THE GANDHIGRAM RURAL INSTITUTE (DEEMED TO BE UNIVERSITY) GANDHIGRAM - 624302 (Ministry of Education, Govt. of India) Accredited by NAAC with 'A' Grade (3rd cycle)

Department of Mathematics M.Sc. Degree (Mathematics) Revised Syllabus with effect from 2021 – 2022 onwards

CURRICULUM WITH OUTCOME BASED EDUCATION (OBE)

Name of	the School	: So	chool of Sciences
Departme Academi	ent c Programme offered	: B. (II	epartment of Mathematics Sc. Mathematics, B.Sc. B.Ed. Mathematics ntegrated), M.Sc. Mathematics and n. D. Mathematics
I.	VISION	:	Science & Technology Enabled Rural Development through teaching and research in Mathematical Sciences
II.	MISSION	: >>	Proficiency in research and teaching Research studies in International standards and to urge the need for practical significance
III.	PROGRMME CODE	:	MATP
IV.	PROGRAMME	:	M.Sc. Mathematics

- V. PROGRAMME EDUCATIONAL OBJECTIVES (PEO) OF M.SC. MATHEMATICS:
 - PEO1: Developing problem solving & computational skills in the advanced areas of Mathematics and its applied subjects.
 - PEO2: To create new theoretical and Mathematical concepts towards many real life problems



- PEO3: Interpreting mathematical results through geometrical concepts.
- PEO4: Creating competence to qualify National/international level exams.
- PEO5: Ability to think innovatively to do research in high level in Mathematics and interdisciplinary fields.

GRADUATE ATTRIBUTES

GA1: Critical ThinkingGA2: Mathematical Modeling AbilityGA3: Solving Ability

- VI. PROGRAMME OUTCOMES (PO)
 - PO 1: To pursue careers in education, business, industry, government etc., and getting teaching skills in Mathematics and research awareness in pure and applied field of Mathematics.
 - PO 2: Have the ability to do interdisciplinary research in science and engineering
 - PO 3: To demonstrate technical and soft skills through Mathematical knowledge to commensurate with global needs.
 - PO 4: To get employed in higher level institutes in national/international standards
 - PO 5: Have the potential to meet out the challenges in modern technology

VII. PROGRAMME SPECIFIC OUTCOMES(PSO)

- PSO1: Explain advanced concepts of algebra, real and complex analysis, measure theory, functional analysis and number theory.
- PSO2: Succeed in solving problems in differential equations, mechanics, optimization theory, statistics and numerical analysis.
- PSO3: Critique soft skills and computing skills for solving complex problems arising in Mathematics and other interdisciplinary fields.
- PSO4: Identify the significance of mathematical and statistical thinking, training, and approach to problem solving, on a diverse variety of disciplines.
- PSO5: Creating mathematical models for real-world problems.



Name of the Programme	M.Sc. Mathemat	ics			
Year of Introduction	200)8	Year o	of Revision	2021
Semester-wise Courses and Credit distribution	Ι	II	III	IV	Total
No. of Courses	6	7	7	6	26
No. of Credits	22	24	23	22	91

Catalan	Course Code	Course Tiele		Lecture	Exam		Marks	
Category	Course Code	Course Title	Of Credits	Hours per week	Duration (Hours)	C.F.A	E.S.E	Total
	Semester – I		Citulto	per meen	(110410)			
	21MATP0101	Algebra	4	4	3	40	60	100
	21MATP0102	Real Analysis	4	4	3	40	60	100
Core Course	21MATP0103	Numerical Analysis	4	4	3	40	60	100
	21MATP0104	Differential Equations	4	4	3	40	60	100
	21MATP0105	Discrete Mathematics	4	4	3	40	60	100
Foundation Course	21GTPP0001	Gandhi in Everyday Life	2	2		50		50
		TOTAL	22					
	Semester – II							
	21MATP0206	Linear Algebra	4	4	3	40	60	100
Core Course	21MATP0207	Advanced Real Analysis	4	4	3	40	60	100
Core Course	21MATP0208	Mathematical Methods	4	4	3	40	60	100
	21MATP0209	Probability and Statistics	4	4	3	40	60	100
	21MATP0210	Differential Geometry	3	3	3	40	60	100
Electives	21MATP02GX	Generic Elective	3	3	3	40	60	100
Value Added Course	21MATP2VAX	Value Added Course						
Skill Development Course	21ENGP00C1	Communication and Soft Skills	2	2		50		50
	TOTAL 24							

w.e.f. 2021-2022

	Semester – III							
	21MATP0311	Topology	4	4	3	40	60	100
	21MATP0312	Measure Theory	4	4	3	40	60	100
Core Course	21MATP0313	Stochastic Processes	4	4	3	40	60	100
	21MATP0314	Optimization Techniques	4	4	3	40	60	100
Electives	21MATP03DX	Discipline Centric Elective	3	3	3	40	60	100
Modular Course	21MATP03MX	Modular Course	2	2		50		50
Extension	21EXNP03V1	Village Placement Programme	2			50		50
	·	TOTAL	23					
	Semester – IV							
	21MATP0415	Complex Analysis	4	4	3	40	60	100
Core Course	21MATP0416	Functional Analysis	4	4	3	40	60	100
	21MATP0417	Graph Theory	4	4	3	40	60	100
	21MATP0418	Dissertation	6	12		75	75+50	200
Value Added Course	21GTPP00H1	Human values and Professional Ethics	2	2		50		50
Modular Course	21MATP04MX	Modular Course	2	2		50		50
		TOTAL	22			-		
	GR	AND TOTAL	91					

DISCIPLINE CENTRIC ELECTIVES: (21MATP03DX)

Semester – III

- 1. 21MATP03D1 Classical Dynamics
- 2. 21MATP03D2 Control Theory
- 3. 21MATP03D3 Optimal Control
- 4. 21MATP04D4 Fractal Analysis

GENERIC ELECTIVES: (21MATP02GX)

Semester-II

- 1. 21MATP02G1 Numerical and Statistical Methods
- 2. 21MATP02G2 Coding Theory



VALUE ADDED COURSES: (21MATP02VAX)

- 1. 21MATP2VA1 Numerical Methods for Engineers
- 2. 21MATP2VA2 Mathematics for Completive Examinations

VALUE ADDED COURSES: - Semester IV

1. 21GTPP00H1 Human values and Professional Ethics

MODULAR COURSES: (21MATP03MX/21MATP04MX)

${\bf Semester-III}$

- 1. 21MATP03M1Calculus of Variations
- 2. 21MATP03M2 Wavelet Analysis

Semester - IV

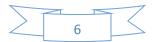
- 1. 21MATP04M3 Introduction to SciLab
- 2. 21MATP04M4 Neural Networks

ABSTRACT			
Course type	Total number of Courses		
Core Course	17		
Discipline Centric Elective	01		
Generic Elective	01		
Modular Course	02		
Foundation Course	01		
Extension	01		
Dissertation	01		
Value Added Course	01		
Human values and Professional Ethics	01		



w.e.f.	2021-
2022	

Semester	I	Course Code	21MATP0	101		
Course Title	Algebra					
No. of. Credits	4 No. of. contact hours per 4					
New Course/ Revised Course		If revised, Percentage of Revision effected (Minimum 20%)				
Category	Core Course					
Scope of the Course	Advanced Skill					
Cognitive Levels addressed by the course	 Recognizing some advances of theory of groups, extension fields, Galois theory (K1 Remember) Understanding automorphism group of a group, class equation of a group and the structure of finite abelian groups (K2-Understanding) Applying Sylow's Theorem to study the properties of groups. Using class equation to find the conjugacy classes in symmetric groups (K3-Applying) Examining the degree of extension fields and degree of splitting field of the polynomial. Testing the irreducibility of a polynomial (K4-Analyse) Investigating the structure of two isomorphic algebraic structures like groups, rings, fields (K5-Evaluate) 					
Course Objective	 Formulating some special types of rings, ideals (K6-Create) The Course aims to provide deep knowledge about various algebraic structures. 					
Unit	Content No. of. Hour					
Ι	A counting principle - Normal subgroups and quotient groups – Homomorphisms – Automorphisms - Cayley's theorem - Permutation 14 groups.					
II	Another counting principle - Sylow's theorems - Direct product - Finite 12					
III	Euclidean rings - A particular Euclidean ring - Polynomial rings - Polynomials over the rational field - Polynomial rings over commutative 13 rings.					
IV	Extension fields - Roots of polyno	mials - More about roots - Finite	fields.	12		
V	The elements of Galois theory - S the rationals.	Solvability by radicals - Galois g	roup over	13		



