functional analysis (i.e., Han-Banach Theorem, Uniform Boundedness Principle, Open Mapping Theorem and Closed Graph Theorem) and their applications, spectral theory of compact linear operators and spectral theory of compact self-adjoint operators. The goal of the course is to help students who pursue advanced studies in mathematics and related fields to lay a solid foundation in functional analysis.

COURSE OBJECTIVES

1. To emphasize very basic results which are needed for analysts and to give typical applications.
2. To study normed linear spaces, four pillars of functional analysis, weak topologies and duality, Hilbert space theory and algebra of bounded linear operators.

UNIT – I: Banach Spaces (18 HRS)

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.

UNIT – II : Hilbert Spaces (18 HRS)

The definition and some simple properties – Orthogonal complements –Orthonormal sets – The conjugate space H* - The adjoint of an operator – Self-adjoint operators – Normal and Unitary operators – Projections.

UNIT – III : Finite-Dimensional Spectral Theory (18 HRS)

Matrices – Determinants and the spectrum of an operator – The Spectral theorem – A survey of the situation.

UNIT – IV : General Preliminaries on Banach Algebras (18 HRS)

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.

UNIT – V : The Structure of Commutative Banach Algebras (18 HRS)

The Gelfand mapping – Applications of the formula

$r(x) = \lim ||x^n||^{1/n}$- Involutions in Banach Algebras – The Gelfand –Neumark theorem.

TEXT BOOK:

G.F. Simmons ,Introduction to Topology and Modern Analysis, , Tata McGraw- Hill Publishing Company Limited, 2004.

UNIT I : Chapter 9 (46-51)
UNIT II : Chapter 10(52-59)
UNIT III : Chapter 11(60-63)
UNIT IV : Chapter 12(64-69)
UNIT V : Chapter 13(70-73)

REFERENCES:

1. Walter Rudin, Functional Analysis, TMH Edition, 1974. [2] B.V. Limaye, Functional Analysis, Wiley Eastern Limited, Bombay, Second Print, 1985.
2. K. Yosida, Functional Analysis, Springer – Verlag, 1974.
3. Laurent Schwarz, Functional Analysis, Courant Institute of Mathematical Sciences,New York University, 1964.

DIGITAL OPEN EDUCATIONAL RESOURCES:

1. **https://math.mit.edu/~rbm/18-102-S15/**
2. **https://faculty.etsu.edu/gardnerr/Func/sillsummer15.htm**

Levels	C1	C2	C3	C4	Total scholastic marks	Non Scholastic Marks C6	CIA Total	% of Assessment
	T1 5 Mks	T2 6 Mks	Assignment 4 Mks	Seminar 5 Mks	20 Mks	5 Mks	25 Mks	
K1	2	2	-	1	5			20%
K2	1	2	1	1	5			20%
K3	1	1	2	2	6			24%
K4	1	1	1	1	4			16%
Non Scholastic	-	-	-	-	-	5	5	20%
Total	5	6	4	5	20	5	25	100%

COURSE OUTCOMES

NO	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
1	Knowledge of Banach spaces , Hahn Banach Theorem and its applications	K1,K2	PSO1, PSO2
2	Understanding on Hilbert Spaces	K2, K3	PSO3
3	Understanding the operator theory in Hilbert Spaces and Banach Algebra	K2,K3	PSO4, PSO6
4	Learning Gelfand mapping and the Gelfand – Neumark theorem	K3,K4	PSO4, PSO5
5	Knowledge of operators and Infinite dimensional spaces	K2,K3,K4	PSO4, PSO7

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	3	3	2	3	3	3
CO2	3	2	2	3	2	3	3	3
CO3	3	2	2	3	2	3	3	3
CO4	3	2	3	2	3	3	3	2
CO5	3	2	2	3	2	3	3	2

Mapping COs Consistency with POs

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	2
CO2	3	2	3	3	2
C03	3	3	3	3	3
C04	3	2	3	2	2
C05	2	2	2	3	3

Note:
Strongly Correlated-3
Moderately Correlated-2
Weakly Correlated-1

SEMESTER - IV OPTIMIZATION TECHNIQUES

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/ WEEK	CREDITS
	P22MS17	**OPTIMIZATION TECHNIQUES**	**Lecture method**	**6**	**5**

COURSE DESCRIPTION

To get knowledge in optimization techniques especially in different fields like game theory Dynamic programming NLPP IPP.

COURSE OBJECTIVES

1. To provide the insights into structures and processors that operations research can offer and the enormous practical utility of its various techniques.
2. To explain the concepts and simultaneously to develop an understanding of problem solving methods based upon model formulation, solution procedures and analysis.

UNITS

UNIT-I (Games and Strategies) (18 HRS)
Introduction-Two-person Zero-Sum Games-The Maximin-Minimax Principle-Games without saddle points-Mixed strategies-Graphical Solution of 2xn and mx2 Games-Dominance Property.

UNIT-II (Dynamic Programming:) (18 HRS)
Introduction-The Recursive Equation Approach-Characteristics of Dynamic Programming-Dynamic Programming Algorithm-Solution of Discrete DynamicProgrammingProblem-Some Applications-Solution of Linear Programming Problem by Dynamic Programming.

UNIT- III (Non-Linear Programming:) (18 HRS)
Introduction-Formulating a Non-Linear Programming Problem-General Non-Linear Programming Problem – Constrained Optimization with equality constraints- Constrained Optimization with inequality constraints – Saddle Point Problems – Saddle Points and Non-Linear Programming Problem.

UNIT-IV (Integer Programming Problem:) (18 HRS)
Introduction- pure & mixed interger programming problem-Gomory's all - Integer Programming Problem method-Construction of Gomory's Constraints-Fractional Cut Method -All Integer-Fractional Cut Method –Mixed Integer - Branch and Bound Method-Applications Integer Programming Problem.

UNIT-V (Replacement Models:) (18 HRS)
Replacement of Equipment that deteriorates gradually- Replacement of Equipment that fails suddenly- Group Replacement-Recruitment and promotion problem.

TEXT BOOK:

Kanti Swarp,P.K.Gupta,Man-Mohan, Operations Research,Sultan Chand & Sons Educational Publishers New Delhi, 19th Revised Edition, 2017.

UNIT-I – Chapter 17: Sections 17.1 to17.7

UNIT –II - Chapter 13: Sections 13.1 to 13.7

UNIT-III - Chapter24: Sections 27.1 to 27.7

UNIT –IV - Chapter 7: Sections 7.1 to 7.8

UNIT – V - Chapter 18: Sections 18.1to 18.4

REFERENCE(S):

1. Problems in O.R by D.S.Hira & P.K.Gupta.
2. Prem Kumar Gupta and D.S.Hira,Operations Research:An Introduction,S.Chand and Co.,Ltd. New Delhi.
3. S.S.Rao,Optimization Theory and Applications,Wiley Eastern Limited,New Delhi.