w.e.f. 2021-2022

	Text Books:				
	1. I. N. Herstein, Topics in Algebra , 2 nd edition, John Wiley & Sons, Singapore, 2006.				
	Unit 1: Chapter 2: Sections 2.5, 2.6, 2.7, 2.8, 2.9, 2.10				
	Unit 2: Chapter 2: Sections 2.11, 2.12, 2.13, 2.14				
	Unit 3: Chapter 3: Sections 3.7, 3.8, 3.9, 3.10, 3.11				
	Unit 4: Chapter 5: Sections 5.1, 5.3, 5.5 & Chapter 7: Section 7.1				
	Unit 5: Chapter 5: Sections 5.6, 5.7, 5.8.				
	Reference Books:				
Defense	1. John. B. Fraleigh, A First Course in Abstract Algebra, 7th Edition, Addison-Wesley,				
References	New Delhi, 2003.				
	2. P. B. Bhattacharya, S. K. Jain & S. R. Nagpaul, Basic Abstract Algebra, Cambridge				
	University Press, USA, 1986.				
	3. Charles Lanski, Concepts in Abstract Algebra, AMS, USA, 2010.				
	4. M. Artin, Algebra, Prentice-Hall of India, New Delhi, 1991.				
	5. D. S. Dummit & R. M. Foot, Abstract Algebra, John Wiley, New York, 1999.				
	E- Resources:				
	1. <u>https://onlinecourses.nptel.ac.in/noc18_ma15</u>				
	2. <u>https://onlinecourses.nptel.ac.in/noc18_ma16</u>				
	On completion of the course students should be able to				
	CO1: Explain advances of the theory of groups.				
Course	CO2: Use Sylow's theorems in the study of finite groups.				
Outcomes	CO3: Formulate some special types of rings and their properties.				
	CO4: Assess the interplay between fields and vector spaces.				
	CO5: Apply the algebraic methods for solving problems.				

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	1	3
CO2	3	1	2	1	3
CO3	3	2	1	1	2
CO4	3	3	1	1	3
CO5	3	3	2	1	3

Semester	I	Course Code	21MATP0102
Course Title	Real Analysis		
No. of. Credits	4	No. of. contact hours per week	4
New Course/		If revised, Percentage of	
Revised		Revision effected	
Course		(Minimum 20%)	



Category	Core Course	
Scope of the Course	Advanced Skill	
Cognitive Levels addressed by the course	 Understanding the fundamentals of sets and axioms (K1 & K2-Rememberi understanding). Understanding the geometry of metric spaces and identifying open, closed and compact sets in metric spaces (K2 & K4 -Remembering and Analyzing Evaluating the limit of a sequence/series by analysing the convergence of the sequence/series (K4 & K5-Analyzing and Evaluating). Applying open & closed set to study continuous and discontinuous function Applying). Identifying differentiable functions and evaluate its derivatives (K4 & K5 and Evaluating) 	, connected ;). the ons (K3-
Course Objective	The Course aims to impart the concepts of sets and functions on metric spaces	5.
Unit	Content	No. of. Hours
Ι	The real and complex number systems: Introduction, Ordered sets – Fields - The real field - The extended real number system - The complex field - Euclidean spaces.	13
II	Basic Topology: Finite - Countable and Uncountable sets - Metric spaces - Compact sets - Perfect sets - Connected sets.	13
III	Numerical Sequences and Series: Convergent sequences – Subsequences – Cauchy sequences - Upper and lower limits - Some special sequences – Series - The number e - The root and ratio tests – Power series - Summation by parts - Absolute convergence - Addition and multiplication of series - Rearrangements.	16
IV	Continuity: Limits of functions - Continuous functions - Continuity and compactness - Continuity and connectedness - Monotonic functions - Infinite limits and limits at infinity.	11
V	Differentiation: The derivative of a real function - Mean value theorems - The continuity of derivatives - L'Hospital's rule - Derivatives of Higher order - Taylor's theorem - Differentiation of vector valued functions.	13
References	 Text Books: Walter Rudin, Principles of Mathematical Analysis, 3rd Edition, International Book Company, Singapore, 1982. Units 1-5: Chapters: 1 – 5 (Including Appendix of chapter 1). Reference Books: Tom M. Apostol, Mathematical Analysis, Narosa Publishing House, New 2. G. F. Simmons, Introduction to Topology and Modern Analysis, McG Delhi, 2004. R. G. Bartle & D.R. Sherbert, Introduction to Real Analysis, John Wi 	⁻ Delhi, 1997. Graw- Hill, New

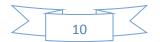


	York, 1982.
	4. Kenneth A. Ross, Elementary Analysis: The theory of Calculus, Springer, New York,
	2004.
	5. N. L. Carothers, Real Analysis, Cambridge University Press, UK, 2000.
	6. S. C. Malik, Mathematical Analysis, Willey Eastern Ltd., New Delhi, 1985.
	E- Resources:
	1. <u>http://nptel.ac.in/courses/109104124/</u>
	2. <u>http://nptel.ac.in/courses/111101100/</u>
	On completion of the course students should be able to
	CO1: Discuss various axioms and properties of real and complex numbers.
Course	CO2: Identify the topological properties of sets in metric spaces.
Outcomes	CO3: Compute the limits of convergent sequences/series.
	CO4: Identify the topological properties of functions defined on metric spaces.
	CO5: Evaluate the derivative of real valued functions.

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	1
CO2	3	2	3	1	2
CO3	3	3	2	2	2
CO4	3	3	2	1	2
CO5	3	3	2	1	2

Semester	Ι	Course Code	21MATP0103
Course Title	Numerical Analysis		
No. of. Credits	4	No. of. contact hours per week	4
New Course/		If revised, Percentage of	
Revised		Revision effected	
Course		(Minimum 20%)	
Category	Core Course		
Scope of the Course	Employability		
Cognitive Levels addressed by the course	 Knowing large number numerical calculations (K1) Understanding numerical ability (K2) Applying algorithms numerically (K3) 		

Course Objective	The Course aims to develop skills to solve many physical problems in a efficient manner using different numerical techniques.	n effective and
Unit	Content	No. of. Hours
Ι	Solving a system of simultaneous equations: Elimination method - The Gaussian elimination and Gauss -Jordan method - Iterative methods - Gauss Jacobi iteration- Gauss Seidel iteration- Relaxation method.	13
II	Interpolation and curve fitting: Lagrangian polynomials - Divided differences - Interpolation with cubic spline – Least square approximation of functions.	13
III	Numerical differentiation and integration: Numerical differentiation- derivatives using Newton's forward and backward formula - Derivatives using Stirling's formula - Trapezoidal rule - Simpson's 1/3 rd rule - 3/8 rule - Weddles's rule - Errors in quadrature formula.	13
IV	Numerical solution of ordinary differential equations: The Taylor series method – Picard's method - Euler and modified Euler methods – Runge - Kutta methods - Milne's method - The Adams - Moulton method.	13
V	Numerical Solution of Partial Differential Equations:Introduction - Difference quotients - Geometrical representation of partial differential quotients - Classification of partial differential equations - Elliptic equations - Solutions to Laplace's equation by Liebmann's iteration process - Poisson's equations and its solutions - Parabolic equations - Crank - Nicholson method - Hyperbolic equations.	12
References	Text Books: 1. Curtis. F. Gerald, Patrick & O. Wheatley, Applied Numerical Analy Pearson Education, New Delhi, 2005. Unit 1: Chapter 2: Sections 2.3, 2.4, 2.10, 2.11 Unit 2: Chapter 3: Sections 3.1, 3.2, 3.3, 3.4, 3.7. 2. V. N. Vedamurthy& N. Ch. S. N. Iyengar, Numerical Methods, V House, Pvt. Ltd., Noida, 2000. Unit 3: Chapter 9: Sections 9.1 to 9.4, 9.6 to 9.12. Unit 4: Chapter 11: Sections 11.4 to 11.20. Unit 5: Chapter 12: Sections 12.1 to 12.9. Reference Books: 1. M. K. Jain, S. R. K. Iyengar & R. K. Jain, Numerical Methods for Engineering Computation, 3 rd Edition, Wiley Eastern Edition, New D. 2. R. L. Burden & J. Douglas Faires, Numerical Analysis, Thompson Bool E- Resources: 1. http://nptel.ac.in/courses/111107105/	ikas Publishing r Scientific and elhi, 2003.

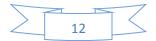


	On completion of the course students should be able to
	CO1: Apply different methods to solve the system of equations
Course	CO2: Realize the nature of different curves along with specified properties
Outcomes	CO3: Utilize various types of integrals to solve many complicated problems
	CO4: Outline the methods to solve higher order differential equations
	CO5: Discuss various types of partial differential equations.

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	1	2
CO2	3	3	3	3	2
CO3	2	2	3	3	3
CO4	3	3	2	3	1
CO5	1	2	3	3	3

Semester	Ι	Course Code	21MATP0	104
Course Title	Differential Equations			
No. of. Credits	4	No. of. contact hours per week	4	
New Course/		If revised, Percentage of		
Revised	Revised Course	Revision effected		20%
Course		(Minimum 20%)		
Category	Core Course			
Scope of the Course	Advanced Skill			
Cognitive Levels addressed by the course	 Identify various basic concepts on differentiations(K1) Use to model differential systems (K2) To develop approximation methods and fixed point theorems to get solutions of differential equations (K3) Extend the results to higher order differential calculus(K4) To develop skills to obtain solutions partial differential equations(K5) 			
Course Objective	The Course aims to study in-depth concepts and applications of differential equations.			
Unit	Content No. of. Hour			No. of. Hours
Ι	Systems of linear differential equa equations - Existence and unique - homogeneous linear systems - L Linear systems with periodic coef	ness theorem - Fundamental ma inear systems with constant co	trix – Non	13

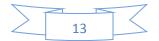
II	Existence and uniqueness of solutions: Introduction - Successive approximations - Picard's theorem - Continuation and dependence of initial conditions – Fixed point method.	12		
III	Boundary value problem: Introduction - Strum Liouville problem - Green's function - Applications of boundary value problems - Picard's theorem.			
IV	First order partial differential equations: Linear equations of the first order– Pfaffian differential equations – Compatible systems – Charpit's method13– Jacobi's method – Integral surface through a given circle.13			
V	Genesis of second order PDE: Classifications of second order PDE – 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) – Heat conduction problem – Heat conduction of infinite rod case - Heat conduction of finite rod case.	13		
References	 Text Books: S. G. Deo, V. Lakshmikantham & V. Raghavendra, Ordinary Differed Second Edition, McGraw-Hill Education (India) Pvt. Ltd., New Delhi, 20 Unit 1: Chapter 4: Sections 4.1 to 4.8. Unit 2: Chapter 5: Sections 5.1 to 5.6, 5.9 Unit 3: Chapter 7: Sections 7.1 to 7.5. T. Amarnath, An Elementary Course in Partial Differential Equations, N New Delhi, 1997. Unit 4: Chapter 1: Sections 1.4 to 1.9 Unit 5:Chapter 2: Sections 2.1, 2.2, 2.3.1, 2.3.2, 2.3.3, 2.3.5, 2.5.1, 2.5.2 Reference Books: S. G. Deo, V. Raghavendra , Rasmita Kar & V. Lakshmikantham, Text bo Differential Equations, Third Edition, McGraw-Hill Education(India) Pv Delhi, 2016. Earl. A. Coddington, An Introduction to Ordinary Differential Equations Pvt. Ltd., New Delhi, 2013. G. F. Simmons, S. G. Krantz, Differential Equations: Theory, Technique a Tata McGraw Hill Book Company, New Delhi, India, 2007. Clive R. Chester, Techniques in Partial Differential Equations, McGraw-J. 5. K. Sankara Rao, Introduction to Partial Differential Equations, Second Ed Hall of India Pvt. Ltd., New Delhi, 2005. E- Resources: https://onlinecourses.nptel.ac.in/noc18_ma10 https://nptel.ac.in/courses/111/107/1111/ 	13. arosa Publishers, ok of Ordinary t. Ltd., New s , PHI Learning nd Practice , Hill, 1970		



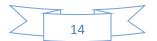
	On completion of the course students should be able to CO1: Formulate problems in Differential Equations. CO2: Apply basic concepts of both ordinary and partial differential equations in physical
Course Outcomes	problems CO3: Explain various types of differentiations. CO4: Discuss problems in differential equations.
	CO5: Identify various partial differential equations models in Physics.

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	2	3
CO2	2	3	2	2	2
CO3	1	2	1	2	3
CO4	1	2	2	1	3
CO5	1	2	2	2	2

Semester	Ι	Course Code	21MATP0	105
Course Title	Discrete Mathematics	·		
No. of. Credits	4	No. of. contact hours per week		4
New Course/		If revised, Percentage of		
Revised		Revision effected		
Course		(Minimum 20%)		
Category	Core Course			
Scope of the Course	Advanced Skill			
Cognitive	• K-1: Knowing the concepts of basic principles to solve the counting problems			
Levels	• K-2: Understanding the permutation and combinatorial problem			
addressed by	• K-3: Applying Inclusion-exclusion principle to real life problems.			
the course	• K-3: Evaluating number theoretical problems by using number theoretic functions			
Course	The Course aims to impart various concepts about permutations, combinations and theory of			
Objective	numbers.			
Unit	Content No. of. Hour		No. of. Hours	
Ι	(subsets) of sets -Permutations Pigeonhole principle: simple for	es - Permutations of sets -Com of multi sets -Combinations of mu orm - strong form - Pascal's triang dality of binomial coefficients 's binomial theorem.	ulti sets - gle - The	14



II	The inclusion – exclusion principle – Combinations with repetition – Derangements – Permutations with forbidden positions – Some number sequences – Generating functions – Exponential generating functions – Solving linear homogeneous recurrence relations and non-homogeneous recurrence relations.	13		
III	Divisibility theory in the integers: Early number theory -The divisionalgorithm - The greatest common divisor - The Euclidean algorithm -TheDiophantine equation. Primes and their distributions: The fundamentaltheorem of arithmetic -The sieve of Eratosthenes -The Goldbachconjecture.			
IV	The theory of congruence: Basic properties of congruence - Linear congruence and the Chinese Reminder Theorem -Fermat's Theorem: Fermat's little theorem and pseudoprimes - Wilson's theorem - The Fermat- Kraitchik factorization method.			
V	Number theoretic functions: The sum and number of divisors - The Mobius inversion formula. Euler's generalization of Fermat's theorem: Euler's Phi function-Euler's theorem - Some properties of Phi function. Primitive roots:12The order of an integer modulo <i>n</i> - Primitive roots for primes - Composite12			
References	 numbers having primitive roots. Text Books: Richard A. Brualdi, Introductory Combinatorics, 5th edition, Pearson Education Inc, England, 2010. Unit 1: Chapter 2: Sections 2.1 - 2.5. Chapter 3: Sections 3.1, 3.2. Chapter 5: Sections 5.1 - 5.5. Unit 2: Chapter 6: Sections 6.1 - 6.4. Chapter 7: Sections 7.1 - 7.5. David M. Burton, Elementary Number Theory, 6th Edition, Tata McGraw Hill, New Delhi, 2006. Unit 3: Chapter 2: Sections 2.1 - 2.5, Chapter 3: Sections 3.2 - 3.3. Unit 4: Chapter 4: Sections 4.2, 4.4, Chapter 5: Sections 5.2 - 5.4. Unit5: Chapter 6: Sections 6.1, 6.2, Chapter 7: Sections 7.2, 7.3, Chapter 8: Sections 8.1 - 8.3. Reference Books: C. Berg, Principles of Combinatorics, Academic Press, New York, 1971. S. Lipschutz & M. Lipson, Discrete Mathematics, Tata McGraw-Hill Publishing Company, New Delhi, 2006. J. Truss, Discrete Mathematics for Computer Scientists, Pearson Education Limited, England, 1999. Tom. M. Apostol, Introduction to Analytic Number Theory, Springer, New Delhi, 1993. Thomas Koshy, Elementary Number Theory, Elsevier, California, 2005. N. Robbins, Beginning Number Theory, 2nd Edition, Narosa Publishing House, New			



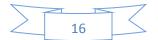
w.e.f.	2021-
2022	

	E- Resources:					
	1. https://www.tutorialspoint.com/discrete_mathematics/					
	2. <u>home.iitk.ac.in/~arlal/book/mth202.pdf</u>					
	On completion of the course students should be able to					
	CO1: Outline the ideas of permutations, combinations and its properties					
Course	CO2: Apply the permutations and combinations to solve problems					
Outcomes	CO3: Predict the concepts of divisibility and related algorithms					
	CO4: Analyse the properties of congruence relations					
	CO5: Explain the number theoretic functions					

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2
CO2	3	1	2	1	2
CO3	2	2	1	2	2
CO4	2	2	1	2	2
CO5	2	2	1	2	2

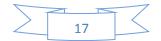
Semester	II	Course Code	21MATP0206				
Course Title	Linear Algebra						
No. of. Credits	4	No. of. contact hours per week	4				
New Course/ Revised Course		If revised, Percentage of Revision effected (Minimum 20%)					
Category	Core Course						
Scope of the Course	Advanced Skill						
Cognitive Levels addressed by the course	 Recognizing some advances of vector spaces, inner product spaces and linear transformations (K1-Knowing). Discussing certain canonical forms of vector spaces, visualizing linear transformations in matrix form, diagonalization of quadratic forms, dual spaces (K2-Understanding). Using Gram-Schmidt Orthogonalization process to find a orthonormal basis (K3-Apply). Examining the linear independence and orthogonality of set of vectors, dimension of vector spaces, linear transformations (K4-Analyse). Constructing linearly independent sets, basis, subspaces, linear transformations in a vector space (K6-Create). 						
Course Objective	The Course aims to introduce som	ne important concepts of vector	spaces.				