DIGITAL OPEN EDUCATIONAL RESOURCES:

1. **https://nptel.ac.in/course/111/104/111104071/**

2. **https://nptel.ac.in/course/111/105/111105100/**

3. **http://apmonitor.com/me575/**

Levels	C1	C2	C3	C4	C5	Total scholastic marks	Non Scholastic Marks C6	CIA Total	% of Assessment
	T1 5 Mks	T2 6 Mks	Assignment 4 Mks	Seminar 5 Mks	Atttendence 5 MkS	20 Mks	5 Mks	25 Mks	
K1	1	2	1	1		5		5	20
K2	1	2	1	1		5		5	20
K3	2	1	1	2		6		6	24
K4	1	1	1	1		4		4	16
Non Scholastic					5		5	5	20
Total	5	6	4	5	5	20	5	25	100

COURSE OUTCOMES

NO	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
1	To understand the theory behind optimization techniques.	K1	PSO1&PSO6
2	To introduce the Game theory and its Strategies.	K2 &k3	PSO6
3	To study the Dynamic programming for Problem solving.	K3	PSO4&PSO5
4	Analyzing the methods of non-linear programming.	K4	PSO3&PSO7
5	Understanding the concepts of replacement models	K3 & K4	PSO6

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	2	3	2	2	2	3	3	2
CO2	2	3	3	2	3	2	2	3
CO3	3	2	3	3	2	2	3	2
CO4	2	3	2	3	3	2	2	3
CO5	3	2	3	2	2	3	2	3

Mapping COs Consistency with POs

CO/PO	PO1	PO2	PO3	PO4
CO1	2	3	2	2
CO2	2	3	2	3
C03	3	3	3	2
C04	2	2	2	3
C05	3	2	2	3

Note:
Strongly Correlated-3
Moderately Correlated-2
Weakly Correlated-1

SEMESTER - IV DIFFERENTIAL GEOMETRY

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/ WEEK	CREDITS
	P22MS18	DIFFERENTIAL GEOMETRY	Lecture Method	6	5

COURSE DESCRIPTION

The geometry of curves and surfaces in Euclideal space. Frenet formulas, the isometric relations, local theory of surfaces, first and second fundamental forms. Gaussian and Mean curvature, Geodesics and the Gauss Bonnet theorem.

Course Objectives:

1. To introduce the geometry of n-dimensional oriented surfaces on Euclidean spaces using calculus of vector fields as a tool.
2. To study intrinsic equations, fundamental existence theorem and curves on surfaces.
3. To study about first fundamental form and isometric correspondence.
4. To know about different types of curvatures.
5. To introduce intrinsic property of surfaces and second fundamental forms.

UNITS

Unit I(INTRODUCTORY REMARKS ABOUT SPACE CURVES) (18hrs)

Introductory remarks about Space Curves- Definitions- Arc length -Tangent, normal and binormal – curvature and torsion of a given curve – contact between curves and surfaces .

Unit II(INTRINSIC PROPERTIES OF A SURFACE) (18hrs)

Tangent surface, involutes and evolutes- intrinsic equations, Fundamental Existence theorem for space curves – Helics Intrinsic properties of a surface: Definition of a surface – curves on a surface – surface of revolution – Helicoids –.

Unit III(METRIC) (18hrs)

Metric – Direction coefficients – families of curves – Isometric correspondence – Intrinsic Properties – Geodesics.

Unit IV(GEODESICS) (18hrs)

Canonical Geodesic equation – Normal property of Geodesics – (Existence theorem) – Geodesics Parallels – Geodesics curvature - Gauss Bonnet Theorem – Gaussian Curvature.

Unit V(NON INTRINSIC PROPERTIES OF A SURFACE) (18hrs)

Non intrinsic properties of a surface: The second fundamental form – Principal curvature - Lines of curvature – Developable -Developables associated with space curves- Developable associated with curves on surface – Minimal surfaces – Ruled surfaces.

Text Book(S)

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

Unit I : Chapter I: Sections 1to 6.
Unit II : Chapter I: Section 7 to 9.Chapter 2: Sec 1 to 4
Unit III : Chapter II: Section 5 to 10.
Unit IV : Chapter II: Section 11 to 17.
Unit V : Chapter III: Section 1 to 8.

REFERENCE(S)

1. Struik, D.T.Lectures on classical Differential Geometry, Addison – Wesley, Mass. 1950.
2. Kobayashi S. and Nomizu.K. Foundations of Differential Geometry, InterScience publishers, 1963.
3. Wihelm Klingenberg : A Course in Differential Geometry. Graduate Texts in Mathematics, Springer Verlag, 1978.
4. J.A.Thorpe Elementary topics in Differential Geometry, Under- Graduate Texts in Mathematics, Springer Verlag, 1979.

DIGITAL OPEN EDUCATIONAL RESOURCES:

1. **https://youtu.be/Y5KvFAdxo0A**

2. **http://etananyag.ttk.elte.hu (PDF)**

Levels	**C1**	**C2**	**C3**	**C4**	**C5**	**Total scholastic marks**	**Non Scholastic Marks C6**	**CIA Total**	**% of Assessment**
	T1 5 Mks	**T2 6 Mks**	**Assignment 4 Mks**	**Seminar 5 Mks**	**Atttendence 5 MkS**	**20 Mks**	**5 Mks**	**25 Mks**	
K1	**1**	**1**	**1**	**1**	**-**	**4**	**-**	**4**	**16%**
K2	**1**	**1**	**1**	**1**	**-**	**4**	**-**	**4**	**16%**
K3	**1**	**2**	**1**	**1**	**-**	**5**	**-**	**5**	**20%**
K4	**2**	**2**	**1**	**2**	**-**	**7**	**-**	**7**	**28%**
Non Scholastic	**-**	**-**	**-**	**-**	**5**	**-**	**5**	**5**	**20%**
Total	**5**	**6**	**4**	**5**	**5**	**20**	**5**	**25**	**100%**

COURSE OUTCOMES

NO	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO1	To introduce difference surfaces and their uses.	K1&K2	PSO1,PSO2
CO2	To explain the various intrinsic concepts of Differential Geometry	K3	PSO4
CO3	To study different types of curvatures in Differential Geometry	K4	PSO2
CO4	To explain about the geodesics of the surfaces.	K3&K4	PSO4
CO5	To study about non intrinsic properties.	K3	PSO2

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	3	2	2	2	2	2	2
CO2	2	2	2	3	2	2	2	2
CO3	2	3	2	2	2	2	2	2
CO4	2	2	2	3	2	2	2	2
CO5	2	3	2	2	2	2	2	2

Mapping COs Consistency with POs

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	2	3
CO2	3	3	2	3	3
C03	2	3	3	3	3
C04	2	2	2	2	2
C05	3	2	2	2	3

Note:

- **Strongly Correlated-3**
- **Moderately Correlated-2**
- **Weakly Correlated-1**

SEMESTER - IV MATHEMATICAL MODELING

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	Hrs/ WEEK	CREDITS
	P22MS19E	MATHEMATICAL MODELING	LECTURE	6	3

Course Description:

To introduce a mathematical model for solving real life situations using models through ordinary differential equations of first order , difference equations and also through graphs.