Unit	Content	No. of. Hours			
Ι	Vector spaces: Elementary basic concepts - Linear independence and bases - Dual spaces.	14			
II	Linear Transformations: The algebra of linear transformations - Characteristic roots – Matrices.	13			
III	Canonical Forms: Triangular forms - Nilpotent transformations - A decomposition of vector spaces: Jordan form.	13			
IV	Inner product spaces – Orthogonality – Orthogonalization - Orthogonal Complement – Trace and Transpose.	12			
V	Hermitian - Unitary and Normal Transformations - Quadratic forms: Basic properties of quadratic forms – Diagonalization of quadratic forms.	12			
References					
Course Outcomes	1.https://onlinecourses.nptel.ac.in/noc18_ma16On completion of the course students should be able to CO1: Identify the advances of vector spaces and linear transformations. CO2: Analyse the concepts of linear algebra in geometric point of view. CO3: Visualize linear transformations as matrix form. CO4: Decompose a given vector space into certain canonical forms. CO5: Formulate several classes of linear transformations and their properties.				



PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	1	3
CO2	3	3	3	1	3
CO3	3	3	2	1	3
CO4	3	2	2	1	3
CO5	3	3	3	1	3

Semester	П	Course Code	21MATP0	207			
Course Title	Advanced Real Analysis						
No. of. Credits	4	No. of. contact hours per week	4				
New Course/ Revised Course		If revised, Percentage of Revision effected (Minimum 20%)					
Category	Core Course						
Scope of the Course	Advanced Skill						
Cognitive Levels addressed by the course	 Interpreting the geometry of integrals and evaluating the integral values (K4 & K5). Understanding the concepts of uniform convergence and apply them to evaluate the derivatives and integrals (K2 & K3). Understanding the concepts trigonometric functions and applying them to study Fourier series. (K2 & K3). Understanding the concepts of functions of several variables and evaluating the derivatives of multi-variable functions (K2 & K5) Applying Implicit function theorem to Identifying solutions of differential equations (K3 & K6). 						
Course Objective	The Course aims to introduce the and series of functions.	concept of integration of real-	valued funct	tions, sequences			
Unit	Content No. of. Hours						
Ι	The Riemann-Stieltjes integral: Definition and existence of the integral -Properties of the integral - Integration and differentiation - Integration of13vector valued functions - Rectifiable curves.						
II	Sequences and series of functions Convergence - Uniform conv convergence and Integration - Un Equicontinuous families of function	ergence and continuity - aiform convergence and differe	Uniform entiation -	12			



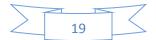
III	Some special functions: Power series - The exponential and Logarithmic functions - The trigonometric functions - The algebraic completeness of the complex field - Fourier Series - The Gamma functions.	13						
IV	Functions of several variables: Linear transformations – Differentiation - The contraction principle - The inverse function theorem.13							
V	The implicit function theorem - The rank theorem - Determinants - Derivatives of higher order - Differentiation of integrals.							
References	 Text Books: Walter Rudin, Principles of Mathematical Analysis, 3rd Edition, McGraw – Hill International Book Company, Singapore, 1982. Unit 1: Chapter 6, Unit 2: Chapter 7, Unit 3: Chapter 8. Unit 4, 5: Chapter 9. Reference Books: Tom M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, India, 1997. G. F. Simmons, Introduction to Topology and Modern Analysis, 3rd Ed., McGraw-Hill, New Delhi, 2004. S. C. Malik, Mathematical Analysis, Wiley Eastern Ltd., New Delhi, 1985. N. L. Carothers, Real Analysis, Cambridge University Press, UK, 2000. E- Resources: https://nptel.ac.in/courses/111/106/111106053/ 							
Course	2. <u>https://nptel.ac.in/courses/111/106/111106153/</u> On completion of the course students should be able to CO1: Evaluate the integrals of a bounded function on a closed bounded interval. CO2: Compute the pointwise limit and Uniform limit of accuraces of functions.							
Outcomes	 CO2: Compute the pointwise limit and Uniform limit of sequences of functions. CO3: Analyse the convergence of Fourier series CO4: Evaluate the derivative of functions of several variables CO5: Compute higher order derivatives for vector valued functions 							

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	1
CO2	3	3	2	2	2
CO3	3	3	2	1	2
CO4	3	3	2	2	2
CO5	3	3	2	1	2



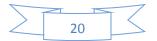
w.e.f.	2021-
2022	

Semester	II	Course Code	21MATP0208			
Course Title	Mathematical Methods					
No. of. Credits	4	No. of. contact hours per week	4			
New Course/ Revised Course		If revised, Percentage of Revision effected (Minimum 20%)				
Category	Core Course					
Scope of the Course	Advanced Skill					
Cognitive Levels addressed by the course Course	 Knowing different methods of Understanding the in-build t Applying various transformation The Course aims to learn vario 	echniques of calculations (K2) tions to reality (K3)	mation technique	es and its		
Objective	applications.					
Unit		Content		No. of. Hours		
Ι	Integral equations: Types of integral equations - conversion of ordinary differential equation into integral equation - Method of converting initial value problem into a Volterra integral equation - Boundary value problem - Method of converting a boundary value problem into a Fredholm integral equation - Solution of Homogeneous Fredholm integral equation of the second kind with separable kernels - Problems - Characteristic values and functions - Solutions of Fredholm integral equation of the second kind with separable kernels - Problems.					
II	Method of successive approximations : Introduction - Iterated kernels or functions - Resolvent (or reciprocal) kernel - Solution of Fredholm integral equation of the second kind by successive substitutions - Solution of Volterra integral equation of the second kind by successive approximations - Reciprocal functions Neumann series -Solutions of Volterra integral equation of the second kind when its kernel is of some particular form - Solution of Volterra equation of the second kind by reducing to differential equation.					
III	Classical Fredholm theory – Introduction - Fredholm's first fundamental theorem - Problems based on Fredholm's first fundamental theorem - Fredholm's second					
IV	fundamental theorem - Fredholm's third fundamental theorem - Including proof.Singular integral equations - The solution of Abel's integral equation - Some general form of Abel's singular integral equation - Problem- Applications of integral equation and Green's functions to ordinary differential equation - Green's function- Conversion of a boundary value problem into Fredholm's integral equation - Some special cases - Examples based on construction of Green's functions and problems.13					



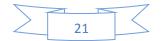
	Fourier Transforms - Definition- Inversion theorem - Fourier sine and cosine					
V	transform - Fourier transforms of derivatives - Convolution theorem - Parsevel's 13					
	relation for Fourier transform and problems on self-reciprocal.					
	Text Books:					
	1. M. D. Raisinghania, Integral Equations and boundary value Problems, Third	d Revised				
	Edition, S. Chand & Company Ltd. New Delhi, 2010.					
	Unit I: Chapter 2 Sections 2.1 to 2.6 and Chapter 3 Sections 3.1 to 3.3					
	Unit 2: Chapter 5 Sections 5.1 to 5.15					
	Unit 3: Chapter 6.1 to 6.5					
	Unit 4: Chapter 8, Section 8.1 to 8.6, Chapter 11 Section 11.1 to 11.8					
	2. I. N. Sneddon, The use of Integral Transform , Tata McGraw Hill, New Delhi, 1974.					
References	Unit 5:					
	Reference Books:					
	1. J. K. Goyal & K. P. Gupta, Laplace and Fourier Transforms, 12th Edition	n. Pragati				
	Prakashan Meerukt, 2000.	, 0				
	2. W. V. Lovitt, Linear Integral equations, Dover Publications, New York, 1950.					
	E- Resources:					
	1. http://nptel.ac.in/courses/111107103/					
	2. <u>https://onlinecourses.nptel.ac.in/noc18_ma12</u>					
	3. http://nptel.ac.in/courses/111107103/					
	On completion of the course students should be able to					
	CO1: Apply the various concepts of integral equations in various problems					
Course						
	CO2: Discuss the solutions of various integral equations	unth or				
Outcomes	CO3: Assess various theorems with proof techniques that will motivate to develop f	urther				
	CO4: Create different functions based on applications					
	CO5: Apply different transformation techniques in solving problems.					