Course Objectives:

1. To explain the various intrinsic concepts of Mathematical modelling .
2. To give a wide range view of applications of mathematics in science and technology.
3. To study the different mathematical models in ODE and Difference equations.
4. To understand the mathematical modelling concepts through Graph theory .
5. Applications into real life problems.

UNITS

UNIT I - Mathematical Modelling through Ordinary Differential Equations of First order: (18 Hrs)

Linear Growth and Decay Models – Non-Linear Growth and Decay Models – Compartment Models – Dynamics problems – Geometrical problems

UNIT II - Mathematical Modelling through Systems of Ordinary Differential Equations of First Order : (18 Hrs)

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

UNIT III - Mathematical Modelling through Ordinary Differential Equations of Second Order: (18 Hrs)

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

UNIT IV – Mathematical Modelling through Difference Equations : (18 Hrs)

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

UNIT V - Mathematical Modelling through Graphs : (18 Hrs)

Solutions that can be Modelled through Graphs – Mathematical Modelling in Terms of Directed Graphs, Signed Graphs, Weighted Digraphs and Unoriented Graphs.

TEXT BOOK

J.N. Kapur, Mathematical Modelling, Wiley Eastern Limited, New Delhi, 1988.

Unit I: Chapter 2 – 2.2 to 2.6
Unit II: Chapter 3 – 3.1 to 3.6
Unit III: Chapter 4 – 4.1 to 4.4
Unit IV: Chapter 5 – 5.1 to 5.5
Unit V: Chapter 7 – 7.1 to 7.5

REFERENCES

J. N. Kapur, Mathematical Models in Biology and Medicine, Affiliated East – West Press Pvt Limited, New Delhi, 19

DIGITAL OPEN EDUCATIONAL RESOURCES:

https://books.google.co.in/books/about/Mathematical_Modelling.html?id=NuQeYMTIvoYC

Levels	C1	C2	C3	C4	Total scholastic marks	Non Scholastic Marks C5	CIA Total	% of Assess Ment
	T1 5 Mks	T2 6 Mks	Assignment 4 Mks	Seminar 5 Mks	20 Mks	5 Mks	25 Mks	
K1	2	2	1	1	6	-	6	24%
K2	1	2	1	1	5	-	5	20%
K3	1	1	1	2	5	-	5	20%
K4	1	1	1	1	4	-	4	16%
Non Scholastic	-	-	-	-	-	5	5	20%
Total	5	6	4	5	20	5	25	100%

COURSE OUTCOMES

NO	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	To explain the various intrinsic concepts of Mathematical modelling .	K3 & K4	PSO 1 &PSO 3 1 ,5
CO 2	To understand the theory of mathematical modeling through ordinary differential equations.	K1 & K2	PSO 2 &PSO 3 4
CO 3	To understand the mathematical modelling concepts through difference equations.	K1 & K2	PSO 4 3,4
CO 4	To understand the mathematical modelling concepts through Graph theory .	K1 & K2	PSO 5 2,3
CO 5	Applications into real life problems.	K3 & K4	PSO 3 &PSO 5 2, 5

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	2
CO2	2	3	3	2	2
CO3	2	2	2	3	2
CO4	2	2	2	2	3
CO5	2	2	3	2	3

Mapping COs Consistency with POs

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	2	2
CO2	3	2	2	3	2
CO3	2	2	2	2	3
CO4	2	2	2	3	2
CO5	2	2	2	3	3

Note:
Strongly Correlated-3
Moderately Correlated-2
Weakly Correlated-1

CHOICE BASED ELECTIVES

TENSOR ANALYSIS AND SPECIAL THEORY OF RELATIVITY

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	Hrs/ WEEK	CREDITS
		TENSOR ANALYSIS AND SPECIAL THEORY OF RELATIVITY	LECTURE	6	3

Course Description:

This course is designed to get knowledge in Tensor and Tensor characters, Algebras of tensors, Metric Tensor, Einstein Tensor, Special Theory of Relativity and Relativistic Dynamics.

Course Objectives:

1. To develop familiarity of Algebras of Tensors.
2. To develop skills in Metric Tensor.

UNITS

UNIT I (Invariance Transformations) (18 Hrs)

Invariance Transformations of coordinates and its properties Transformation by invariance - Transformation by covariance and contra variance - Covariance and contra variance - Tensor and Tensor character of their laws - Algebras of tensors - Quotient tensors - Symmetric and skew symmetric tensors - Relative tensors.

UNIT II Metric Tensor (18 Hrs)

Metric Tensor - The fundamental and associated tensors - Christoffel's symbols - Transformations of Christoffel's symbols- Covariant Differentiation of Tensors - Formulas for covariant Differentiation- Ricci Theorem - Riemann -Christoffel Tensor and their properties.

Unit III Einstein Tensor (18 Hrs)

Einstein Tensor - Riemannian and Euclidean Spaces (Existence Theorem) – The e-systems and the generalized Kronecker deltas - Application of the e-systems

UNIT IV Special Theory of Relativity (18 Hrs)

Special Theory of Relativity: Galilean Transformation - Maxwell's equations - The ether Theory — The Principle of Relativity Relativistic Kinamatics : Lorentz Transformation equations – Events and simultaneity - Example Einstein Train - Time dilation – Longitudinal Contraction -Invariant Interval - Proper time and Proper distance — World line – Example - twin paradox - addition of velocities - Relativistic Doppler effect.

UNIT V Relativistic Dynamics **(18 Hrs)**

Relativistic Dynamics: Momentum - energy – Momentum energy four vector - Force - Conservation of Energy - Mass and energy - Example - inelastic collision - Principle of equivalence - Lagrangian and Hamiltonian formulations. Accelerated Systems : Rocket with constant acceleration - example - Rocket with constant thrust.

TEXT BOOK(S)

1. **I.S. Sokolnikoff, Tensor Analysis, John Wiley and Sons, New York, 1964**
2. **D. Greenwood, Classical Dynamics, Prentice Hall of India, NewDelhi, 1985**

UNIT I -Chapter 2 : Sections 18 to 28 of [1]
UNIT II -Chapter 2 : Sections 2910 37 of [1]
UNIT III -Chapter 2 : Section 38 to 41 o [1]
UNIT IV -Chapter 7 : Sections 7.1 and 7.2 of [2]
UNIT V- Chapter 7 : Sections 7.3 and 7.4 of [2]

REFERENCE(S)

1. J.L. Synge and A.Schild, Tensor Calculus, Toronto, 1949.
2. A,S. Eddington, The Mathematical Theory of Relativity, Cambridge University Press, 1930.
3. P.G. Bergman, An introduction to Theory of Relativity, New york, 1942,
4. G.E. Weatherburn, Riemannian Geometry and Tensor Calculus, Cambridge,1938.

Levels	**C1**	**C2**	**C3**	**C4**	**Total scholastic marks**	**Non Scholastic Marks C6**	**CIA Total**	**% of Assessment**
	T1 **5 Mks**	**T2** **6 Mks**	**Assignment 4 Mks**	**Seminar** **5 Mks**	**20 Mks**	**5 Mks**	**25 Mks**	
K1	1	1	1	1	4	-	4	16%
K2	2	1	1	1	5	-	5	20%
K3	1	2	1	1	5	-	5	20%
K4	1	2	1	2	6	-	6	24%
Non Scholastic	-	-	-	-	-	5	5	20%
Total	5	6	4	5	20	5	25	100%

COURSE OUTCOMES

NO	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO1	**To Study Covariance and the Tensor.**	K1 & K2	PSO 1 & PSO2
CO2	**To Understand the concept of Formulas of covariant Differentiation.**	K2 & K3	PSO 2 & PSO 6
CO3	**To Understand the Einstein Tensor and Euclidean Spaces.**	K2 & K3	PSO 2 & PSO 7
CO4	**To Understand the Special Theory of Relativity.**	K2 & K3	PSO 7 & PSO8
CO5	**To Study the Lagrangian and Hamiltonian formulations.**	K2 & K3	PSO 2 & PSO 8

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	3	2	2	2	3	3	3
CO2	3	3	2	3	2	3	3	3
CO3	3	3	2	3	2	3	2	3
CO4	3	3	2	2	2	3	3	3
CO5	3	3	2	3	3	3	3	3

Mapping COs Consistency with POs

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Note:
Strongly Correlated-3
Moderately Correlated-2
Weakly Correlated-1

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/ WEEK	CREDITS

		NUMERICAL METHODS USING MATLAB	**LECTURE**	**6**	**3**

NUMERICAL METHODS USING MATLAB

COURSE DESCRIPTION

To understand the Basics of MATLAB , Built-in Functions, and also to gain the knowledge of Graphics, and to know the detailed structure of MATLAB Algorithms and Programs Curve Fitting.

COURSE OBJECTIVES

1. To Study the Basics of MATLAB.
2. To Solve the Equations using MATLAB algorithms.

Unit-I: (Basics of MATLAB) **(18 Hrs)**

Matrix functions Basics, windows, Variables, File types, Matrices and Vectors, Matrix manipulation, Matrix and Array Operations, Arithmetic operations, Relational operations, Logical operations, Elementary math functions, Matrix functions, Manipulating character strings, Array Operations, Vectorization.

Unit-II: (Built-in functions) **(18 Hrs)**

Built-in functions Inline functions, Anonymous functions, Built-in functions, Complex Arithmetic, Solving linear systems, Eigen Values and Vectors, Calculus.

Unit-III: (Graphics) **(18 Hrs)**

Basic 2-D Plots, Specialized 2-D plots, 3-D Plots, 3-D Surface Graphics.

Unit-IV: (MATLAB Algorithms and Programs) **(18 Hrs)**

The Solution of Non-linear Equations f(x) = 0 : Bracketing Methods for Locating a Root Newton-Raphson and Secant Methods, The Solution of Linear Systems AX = Â : Gaussian elimination and Pivoting, Iteration for Nonlinear Systems: Seidel and Newton's Methods (Optional). (Algorithms and Programs only,No derivations and Theorems)

Unit-V: (MATLAB Algorithms and Programs Curve Fitting) **(18 Hrs)**

Least-squares Line, Numerical Integration : Composite Trapezoidal and Simpson's Rule, Solution of Differential Equations : Euler's Method - Taylor Series Method - Runge-Kutta Methods - Predictor-Corrector Methods (Algorithms and Programs only, No derivations and Theorems)

Textbook

1. RudraPratap, Getting started with MATLAB 7, Oxford University Press,2008.
2. John H. Mathews and Kurds D. Fink, Numerical Methods using MATLAB, Third Edition, Prentice Hall, Upper Saddle River, NJ, 1999.
3. Brain R Hunt, Ronald L Lipsman, Jonathan M Rosenberg, A Guide to MATLAB for Beginners and Experienced Users, Cambridge University Press, 2003.
4. C. Woodford and C. Phillips, Numerical Methods with Worked Examples, Matlab Edition, Springer, Netherlands, 2012.

DIGITAL OPEN EDUCATIONAL RESOURCES:

https://www.mathworks.com/academia/books/getting-started-with-matlab-pratap.html

Levels	**C1**	**C2**	**C3**	**C4**	**Total scholastic marks**	**Non Scholastic Marks C5**	**CIA Total**	**% of Assessment**
	T1 **5 Mks**	**T2** **6 Mks**	**Assignment 4 Mks**	**Seminar** **5 Mks**	**20 Mks**	**5 Mks**	**25 Mks**	
K1	2	2	1	1	**6**	**-**	**6**	**24%**
K2	1	2	1	1	**5**	**-**	**5**	**20%**
K3	1	1	1	2	**5**	**-**	**5**	**20%**
K4	1	1	1	1	**4**	**-**	**4**	**16%**
Non Scholastic	**-**	**-**	**-**	**-**	**-**	**5**	**5**	**20%**
Total	**5**	**6**	**4**	**5**	**20**	**5**	**25**	**100%**

COURSE OUTCOMES

NO	**COURSE OUTCOMES**	**KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)**	**PSOs ADDRESSED**
CO 1	**To introduce the Mathematical software MATLAB for high-performance numerical computations and visualization.**	**K3 & K4**	**PSO 1 & PSO 2**
CO 2	**To learn MATLAB built-in functions provided to solve all type of scientific problems.**	**K2**	**PSO 2**
CO 3	**Drawing 2D and 3D Plots and Solving Matrix Problems**	**K1 & K2**	**PSO 1 & PSO 5**
CO 4	**Solving Linear systems**	**K2 & K3**	**PSO 4**
CO 5	**Solving Differential equations**	**K2 & K3**	**PSO 3& PSO 2**

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	3	2
CO2	2	2	3	2	2
CO3	2	3	2	2	2
CO4	2	2	3	3	2
CO5	3	2	2	2	2

Mapping COs Consistency with POs

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	2	3	2	2	2
CO2	2	2	3	2	2
CO3	3	2	2	2	3
CO4	2	2	2	3	2
CO5	2	3	2	3	2

Note:

Strongly Correlated-3

Moderately Correlated-2
Weakly Correlated-1

THEORY OF NUMBERS

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	Hrs/ WEEK	CREDITS
		THEORY OF NUMBERS	LECTURE	6	3

COURSE DESCRIPTION

To understand the primitive roots and Power Residues of Numbers & to analyse the Quadratic Residues and the Solving techniques of Diophantine Equations.