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3
CO2	3	3	3	2	3
CO3	1	1	3	2	3
CO4	2	3	2	3	2
CO5	3	2	1	3	3

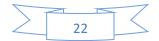


w.e.f.	2021-
2022	

Semester	II	Course Code	21MATP()209	
Course Title	Probability and Statistics				
No. of. Credits	4	No. of. contact hours per week	4		
New Course/ Revised Course	Revised Course If revised, Percentage of Revision effected (Minimum 20%)			80%	
Category	Core Course				
Scope of the Course	Advanced Skill				
Cognitive Levels addressed by the course	 K2: Understanding the pro K3: Applying central limit K4: Analyzing various pro 	s of probability, random variables operties of moment generating fu t theorem for limiting problems is bability distributions s through various methods	nctions	tion	
Course Objective	The Course aims to learn the ad	dvanced theory of probability and	d some statisti	cal techniques.	
Unit	Content			No. of. Hours	
Ι	Random variables and its Distributions: Introduction-Random Variable- Types of Random Variables-Probability Mass Function, Probability Density Function and Probability Distribution- Distribution Function- Functions of Random Variables and their Distributions.			12	
II	Expectation, Variance and Other Moments of Random Variable : Introduction-Expected value of a random variable-Properties of expected value-Conditional Expectation-Variance and covariance of Random variables-Properties of variance-Conditional Variance-Theorems on Mean and Variance : Cauchy-Schwartz Inequality-Chebyshev's Inequality- Marko's Inequality-Moments of Random variable-Moment Generating function-Factorial Moment Generating function- Joint Moment Generating function-Characteristics of Moment Generating function- Cumulant and Cumulant Moment Generating function- Properties of Moment Generating function-Characteristic function- Characteristic function of k-dimensional random variables-Properties of Characteristic function.			14	
III	function. Convergence in probability-Weak Law of Large number-Strong Law of Large Numbers-Central Limit Theorem-Binomial distribution: Definition and origin-First four moments of the Binomial distribution-Generating functions of the Binomial distribution- Applications of Binomial distribution-Poisson distribution: Definition and applications-First four moments of the Poisson distribution-Generating functions of the Poisson distribution-Fitting of Poisson distribution-Normal distribution: Definition and remarks-Moments and Generating functions of Normal distribution-			13	

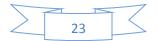


Fitting of Normal distribution-Properties of Normal distribution. IV Method of Estimation: Introduction-Maximum Likelihood (ML) Method- Properties of ML Estimators-Method of Least Squares-Properties of Least squares Estimator-Method of Moment-Method of Minimum Chi-square- Bayes method of Estimation. 12 Interval Estimation: Introduction-Method of construction of Confidence Interval Estimation: Introduction-Method of construction of Confidence interval using Chebyshev's Inequality-Uniformly most accurate (UMA) 13 V Confidence Interval-Unbiased Confidence Interval-Confidence interval for the difference of two Means-Confidence interval for the Difference of two proportions. 13 Text Books: 1. K. C. Bhuyan, Probability Distribution Theory and Statistical Inference, New Cerr Book Agency Pvt. Ltd., London, 2015. Unit.1 Section 2.1-2.6, Unit.2 Section 3.1-3.19 (Except 3.15, 3.16) Unit.3 Section 3.21-3.24, Section 7.1-7.4, 8.1-8.4-16.1-16.3, 16.5 Unit.4 Section 33.1-33.8. Unit.5 Section 35.1-35.6.
IV Properties of ML Estimators-Method of Least Squares-Properties of Least squares Estimator-Method of Moment-Method of Minimum Chi-square-Bayes method of Estimation. 12 Interval Estimation: Introduction-Method of construction of Confidence Interval-Pivotal-Method to find Confidence Interval-Confidence interval using large sample-Statistical Method of Confidence Interval-Confidence interval using Chebyshev's Inequality-Uniformly most accurate (UMA) 13 Confidence Interval-Unbiased Confidence Interval-Confidence interval for the difference of two Means-Confidence interval for the Difference of two morportions. 1 Text Books: 1. K. C. Bhuyan, Probability Distribution Theory and Statistical Inference, New Cerr Book Agency Pvt. Ltd., London, 2015. 1 Unit.1 Section 2.1-2.6, Unit.2 Section 3.1-3.19 (Except 3.15, 3.16) 1 1 Unit.4 Section 33.1-33.8. 0 0 0 Unit.5 Section 35.1-35.6. 0 0 0
Interval Estimation: Introduction-Method of construction of Confidence Interval- Pivotal-Method to find Confidence Interval-Confidence interval using large sample-Statistical Method of Confidence Interval-Confidence V interval using Chebyshev's Inequality-Uniformly most accurate (UMA) Confidence Interval-Unbiased Confidence Interval-Confidence interval for the difference of two Means-Confidence interval for the difference of two Means-Confidence interval for the Difference of two proportions. Text Books: 1. K. C. Bhuyan, Probability Distribution Theory and Statistical Inference, New Cer Book Agency Pvt. Ltd., London, 2015. Unit.1 Section 2.1-2.6, Unit.2 Section 3.1-3.19 (Except 3.15, 3.16) Unit.3 Section 3.21-3.24, Section 7.1-7.4, 8.1-8.4-16.1-16.3, 16.5 Unit.4 Section 33.1-33.8. Unit.5 Section 35.1-35.6.
Interval- Pivotal-Method to find Confidence Interval-Confidence interval using large sample-Statistical Method of Confidence Interval-Confidence interval using Chebyshev's Inequality-Uniformly most accurate (UMA) Confidence Interval-Unbiased Confidence Interval-Confidence interval for the difference of two Means-Confidence interval for the Difference of two proportions.13Text Books:1. K. C. Bhuyan, Probability Distribution Theory and Statistical Inference, New Cert Book Agency Pvt. Ltd., London, 2015. Unit.1 Section 2.1-2.6, Unit.2 Section 3.1-3.19 (Except 3.15, 3.16) Unit.3 Section 3.21-3.24, Section 7.1-7.4, 8.1-8.4-16.1-16.3, 16.5 Unit.4 Section 33.1-33.8. Unit.5 Section 35.1-35.6.
 K. C. Bhuyan, Probability Distribution Theory and Statistical Inference, New Cern Book Agency Pvt. Ltd., London, 2015. Unit.1 Section 2.1-2.6, Unit.2 Section 3.1-3.19 (Except 3.15, 3.16) Unit.3 Section 3.21-3.24, Section 7.1-7.4, 8.1-8.4-16.1-16.3, 16.5 Unit.4 Section 33.1-33.8. Unit.5 Section 35.1-35.6.
Book Agency Pvt. Ltd., London, 2015. Unit.1 Section 2.1-2.6, Unit.2 Section 3.1-3.19 (Except 3.15, 3.16) Unit.3 Section 3.21-3.24, Section 7.1-7.4, 8.1-8.4-16.1-16.3, 16.5 Unit.4 Section 33.1-33.8. Unit.5 Section 35.1-35.6.
Reference Books:
References 1. Robert V. Hogg & Allen T. Craig, Introduction to Mathematical Statistics, 5th Ed
Pearson Education, Singapore, 2002.
2. Irwin Miller & Marylees Miller, John E. Freund's Mathematical Statistics, 6th Ed
Pearson Education, New Delhi, 2002.
3. John E. Freund, Mathematical Statistics, 5th edition, Prentice Hall India, 1994.
4. S.M. Ross, Introduction to Probability Models, Academic Press, India, 2000.
E- Resources:
1. <u>https://onlinecourses.nptel.ac.in/noc18_ma19</u>
2. <u>https://onlinecourses.nptel.ac.in/noc18_ma22</u>
On completion of the course students should be able to
CO1: Explain the basic concepts of probability and its properties. CO2: Construct the probability distribution of a random variable, based on a real-world
Course situation, and use it to compute expectation and variable.
Outcomes CO3: Compute probabilities based on practical situations using the binomial, normal and other distributions.
CO4: Evaluate the limiting process of distributions and solve related problems. CO5: Constructing confidence intervals for ML estimators



PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	2	2	2
CO2	1	3	1	3	2
CO3	2	3	2	2	2
CO4	2	3	1	2	2
CO5	1	3	1	2	2

Semester	II	Course Code	21MATPO	210	
Course Title	Differential Geometry				
No. of. Credits	3	No. of. contact hours per week	3		
New Course/ Revised Course	New Course	If revised, Percentage of Revision effected (Minimum 20%)			
Category	Core Course				
Scope of the Course	Advanced Skill				
Cognitive Levels addressed by the course	 Understanding the concepts of curves in space and its tangents, normals, curvature (K1). Evaluating evolutes and involutes for space curves (K5) Evaluating first fundamental form and local intrinsic properties of surfaces (K5) Analysing curves on surfaces and its properties (K4) Creating Geodesics on different spaces (K6) 				
Course Objective	The Course aims to introduce the concepts of space curves, surfaces, and their properties.				
Unit	Content			No. of. Hours	
Ι	Theory of space curves: Unique parametric representation of a space curve - Arc- length - tangent and osculating plane - principal normal and binormal - curvature and torsion - contact between curves and surfaces - osculating circle and osculating sphere - locus of centres of spherical curvature.			9	
II	Tangent surfaces - Involutes and evolutes – Betrand curves - Spherical indicatrix - Intrinsic equations of space curves - Fundamental existence theorem for space curves - Helices.			10	
III	The first fundamental form and Definition of a surface - Nature of surface - Curves on surfaces - ' general surfaces of revolution - ' fundamental form - Direction coe	of points on a surface - Represen Fangent plane and surface non Helicoids - Metric on a surface	ntation of a rmal - The	10	