COURSE OBJECTIVES

1. Number theory is one of the classical branches of Mathematics. In this course, the basic concepts such as divisibility, primes, congruences and solutions in congruences are introduced in detail. Emphasize is made on the concepts which turn out to be concrete examples which motivate the abstract ideas in the algebra course.
2. Quadratic Residues, Mobius inversion Formula and the Diophantine equations and their solutions have to be introduced.

UNITS

UNIT I (Introduction) **(18 Hrs)**

Divisibility – Primes – The Binomial Theorem – Congruences Euler's totient - Fermat's, Euler's and Wilson's Theorems – Solutions of congruences – The Chinese Remainder theorem.

UNIT II (Prime power Moduli) **(18 Hrs)**

Primitive roots and Power Residues – Number theory from an Algebraic Viewpoint – Groups, rings and fields.

UNIT III (Quadratic Residues) **(18 Hrs)**

Quadratic Reciprocity – The Jacobi Symbol – Binary Quadratic Forms – Equivalence and Reduction of Binary Quadratic Forms – sum of two squares.

UNIT IV (Quadratic Residues) **(18 Hrs)**

Greatest integer Function – Arithmetic Functions – The Mobius Inversion Formula Recurrence Functions – Combinatorial number theory

UNIT V (Diophantine Equations) **(18 Hrs)**

The equation $ax+by = c$ – Simultaneous Linear Diophantine Equations – Pythagorean Triangles – Assorted examples

TEXT BOOK(S)

[1] Ivan Niven, Herbert S, Zuckerman and Hugh L, Montgomery, An Introduction to the Theory of Numbers, Fifth edn., John Wiley & Sons Inc, 2004.

UNIT I- Chapter 1 and Chapter 2 : Sections 2.1 to 2.3

UNIT II- Chapter 2 : Sections 2.6 to 2.11

UNIT III- Chapter 3: Sections 3.1 to 3.6

UNIT IV- Chapter 4

UNIT V- Chapter 5: Sections 5.1 to 5.4

REFERENCE(S) :

1. Gareth A. Jones and J. Mary Jones, Elementary Number Theory, Springer Verlag, Indian Reprint, 2005.
2. David M. Burton, Elementary Number Theory, 6th edition, McGraw Hill, 2007.
3. George Andrews, Theory of Numbers, Saunders, 1971.

DIGITAL OPEN EDUCATIONAL RESOURCES:

https://books.google.co.in/books/about/An_Introduction_to_the_Theory_of_Numbers.html?id=V52HIcKguJ4C&redir_esc=y

Levels	**C1**	**C2**	**C3**	**C4**	**Total scholastic marks**	**Non Scholastic Marks C5**	**CIA Total**	**% of Assessment**
	T1 **5 Mks**	**T2** **6 Mks**	**Assignment 4 Mks**	**Seminar** **5 Mks**	**20 Mks**	**5 Mks**	**25 Mks**	
K1	2	2	1	1	**6**	**-**	**6**	**24%**
K2	1	2	1	1	**5**	**-**	**5**	**20%**
K3	1	1	1	2	**5**	**-**	**5**	**20%**
K4	1	1	1	1	**4**	**-**	**4**	**16%**
Non Scholastic	**-**	**-**	**-**	**-**	**-**	**5**	**5**	**20%**
Total	**5**	**6**	**4**	**5**	**20**	**5**	**25**	**100%**

COURSE OUTCOMES

NO	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Understand and work numerous problems on concepts of divisibility and primes	K3 & K4	PSO 1 & PSO 2
CO 2	Gain expertise in Euler's totient, Fermat's, Euler's and Wilson's Theorems and work on applications illustrating them.	K2	PSO 2
CO 3	Solve congruences as application of Chinese remainder Theorem Understand number theory from algebraic point of view there by improving their sense of abstraction.	K1 & K2	PSO 1 & PSO 5
CO 4	Describe power residues and multiplicative groups.	K2 & K3	PSO 4
CO 5	Attained mastery in the fundamentals of greatest Course Outcomes integer function and recurrence functions and attacking combinatorial problems using them.	K2 & K3	PSO 3& PSO 2

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	2
CO2	2	3	2	2	2
CO3	3	2	2	2	3
CO4	2	2	2	3	2
CO5	2	3	2	2	2

Mapping COs Consistency with POs

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	2	2	3	2	2
CO2	2	2	2	3	2
CO3	2	3	2	2	2
CO4	3	2	2	2	3
CO5	2	2	3	3	2

Note:
Strongly Correlated-3
Moderately Correlated-2
Weakly Correlated-1

Operator Theory

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/ WEEK	CREDITS
		Operator Theory	**Lecture**	**6**	**3**

COURSE DESCRIPTION

This is a second course on functional analysis which emphasize very basic results which are left out in the first course and are important for researchers.

COURSE OBJECTIVES

The idea behind the second course on functional analysis is to emphasize very basic results which are left out in the first course and are important for analysts who apply these tools. To study compact operators, spectral theory of Banach space operators and Hilbert space operators, Banach algebras and Gelfand Neumark theorem.

UNITS

UNIT-I Compact Operators **(18 HRS)**
Characterizations – Some Properties.

UNIT-II Spectral Results for Banach Space Operators **(18 HRS)**
Spectrum – Eigen spectrum – Resolvent set – Riesz - Schauder Theory

UNIT- III Operators on Hilbert Spaces **(18 HRS)**
Adjoint – Self Adjoint – Normal – Unitary – Opertors – Numerical range – Hilbert-Schmidt operators.

UNIT-IV Spectral Results for Hilbert space Operators **(18 HRS)**
Normal and Self Adjoint Operators- Spectral Representations

UNIT-V Banach Algebras **(18 HRS)**
Regular and Singular elements – Spectrum – Gelfand mapping – Gelfand Neumark Theorem

TEXT BOOK:

[1] M.Thamban Nair, Functional Analysis: A first course, Prentice Hall of India, New Delhi, 2002.
[2] G.F.Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill International Ed. 1963.

Unit – I : Chapter 9 from [1]
Unit – II : Chapter 10 from [1]
Unit – III : Chapter 11 from [1]
Unit – IV : Chapters 12 and 13 from [1]
Unit – V : Chapters 12 and 13 from [2]

REFERENCES:

1.B.V. Limaye, Functional Analysis, Wiley Eastern Limited, Bombay, Second Print, 1985.
2. K. Yosida, Functional Analysis, Springer-Verlag, 1974.
3. E. Kreyszig, Introductory Functional Analysis with applications, John Wiley, 1978

Levels	**C1**	**C2**	**C3**	**C4**	**Total scholastic marks**	**Non Scholastic Marks C5**	**CIA Total**	**% of Assessment**
	T1 **5 Mks**	**T2** **6 Mks**	**Assignment 4 Mks**	**Seminar** **5 Mks**	**20 Mks**	**5 Mks**	**25 Mks**	
K1	2	2	1	1	**6**	**-**	**6**	**24%**
K2	1	2	1	1	**5**	**-**	**5**	**20%**
K3	1	1	1	2	**5**	**-**	**5**	**20%**
K4	1	1	1	1	**4**	**-**	**4**	**16%**
Non Scholastic	**-**	**-**	**-**	**-**	**-**	**5**	**5**	**20%**
Total	**5**	**6**	**4**	**5**	**20**	**5**	**25**	**100%**

COURSE OUTCOMES

NO	**COURSE OUTCOMES**	**KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)**	**PSOs ADDRESSED**
CO1	Revise the important four pillars of functional analysis namely Hahn- Banach theorem, Open mapping theorem, Closed graph theorem, Uniform boundedness principles.	K1	PSO1 & PSO 2
CO2	Gain mastery in compact operators and spectral results on these operators..	K2	PSO3
CO3	Compute eigen spectrum, approximate eigen spectrum and spectrum of various operators and study their interconnections.	K2	PSO4
CO4	Understand spectral theory of compact self adjoint operators	K3	PSO5
CO5	Study in detail the spectral properties of Hilbert space operators.	K2 & K4	PSO6

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	2	3	2	3	2	2	2	2
CO2	2	2	3	3	2	2	2	2
CO3	3	2	3	2	3	3	3	3
CO4	2	2	2	2	3	3	3	3
CO5	2	3	2	3	2	2	2	2

Mapping COs Consistency with POs

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	2	2
CO2	2	3	2	3	3
CO3	3	2	3	2	2
CO4	2	3	3	2	3
CO5	2	3	2	2	2

Note:
Strongly Correlated-3
Moderately Correlated-2
Weakly Correlated-1

Design and Analysis of Algorithms

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/ WEEK	CREDITS
		Design and Analysis of Algorithms	**Lecture**	**6**	**3**

COURSE DESCRIPTION

This course enables the students to acquire knowledge on programming and algorithm and its usage in problem solving and its applications in day today life

COURSE OBJECTIVES

To study the basics of the Algorithm and to understand the concepts of Interpolations and Algebraic Problems.

UNITS

UNIT-I Algorithms (15 Hrs)

Introduction- Algorithm - Algorithm specification: Pseudocode Conventions, Recursive algorithms - Performance analysis: Space Complexity, Time Complexity, Asymptotic Notation, Practical Complexities.

UNIT-II Data structures and Queues (15 Hrs)

Arrays – ordered lists- Representation of Arrays-Stack and Queues –Fundamentals-Evaluation of Expressions.

UNIT- III Linked lists and trees (20 Hrs)

Linked Lists - Singly Linked Lists- Linked Stacks and Queues-More on Linked Lists-Simple algorithms of Doubly Linked Lists (insertion and deletion only).Trees:Binary Trees- Binary Tree Representations- Binary Tree Traversal.

UNIT-IV Search and Sort (20 Hrs)

Divide and conquer - General method - Binary search - Finding the maximum and minimum in a set of items - Merge sort - Quick sort - Selection sort. Basic Traversal and Search Techniques for graphs: Breadth First Search – Depth First Search.

UNIT-V Interpolations (20 Hrs)

Backtracking - The 8-Queens problem - Algebraic problems - The general method - Evaluation and interpolation - Horner's rule - Lagrange interpolation - Newtonian interpolation

TEXT BOOK:

1. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran,
2. Fundamentals of Computer algorithms, Galgotia Publications Pvt. Ltd., 2004.(Units: I, IV, V)

3. Ellis Horowitz, Sartaj Sahni, Fundamentals of Data Structures,
4. Galgotia Book Source, 1981.(Units: II, III)

Unit I : Chapter 1 : Sections: 1.1, 1.2,1.3.1 to 1.3.4 of book 1
Unit II : Chapter 2:Sections: 2.2,2.4,3.1,3.3 of Book 2
Unit III : Chapter 4: Sections :4.1,4.2,4.5,4.8,
Chapter 5:5.2,5.3,5.4 of Book 2
Unit IV : Chapter 3: Sections: 3.1 to 3.5
Chapter 6 :6.2 of Book 1
Unit V : Chapter 7 :Sections: 7.1,7.2,9.1,9.2 of Book 1

REFERENCES:

1. A.V. Aho, J.E.Hopcroft, J.D. Ullman, The Design and Analysis of Computer Algorithms, Addison-Wesley Publ. Comp., 1974.
2. Seymour E.Goodman and S.T. Hedetniemi, Introduction to the design and analysis of algorithms, McGraw Hill International Edition, 2002

Levels	**C1**	**C2**	**C3**	**C4**	**Total scholastic marks**	**Non Scholastic Marks C6**	**CIA Total**	**% of Assessment**
	T1 **5 Mks**	**T2** **6 Mks**	**Assignment 4 Mks**	**Seminar** **5 Mks**	**20 Mks**	**5 Mks**	**25 Mks**	
K1	1	1	1	1	4	-	4	16%
K2	2	1	1	1	5	-	5	20%
K3	1	2	1	1	5	-	5	20%
K4	1	2	1	2	6	-	6	24%
Non Scholastic	-	-	-	-	-	5	5	20%
Total	5	6	4	5	20	5	25	100%

COURSE OUTCOMES

NO	**COURSE OUTCOMES**	**KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)**	**PSOs ADDRESSED**
CO1	Learns the algorithms, conventions and complexities	K1 & K2	PSO 1 & PSO2
CO2	Learns data structures and evaluation of expressions	K2 & K3	PSO 2 & PSO 6
CO3	Learns linked lists and trees and to represent binary trees.	K2 & K3	PSO 2 & PSO 7
CO4	Learns search and sort	K2 & K3	PSO 7 & PSO8
CO5	Learns how to backtrack interpolation problems	K2 & K3	PSO 2 & PSO

			8

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	3	2	2	2	3	3	3
CO2	3	3	2	3	2	3	3	3
CO3	3	3	2	3	2	3	2	3
CO4	3	3	2	2	2	3	3	3
CO5	3	3	2	3	3	3	3	3

Mapping COs Consistency with POs

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Note:
Strongly Correlated-3
Moderately Correlated-2
Weakly Correlated-1

AUTOMATA THEORY

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/ WEEK	CREDITS
		AUTOMATA THEORY	**Lecture method**	**6**	**5**

COURSE DESCRIPTION

This course is designed to get knowledge Finite Automata, Context free Grammarr, Chomsky Normal form, Push down Automaton, Lexical Analysis and Predictive Parsers.

COURSE OBJECTIVES:

1. To Study the Automation Techniques.

2. To study the BasicParsing Techniques.

Unit-I: Finite Automata and Regular expressions (18 Hrs)

Finite Automata and Regular expressions Definitions and examples - Deterministic and Nondeterministic finite Automata - Finite Automata with moves.