IV	Families of curves - Orthogonal trajectories - Double family of curves - Isometric correspondence - Intrinsic properties - Geodesics on a surface: Geodesics and their differential equations - Canonical geodesic equations - Io Geodesics on surface of revolution-Normal property of geodesics - Differential equations of geodesics using normal property.10			
V	Existence theorems - Geodesic parallels - Geodesic polar coordinates - Geodesic curvature - Gauss-Bonnet theorem-Gaussian curvature.			
References	 Text Books: D. Somasundaram, Differential Geometry: A First Course, Narosa Publishing Ho New Delhi, India, 2005. Unit 1: Sections 1.3-1.7, 1.10-1.12 Unit 2: Sections 1.13-1.18 Unit 3: Sections 2.2-2.10 Unit 4: Sections 2.11-2.15, 3.2-3.6 Unit 5: Sections 3.7-3.12. Reference Books: T.J. Willmore, An Introduction to Differential Geometry, Oxford University Pri New Delhi, 2006. Pressley, A.N., Elementary Differential Geometry, Springer, 2010. J. N. Sharma & A. R. Vasistha, Differential Geormetry, Kedar Nath Ram Nath, Meet 1998. Martin Lipschutz, Schaum's Outline of Differential Geometry (Schaum's Outlin McGraw-Hill, 1969. E- Resources: https://nptel.ac.in/courses/111/104/111104095/ https://nptel.ac.in/courses/111/104/111104092/ 	ress, erut,		
Course Outcomes	 On completion of the course students should be able to CO1: Explain the basic concepts about space curves, its arc length, tangents and normal CO2: Compute evolutes and involutes of various space curves CO3: Construct tangent plane, normal plane and osculating plane for space curves CO4: Analyze the orthogonal trajectories and geodesics CO5: Apply the Gauss Bonnet theorem on compact surfaces without boundary 			

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	2
CO2	1	3	2	2	3
CO3	3	2	1	3	2
CO4	2	1	2	3	3
CO5	3	3	2	2	3



Semester	III	Course Code	21MATPO	0311	
Course Title	Topology				
No. of. Credits	4	No. of. contact hours per week	4		
New Course/ Revised Course					
Category	Core Course				
Scope of the Course	Advanced Skill				
Cognitive Levels addressed by the course	 Recognizing topological spaces, basis, subspace topology, continuous functions, countablity axioms, separation axioms (K1- Knowing). Understanding box topology, product topology, metric topology (K2-Understading). Applying results of topology to determine the connectedness, compactness of topological spaces. (K3-Applying). Investigating the connectedness and compactness in Real line (K4 - Analyse). Building new topological spaces, connected spaces, compact spaces, normal spaces, regular spaces and Hausdorff space from the existing topological spaces (K6 - Create) 				
Course Objective	The Course aims to introduce the fundamental concepts of topology and study the properties of topological spaces.				
Unit	Content No. of. Hours				
Ι	Topological spaces -Basis for a top topology on $X \times Y$ – The subspace	14			
II	Continuous functions - The produ	13			
III	Connected spaces - Connected subspaces of the real line - Compact spaces - Compact subspaces of the real line.			13	
IV	Limit point compactness - The countability and separation axioms: The countability axioms - The separation axioms.			10	
V	Normal spaces - The Urysohn's lemma - The Urysohn'smetrization theorem —Tietz extension theorem - The Tychonoff theorem.			14	
References	Text Books: 1. James R. Munkres, Topology Unit 1: Chapter 2: Sect Unit 2: Chapter 2: Sect Unit 3: Chapter 3: Sect Unit 4: Chapter 4: Sect Unit 5: Chapters 4: Sect	ions 2.1- 2.6 ions 2.7-2.10 ions 3.1, 3.2, 3.4, 3.5		2006.	

	Reference Books:					
	1. G. F. Simmons, Introduction to Topology and Modern Analysis, Tata McGraw-Hill					
	Education Pvt. Ltd., New Delhi, 2016.					
	2. B. Mendelson, Introduction to Topology, CBS Publishers, Delhi, 1985.					
	3. Sze- Tsen Hu, Introduction to General Topology, Tata McGraw-Hill Publishing					
	Company Ltd., New Delhi, 1966.					
	4. S. Lipschutz, General Topology, Schaum's Series, McGraw-Hill New Delhi, 1965.					
	5. K. D. Joshi, Introduction to General Topology, New Age International Pvt. Ltd, New					
	Delhi, 1983.					
	6. J. L. Kelly, General Topology, Springer-Verlag, New York, 1975					
	7. James Dugundji, Topology , Allyn and Bacon INC, Boston, 1966.					
	E- Resources:					
	1. <u>https://nptel.ac.in/courses/111/106/111106054/</u>					
	On completion of the course students should be able to do					
	CO1: Discuss several constructions of topological spaces					
Course	CO2: Analyse various properties of topological spaces					
Outcomes	CO3: Apply properties of continuous functions on topological spaces					
	CO4: Examine connected, compact, and normal topological spaces and their properties					
	CO5: Demonstrate various theorems on Normal Topological spaces					

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	1	2
CO2	3	3	3	1	3
CO3	3	3	3	2	2
CO4	3	3	3	1	2
CO5	2	3	2	1	2

Semester	III	Course Code	21MATP0312
Course Title	Measure Theory		
No. of. Credits	4	No. of. contact hours per week	4
New Course/		If revised, Percentage of	
Revised		Revision effected	
Course		(Minimum 20%)	
Category	Core Course		
Scope of the	Advanced Skill		
Course	Advanced Skill		

Cognitive Levels addressed by the course	 Understanding the basic concepts of measurable sets and measurabl applying open sets (K2 & K3). Interpreting geometrically the Lebesgue integration and evaluate it (K4 & Understanding the Lebesgue integration on general spaces by app integration on real line. (K3 & K6). Understanding the concepts convergence of Lebesgue integrable function. Generalising the concept of Lebesgue measure (K6). 	t K5). lying Lebesgue
Course Objective	The Course aims to introduce the fundamentals of measure and integration or	n the real line.
Unit	Content	No. of. Hours
Ι	Measure on the real line: Lebesgue outer measure - Measurable sets - Regularity - Measurable functions - Borel and Lebesgue measurability.	12
II	Integration of functions of a real variable: Integration of non-negative functions - The general integral - Integration of series - Riemann and Lebesgue integrals.	13
III	Abstract measure spaces: Measures and outer measures - Extension of a measure -Uniqueness of the extension - Completion of a measure - Measure spaces - Integration with respect to a measure.	14
IV	Inequalities and the L^p Spaces: The L^p Spaces - Convex functions - Jensen's inequality - The inequalities of Holder and Minkowski - Completeness of $L^p(\mu)$.	13
V	Signed Measures and their derivatives: Signed measures and the decomposition - The Jordan decomposition - The Radon-Nikodym theorem - Some applications of the Radon-Nikodym theorem.	12
References	 Text Books: 1. G.de Barra, Measure Theory and Integration, 1st Edition, New A Publishers, New Delhi, 2003. Unit 1: Sections 2.1-2.5. Unit 2: Sections 3.1-3.4. Unit 3: Sections 5.1-5.6. Unit 4: Sections 6.1-6.5. Unit 5: Sections 8.1-8.4. Reference Books: 1. H. L. Royden, Real analysis, 3rd Ed., Prentice Hall of India, New Delhi, 2. I. K. Rana, An Introduction to Measure and Integration, Narosa Publish Delhi, 1999. 3. D.L. Cohn, Measure Theory, Birkhauser, Switzerland, 1980. 4. E. Hewitt & K. R. Stromberg, Real and Abstract Analysis, Wiley Verlag E- Resources: 1. http://nptel.ac.in/courses/111101100/ 	2005. hing House, New

	On completion of the course students should be able to do
	CO1: Outline the concept of Lebesgue measure and integration.
Course	CO2: Interpret the geometric meaning of measurable functions and integration.
Outcomes	CO3: Formulate the relationships between Riemann and Lebesgue integrals.
	CO4: Describe the applications of measure theory in other branches of Mathematics.
	CO5: Apply the techniques of measure theory to evaluate integrals.