Unit-II: Regular expressions and their relationship (18 Hrs)

Context free grammar Regular expressions and their relationship with automation - Grammar - Ambiguous and unambiguous grammars - Derivation trees – Chomsky Normal form.

Unit-III: Pushdown Automaton (18 Hrs)

Pushdown Automaton - Definition and examples - Relation with Context free languages.

Unit-IV: Finite Automata (18 Hrs)

Finite Automata and lexical analysis Role of a lexical analyzer - Minimizing the number of states of a DFA - Implementation of a lexical analyzer.

Unit-V: Basic parsing techniques (18 Hrs)

Basic parsing techniques Parsers - Bottom up Parsers - Shift reduce - operator precedence - Top down Parsers - Recursive descent - Predictive parsers.

Textbooks

1. John E. Hopcroft and Jeffrey D. Ullman, Introduction to Automata theory, Languages and Computations, Narosa Publishing House, Chennai, 2000.
2. A.V. Aho and Jeffrey D. Ullman, Principles of Compiler Design, Narosa Publishing House, Chennai, 2002.

UNIT – I (Book 1, Ch. 2: Sec. 2.1-2.4)
UNIT – II - (Book 1, Ch. 2, Sec. 2.5, Ch.4, Sec.4.1-4.3, 4.5,)
UNIT – III - (Book 1, Ch.5: Sec.5.2, 5.3)
UNIT – IV - (Book 2, Ch.3: Sec.3.1-3.8)
UNIT – V - (Book 2, Ch.5: Sec. 5.1-5.5)

Reference(s)

1. Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, Second Edition, Prentice Hall, 1997.
2. A.V. Aho, Monica S. Lam, R. Sethi, J.D. Ullman, Compilers: Principles, Techniques, and Tools, Second Edition, Addison-Wesley, 2007.54 55

DIGITAL OPEN EDUCATIONAL RESOURCES:

Levels	**C1**	**C2**	**C3**	**C4**	**Total scholastic marks**	**Non Scholastic Marks C5**	**CIA Total**	**% of Assessment**
	T1 **5 Mks**	**T2** **6 Mks**	**Assignment 4 Mks**	**Seminar** **5 Mks**	**20 Mks**	**5 Mks**	**25 Mks**	
K1	2	2	1	1	**6**	**-**	**6**	**24%**
K2	1	2	1	1	**5**	**-**	**5**	**20%**
K3	1	1	1	2	**5**	**-**	**5**	**20%**
K4	1	1	1	1	**4**	**-**	**4**	**16%**
Non Scholastic	**-**	**-**	**-**	**-**	**-**	**5**	**5**	**20%**
Total	**5**	**6**	**4**	**5**	**20**	**5**	**25**	**100%**

COURSE OUTCOMES

NO	**COURSE OUTCOMES**	**KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)**	**PSOs ADDRESSED**
CO1	**To make the students understand the nuances of Automata and Grammar.**	K1	PSO1 & PSO 2
CO2	**To make them understand the applications of these techniques in computer.**	K2	PSO3
CO3	**To study context free grammar.**	K2	PSO4
CO4	**To learn finite automata and lexical analysis.**	K3	PSO5
CO5	**To understand basic parsing techniques.**	K2 & K4	PSO6

	and basic Knowledge of parsing Techniques.		

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	2	3	2	3	2	2	2	2
CO2	2	2	3	3	2	2	2	2
CO3	3	2	3	2	3	3	3	3
CO4	2	2	2	2	3	3	3	3
CO5	2	3	2	3	2	2	2	2

Mapping COs Consistency with POs

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	2	2
CO2	2	3	2	3	3
CO3	3	2	3	2	2
CO4	2	3	3	2	3
CO5	2	3	2	2	2

Note:
Strongly Correlated-3
Moderately Correlated-2
Weakly Correlated-1

GRAPH THEORY

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/ WEEK	CREDITS
		GRAPH THEORY	**Lecture method**	**6**	**5**

COURSE DESCRIPTION

The course is designed to get knowledge in basic concepts of graph theory, directed graphs, connectivity, counting the number of spanning trees, Independent sets and Matchings, Graph colorings and Planarity of Graphs.

COURSE OBJECTIVES

1. To Study the basic Concepts of Graph Theory and directed graphs.
2. To study connectivity of Graphs.
3. To study about Independent sets and Matchings.
4. To study the Graph Colouring and chromatic polynomial.
5. To study about Planarity, Four colour and five colour theorem.

UNITS

UNIT-I (Basic Results) (18 Hrs)

Basic Concepts - Subgraphs - Degrees of Vertices - Paths and Connectedness- Operations on Graphs - Directed Graphs: Basic Concepts - Tournaments.

UNIT-II (CONNECTIVITY) (18 Hrs)

Vertex Cuts and Edge Cuts - Connectivity and Edge - Connectivity, Trees:Definitions, characterization and Simple Properties - Counting the Numberof Spanning Trees - Cayley's Formula. Counting the Number of Spanning Trees - Cayley's Formula.

UNIT- III (Independent Sets and Matchings) (18 Hrs)

Vertex Independent Sets and Vertex Coverings - Edge Independent Sets -Matchings and Factors - Eulerian Graphs - Hamiltonian Graphs.

UNIT-IV (Graph Colorings) (18 Hrs)

Vertex Colouring - Critical Graphs - Triangle - Free Graphs - Edge Colouringsof Graphs - Chromatic Polynomials.

UNIT-V (Planarity) (18 Hrs)

Planar and Nonplanar Graphs - Euler Formula and its Consequences - K5and K3,3 are Nonplanar Graphs - Dual of a Plane Graph - The Four-ColourTheorem and the Heawood Five-Colour Theorem- Kuratowski's Theorem.

TEXTBOOK:

1. R. Balakrishnan, K. Ranganathan, A Textbook of Graph Theory, Springer International Edition, New Delhi, 2008.

REFERENCES:

1. J.A. Bondy, U.S.R. Murty, Graph Theory with Applications, Mac Milan Press Ltd., 1976.
3. F. Harary, Graph Theory, Addison - Wesley, Reading, Mass., 1969.