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	1	2
CO2	3	2	2	2	2
CO3	3	3	2	1	2
CO4	3	2	1	2	2
CO5	3	2	2	1	1

Semester	III	Course Code	21MATP0313	
Course Title	Stochastic Processes			
No. of. Credits	4	No. of. contact hours per week	4	
New Course/ Revised Course		If revised, Percentage of Revision effected (Minimum 20%)		
Category	Core Course			
Scope of the Course	Advanced Skill			
Cognitive Levels addressed by the course	 processes in queuing system Understanding the in-dept Markov chains. (Understand Applying the concept of Ma Analyses the solving tech (Analysing – K4) 	h knowledge about stationary	stochastic processes and ems. (Applying – K3) ses in queuing systems.	
Course Objective	The Course aims to introduce a w			

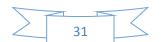


Unit	Content	No. of. Hours
Ι	Random variables and stochastic processes: Generating functions - Stochastic processes: An Introduction - Markov chains: Definition and examples - Higher transition probabilities-Generalization of independent Bernoulli trials: sequence of chain - dependent trials-Classification of states and chains - Determination of higher transition probabilities.	13
II	Markov process with discrete state space: Poisson process and its extensions - Poisson process - Poisson process and related distributions - Generalizations of Poisson process - Birth and death processes.	13
III	Markov processes with continuous state space: Introduction - Brownian motion - Weiner process - Differential equations for a Wiener Process - Kolmogrov equations - First passage time distribution for Weiner process - Ornstein - Uhlenbech process.	13
IV	Branching Processes: Introduction – Properties of generating functions of Branching processes – Distribution of the total number of progeny – Continuous –Time Markov branching process.	13
V	Applications in stochastic models: Queueing systems and models – Birth and death processes in queueing theory: Markovian models – Reliability models.	12
References	 Text Books: J. Medhi, Stochastic Processes, New Age International Private limited, Edition, 2017. Unit 1: Chapter 1: Sections 1.1 & 1.5, Chapter 2: Sections 2.1- 2.5. Unit 2: Chapter 3: Sections 3.1 - 3.4. Unit 3: Chapter 4: Sections 4.1 - 4.6. Unit 4: Chapter 9: Sections 9.1, 9.2, 9.4, 9.7. Unit 5: Chapter 10: Sections 10.1, 10.2, 10.5. Reference Books: K. Basu, Introduction to Stochastic Process, Narosa Publishing House, N Goswami & B. V. Rao, A Course in Applied Stochastic Processes, H Agency, New Delhi, 2006. G. Grimmett & D. Stirzaker, Probability and Random Processes, 3 University Press, New York, 2001. E- Resources: https://nptel.ac.in/courses/111102014/ https://onlinecourses.nptel.ac.in/noc18_ma19 	New Delhi, 2003. Tindustan Book
Course Outcomes	On completion of the course students should be able to do CO1: Discuss about Stationary Stochastic Processes and Markov chains. CO2: Distinguish the Markov Process with discrete state space and continuou CO3: Demonstrate Brownian Motions and its properties CO4: Outline branching processes and age dependent branching process CO5: Apply stochastic processes in queuing systems	is state space

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	2	3
CO2	2	2	2	3	2
CO3	2	2	3	2	2
CO4	1	2	2	3	3
CO5	2	3	2	3	3

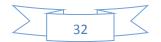
Semester	III	Course Code	21MATP0314		
Course Title	Optimization Techniques				
No. of. Credits	4	No. of. contact hours per week	4		
New Course/ Revised Course		If revised, Percentage of Revision effected (Minimum 20%)			
Category	Core Course				
Scope of the Course	Entrepreneurship				
Cognitive Levels addressed by the course	 Fibonacci method – Gola optimization and Dynamic Pr Understanding the cutting p direct root method, Hooks and Applying the Revised simple solve linear programming pr Tucker conditions to solve the Testing whether the solution convexity (K4). Investigating the Non-linear methods (K5). 	alane method, Transportation a d Jeeves method (K2). x method – Duality concept – oblems. Applying Lagrange's m constrained non-linear program is unique or not for one dime programming problems in diffe	-dimensional c nd Assignment Dual simplex r ultiplier metho uming problems nsional optimiza rent type of op	problems, nethods to d – Kuhn- (K3). ation using timizations	
Course	The Course aims to impart the m	athematical modelling skills thr	ough different	methods of	
Objective	optimization.		I		
Unit		Content	No.	of. Hours	
Ι	Introduction to convex set and problems: Simplex method – Rev Dual simplex method.	8	U	14	

II	Integer Linear Programming: Branch – and Bound method – cutting plane method – Zero – one integer problem – Transportation and Assignment problems.	14
III	Unimodel function – one dimensional optimization: Fibonacci method – Golden Section Method – Quadratic and Cubic interpolation methods – Direct root method – Multidimensional unconstrained optimization: Univariate Method – Hooks and Jeeves method – Fletcher – Reeves method - Newton's method.	12
IV	Multi-dimensional constrained optimization: Lagrange's multiplier method – Kuhn-Tucker conditions – Hessian Matrix Method – Wolfe's method – Beal's method.	12
V	Geometric programming polynomials – Arithmetic Geometric inequality method – Separable programming – Dynamic Programming: Dynamic programming algorithm – solution of LPP by Dynamic Programming.	12
References	 Text Books: H. A. Taha, Operations Research – An Introduction, 8th Edition, Predindia, New Delhi, 2006. Unit 1: 3.3, 4.4, 7.1, 7.2 Unit 2: Chapter 5 and Section 9.2 S. S. Rao, Engineering Optimization, 3td Edition, New Age Internat Publishers, Delhi, 1998. Unit 3: Chapter 5 (Sections 5.1 – 5.12), Chapter 6 (Sections 6.4, 6) Unit 4: Chapter 2 (Sections 2.4, 2.5) Unit 5: Chapters 8 & 9. Kanti Swarup, Gupta P. K. & Man Mohan, Operations Research, S. Char Delhi, 1995. Unit 4: Chapter 28 (Sections 28.3, 28.5, 28.6) Unit 5: Chapter 28 (Sections 28.7, 28.8) Reference Books: J. K. Sharma, Operations Research Theory & Applications, Macmillan In Delhi, 2006. G. Strinivasan, Operations Research: Principles & Applications, Prentice New Delhi, India, 2007. 	ional Pvt. Ltd., 5.6, 6.12.2, 6.13) nd & Sons, New ndia Ltd., New
Course Outcomes	 On completion of the course students should be able to do CO1: Formulate Linear Programming problems and determine its solutions CO2: Discuss Integer Linear Programming problems CO3: Compute one dimensional optimization and Multidimensional unconstr optimization problems CO4: Apply Multi-dimensional constrained optimization problems in Industr CO5: Expertise in solving Geometric and Dynamic Programming problems 	



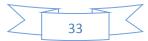
PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	3	2	3	3
CO2	1	3	2	3	3
CO3	2	3	2	3	3
CO4	1	3	2	3	3
CO5	2	3	2	3	3

Semester	IV	Course Code	21MATPO	415	
Course Title	Complex Analysis				
No. of. Credits	4	No. of. contact hours per week	4		
New Course/ Revised Course		If revised, Percentage of Revision effected (Minimum 20%)			
Category	Core Course				
Scope of the Course	Advanced Skill				
Cognitive Levels addressed by the course	 Know the concept of bilinear transformations, power series, operations of power series, conformal mappings, singularities, and residues (K1). Understand the importance of analytic functions, the uniform convergence of a series, the Cauchy's inequality and applications and argument principles (K2). Apply the concept of the complex integration, Cauchy's integral formula to solve integral problems, maximum modulus principles, and the residue theorem to find integral values (K3). Analyse the analyticity of a function (K4). Evaluate the values of real integrals (K5). 				
Course	-	ous concepts about the analytic	functions	in the complex	
Objective	plane.	<u> </u>		N. C.II.	
Unit I	ContentNo. of. HoursAnalytic Functions: Cauchy–Riemann equation – Analyticity - Harmonic functions - Bilinear transformations and mappings: Basic mappings - Linear14fractional transformations.14				
II	Power Series: Sequences revisited - Uniform convergence - Maclaurin and Taylor Series - Operations on power series - Conformal mappings.13				
III	Complex Integration and Cauchy Line Integrals - Cauchy's Theorer	's Theorem: Curves – Parameteriz n.	zations -	13	