UNIT – I - Chapter I: Section 1.1 to 1.4, 1.7,
Chapter II: Section 2.1, 2.2
UNIT – II - Chapter III: Section 3.1, 3.2,
Chapter IV: Section 4.1, 4.3.1 to 4.4
UNIT – III -Chapter V: Section 5.1 to 5.4,
Chapter VI: Section 6.1, 6.2
UNIT – IV - Chapter VII: Section 7.1 to 7.4, 7.7
UNIT – V - Chapter VIII: Section 8.1 to 8.6)

DIGITAL OPEN EDUCATIONAL RESOURCES:

1. https://youtu.be/sWsXBY19o81
2. https://youtu.be/amaH38-mXK4

Levels	C1	C2	C3	C4	C5	Total scholastic marks	Non Scholastic Marks C6	CIA Total	% of Assessment
	T1 5 Mks	T2 6 Mks	Assignment 4 Mks	Seminar 5 Mks	Atttendence 5 MkS	20 Mks	5 Mks	25 Mks	
K1	1	1	1	1	-	4	-	4	16%
K2	1	1	1	1	-	4	-	4	16%
K3	2	2	1	2	-	7	-	7	20%
K4	1	2	1	1	-	5	-	5	28%
Non Scholastic	-	-	-	-	5	-	5		20%
Total	5	6	4	5	5	20	5	25	100%

COURSE OUTCOMES

NO	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO1	To give a rigorous introduction to the basic concepts of Graph Theory.	K1, K2	PSO3, PSO4
CO2	To study the concepts of Connectivity , vertex and edge connectivity and its applications	K3	PSO7
CO3	To introduce the notion of Eulerian and Hamiltonian graphs	K2	PSO4, PSO7, PSO8
CO4	To introduce the concept of colouring and to give applications of Graph Theory in other disciplines	K3, K4	PSO3, PSO4, PSO5, PSO8
CO5	To study the concept of planar graphs, Algorithms and Applications to real life problems	K2, K3	PSO6, PSO8

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	1	1	3	3	3	3	3	3
CO2	1	2	2	2	2	2	3	2
CO3	1	1	2	3	2	2	3	3
CO4	2	2	3	3	3	2	3	3
CO5	1	1	2	2	2	3	2	3

Mapping COs Consistency with POs

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	2
CO2	3	2	2	3	2
CO3	2	2	3	2	2
CO4	3	3	3	3	3
CO5	2	2	2	2	3

Note:
Strongly Correlated-3
Moderately Correlated-2

Weakly Correlated-1

FUZZY ANALYSIS

PROGRAMME CODE	COURSE CODE	COURSE TITLE	CATEGORY	HRS/ WEEK	CREDITS
		Fuzzy analysis	**Lecture**	**6**	**3**

COURSE DESCRIPTION:

This Course gives the deep insight of Fuzzy sets and Fuzzy Logic, operations on Fuzzy, Fuzzy graph theory and Fuzzy measures. Fuzzy Techniques applied in linear programming.

COURSE OUTCOMES:

1. To make the students understand the concept of Crisp set, Fuzzy set and fuzzy logic
2. To get Knowledge of Fuzzy operations like union and intersection
3. To learn about Fuzzy graph theory
4. To know about Fuzzy measures and probability measures
5. To understand the application of Fuzzy in decision making and linear programming.

UNITS

UNIT-I (Fuzzy sets and Fuzzy Logic) (18 hrs)
Crisp sets and fuzzy sets - basic concept of fuzzy set - fuzzy logic – operations on fuzzy sets - general discussion fuzzy complements.

UNIT-II (Fuzzy operations) (18 hrs)
Fuzzy union - fuzzy intersection - combinations operations.

UNIT-III (Fuzzy graphs) (18 hrs)
Fuzzy relations and fuzzy graphs - fuzzy relation on sets and fuzzy sets -composition of fuzzy relations - properties of the min-max composition -fuzzy graphs - special fuzzy relations.

UNIT-IV (Fuzzy Measures) (18 hrs)
Fuzzy measures - general discussion - belief and plausibility measures -probability measures - possibility and necessity measures.

UNIT-V (Fuzzy Applications) (18 hrs)
Fuzzy decision making - individual decision making - fuzzy ranking methods- fuzzy linear programming.

TEXTBOOKS:

1. George J.Klir, Tina. A Folger, Fuzzy sets, uncertainty and information,
2. Prentice Hall of India Pvt Ltd, New Delhi, 2008.
3. H.J. Zimmermann, Fuzzy set theory and its applications, Second Edition,
4. Springer New Delhi, 2006.

5. George J. Klir and Bo Yuan, Fuzzy sets and fuzzy logic theory and applications, Prentice-Hall of India private limited, New Delhi, 1995.

UNIT – I - Book 1: chapter 1- 1.4, 1.6 & chapter 2-2.1 & 2.2.
UNIT – II - Book 1: chapter 2 - 2.3, 2.4, 2.5.
UNIT – III - Book 2: chapter 6 - 6.1, 6.1.1, 6.1.2, 6.2, 6.3.
UNIT – IV Book 1: chapter 4 - 4.1, 4.2, 4.3, 4.4.
UNIT – V - Book 3: chapter 4 - 4.1, 4.2, 4.3, and 4.4.

REFERENCE:

1. Timothy J. Ross, Fuzzy logic with Engineering Applications, McGraw-
2. Hill, Inc. New Delhi, 2000.

DIGITAL OPEN EDUCATIONAL RESOURCES:

1. **https://www.hindawi.com/journals/jfs/si/876792/**
2. **https://www.tutorialspoint.com/fuzzy_logic/fuzzy_logic_applications.htm**
3. **https://www.mdpi.com/2227-7390/7/1/63/htm**

Levels	C1	C2	C3	C4	Total scholastic marks	Non Scholastic Marks C5	CIA Total	% of Assessment
	T1 5 Mks	T2 6 Mks	Assignment 4 Mks	Seminar 5 Mks	20 Mks	5 Mks	25 Mks	
K1	1	1	1	1	4		4	16%
K2	1	1	1	1	4		4	16%
K3	1	2	1	1	5		5	20%
K4	2	2	1	2	7		7	28%
Non Scholastic	-	-	-	-		5	5	20%
Total	5	6	4	5	20	5	25	100%

COURSE OUTCOMES

No.	COURSE OUTCOMES	KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY)	PSOs ADDRESSED
CO 1	Students understand the concept of Crisp set, Fuzzy set and fuzzy logic.	K 1 and K 2	PSO 1
CO 2	Get Knowledge of Fuzzy operations like union and intersection.	K 1,K 2 and K 3	PSO 1 & PSO 2
CO 3	Learn about Fuzzy graph theory.	K 1 ,K 2 and K 3	PSO 2 & PSO 3
CO 4	Know about Fuzzy measures and probability measures	K 1 ,K 2 and k3	PSO 4,PSO 5, PSO 6
CO 5	Understand the application of Fuzzy in decision making and linear programming.	K 1,K 2 ,K 3 and K 4	PSO 6, PSO 7,PSO 8

Mapping COs Consistency with PSOs

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO 1	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
CO 2	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**
CO 3	**2**	**3**	**3**	**2**	**2**	**2**	**2**	**2**
CO 4	**2**	**2**	**2**	**3**	**3**	**2**	**2**	**2**
CO 5	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**3**

Mapping COs Consistency with POs

CO/PO	PO1	PO2	PO3	PO4
CO 1	**3**	**2**	**2**	**2**
CO 2	**2**	**3**	**3**	**2**
CO 3	**2**	**2**	**3**	**2**
CO 4	**2**	**2**	**2**	**3**
CO 5	**2**	**2**	**3**	**3**

Note:
Strongly Correlated-3
Moderately Correlated-2
Weakly Correlated-1