IV	Applications of Cauchy's Theorem: Cauchy's integral formula - Cauchy's inequality and applications - Maximum modulus theorem.	12			
V	Laurent series and the residue theorem: Laurent Series - Classification of singularities - Evaluation of real integrals - Argument principle.				
References	 Text Books: S. Ponnusamy & Herb Silverman, Complex Variables with Application Boston, 2006. Unit 1: Chapter 5: Sections 5.1, 5.2, 5.3, Chapter 3: Sections 3.1, 3.2 Unit 2: Chapter 6: Sections 6.1, 6.2, 6.3, 6.4 Chapter 11: Section 11.1 Unit 3: Chapter 7: Sections 7.1, 7.2, 7.3, 7.4 Unit 4: Chapter 8: Sections 8.1, 8.2, 8.3 Unit 5: Chapter 9: Sections 9.1, 9.2, 9.3, 9.4 Reference Books: S. Ponnusamy, Foundations of Complex analysis, 2ndedition, Narosa Pu 2005. V. Karunakaran, Complex Analysis, Narosa Publishing House, New Dell 3. R.V. Churchill & J. W. Brown, Complex Variables & Applications, N New Delhi, 1990. John. B. Conway, Functions of One Complex Variable, Springer-Verla 1978. B. P. Palka, An Introduction to Complex Function Theory, Springer York, 1991. Lars. V. Ahlfors, Complex Analysis, 3rd edition, McGraw Hill be International Edition, Singapore, 1979. E- Resources: https://nptel.ac.in/courses/111/106/111106141/ https://nptel.ac.in/courses/111/103/111103070/ 	b., New Delhi, ni, 2002. Ic.Graw Hill, ag, New York, r-Verlag, New			
Course Outcomes	On completion of the course students should be able to do CO1: Explain about analytic function and transformations CO2: Examine power series of analytic function CO3: Discuss the concept of complex integration CO4: Apply Cauchy's theorem to evaluate contour integrals CO5: Classify the singularities and residues of complex functions				

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	2	1	2
CO2	3	2	2	1	2
CO3	3	2	2	1	2
CO4	3	2	2	1	1
CO5	2	3	2	3	3



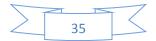
w.e.f. 2021-2022

Semester	IV	Course Code	21MATP0	416
Course Title	Functional Analysis			
No. of. Credits	4	No. of. contact hours per week	4	
New Course/ Revised Course		If revised, Percentage of Revision effected (Minimum 20%)		
Category	Core Course			
Scope of the Course	Advanced Skill			
Cognitive Levels addressed by the course	 between Schauder basis and F Understand the importance lemma, Hahn-Banach extensi Apply the concept of norm in 	of normed linear spaces, Hiene on theorem (K2). various other fields of Mathema lifferent kinds of operators (K4). t kinds of operators (K5).	-Borel theo	
Course Objective	The Course aims to introduce basi and Banach space theory.	cs of functional analysis with spo	ecial empha	sis on Hilbert
Unit		Content		No. of. Hours
Ι	Norm on a linear space - Example quotient spaces - Product space ar sesquilinear form – Banach spaces	nd graph norm – Semi-inner proc		14
II	Incomplete normed linear spaces Some properties of Banach spaces Schauder basis and separability - I Best approximation theorems – Pr	- Completion of normed linear s - Baire category theorem (staten Heine-Borel theorem and Riesz l	nent only) -	13
III	Operators on normed linear space and examples - The space B(X,Y) theorem - Completeness of B(X,Y) and Parseval's formula - Riesz-Fis	- Norm on B(X,Y) - Riesz repres) - Bessel's inequality - Fourier e	entation	13
IV	Hahn-Banach theorem and its consequences - The extension theorem- Consequences on uniqueness of extension - Separation theorem12			
V	Uniform boundedness principle - and its consequences - Bounded in A stability result for operator equa	nverse theorem - Open mapping		12



	Text Books: 1. M. Thamban Nair, Functional Analysis - A First Course, Prentice Hall of India Pvt. Ltd., New Delhi, 2002. Unit 1: Chapter 2: Sections 2.1, 2.1.1, 2.1.2, 2.1.4, 2.1.6, 2.2. Unit 2: Chapter 2: Sections 2.1, 2.2.2, 2.2.3, 2.3 - 2.6. Unit 3: Chapter 3: Sections 3.1, 3.1.1, 3.2, 3.2.1, 3.3, 3.4.1, Chapter 4: Sections 4.2, 4.3, 4.4. Unit 4: Chapter 5: Sections 5, 5.1 - 5.4.
	Unit 5: Chapter 6: Sections 6.1, Chapter 7: Sections 7.1, 7.2, 7.3, 7.3.1.
References	 Reference Books: 1. B. V. Limaye, Functional Analysis, New Age International Pvt. Ltd,New Delhi, 1996. 2. H. Siddiqi, Functional Analysis with Applications, Tata McGraw-Hill Pub., New Delhi, 1986. 3. S. Ponnusamy, Foundations of Functional Analysis, Narosa Publishing House, New Delhi, 2002. 4. Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, New York, 2006. E- Resources: https://nptel.ac.in/courses/111/106/111106147/
Course Outcomes	On completion of the course students should be able to doCO1: Outline the normed linear spaces and Banach spacesCO2: Discuss about the completion of normed linear spacesCO3: Apply various operators on Banach spacesCO4: Demonstrate the consequences of Hahn-Banach theoremCO5: Critique the closed graph theorem and stability result for operator

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



w.e.f. 2021-2022

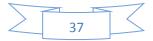
Semester	IV	Course Code	21MATP0417			
Course Title	Graph Theory					
No. of. Credits	4 No. of. contact hours per week 4					
New Course/ Revised Course		If revised, Percentage of Revision effected (Minimum 20%)				
Category	Core Course					
Scope of the Course	Advanced Skill					
Cognitive Levels addressed by the course	 Knowing different types of graphs (K1) Understanding various representation of different structures (K2) Applying solutions to real life problems (K3) 					
Course Objective	The Course aims to impart the different concepts of theory of graphs.					
Unit	Content			No. of. Hours		
Ι	Basic results - Basic concepts Paths and connectedness - Au graphs - Operations on graphs.	14				
II	Connectivity - Vertex cut and edge cut - Connectivity and edge connectivity. Trees – Definition - Characterization and simple properties - Centers and centroids – Counting the number of spanning trees - Cayley's formula.			12		
III	Independent sets and Matchings: Introduction – Vertex independent sets and Vertex covering – Edge independent sets – Matching and factors. Eulerian and Hamiltonian graphs: Introduction - Eulerian graphs – Hamiltonian graphs.			13		
IV	Graph Colorings: Introduction Planarity: Introduction - Planar and its consequences - K5 and K3,3	12				
V	Dominating sets in graphs - Vario domination number - Bounds in Bounds in terms of order and size.	13				



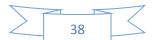
	Text Books:
	1. R. Balakrishnan & K. Ranganathan, A Text Book of Graph Theory, Springer-Verlag New
	York, 2000.
	Unit 1: Chapter I: Sections:1.0 – 1.7
	Unit 2: Chapter III : Sections: $3.0 - 3.2$; Chapter IV: Sections: $4.0 - 4.4$
	Unit 3: Chapter V : Sections : $5.0 - 5.3$; Chapter VI : Sections: $6.0 - 6.2$
	Unit 4: Chapter VII: Sections : 7.0 – 7.2 ; Chapter VIII : Sections: 8.0 – 8.3.
	2. Teresa W. Hayness, Stephen T. Hedetniemi, Peter J. Slater, & Marcel Dekker,
References	Fundamental of Domination in Graphs, INC New York, 1998.
	Unit 5: Chapter 1, Chapter 2: Sections: 2.1-2.4
	Reference Books:
	1. F. Harary, Graph Theory, Addison-Wesley, Reading Mass., 1969.
	2. J. A. Bondy and U. S. R. Murty, Graph theory with applications, The MacMillan Press
	Ltd., New York, 1976.
	E- Resources:
	1. <u>https://nptel.ac.in/courses/111/106/111106050/</u>
	2. <u>https://nptel.ac.in/courses/111/106/111106102/</u>
	On completion of the course students should be able to do
_	CO1: Identify various operations on graphs.
Course	CO2: Classify different types of graphs and their applications.
Outcomes	CO3: Analyse the applications of different parameters of a graph.
	CO4: Predict the domination number and apply in real life problems.
	CO5: Compare different types of graphs and study its properties.

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	1	3
CO2	1	3	2	3	2
CO3	2	3	3	2	2
CO4	3	2	1	3	3
CO5	3	3	3	2	1

Semester	III	Course Code	21MATP03D1
Course Title	Classical Dynamics		
No. of. Credits	3	No. of. contact hours per week	3
New Course/		If revised, Percentage of	
Revised	Revised Course	Revision effected	20%
Course		(Minimum 20%)	



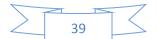
Category	Discipline Centric Elective	
Scope of the Course	Advanced Skill	
Cognitive Levels addressed by the course	 To know about the concepts of mechanical system, potential and kinetic Lagrangian function and momentum, generating functions, Hamilton - Ja (K1) Understanding how to formulate differential equations of motion of a sys solve by variational principle, Hamilton's principle, and the derivation of (K2, K3) Lagrange's equations apply to solve physical problems and the Hamilton–employees to solve problems of differential equation in three-dimensiona To analyse about the variational principles, differential forms, generating canonical transformations, and special transformations (K4) 	tem and to THJB equations Jacobi method Il space (K3)
Course Objective	The Course aims to study the system dynamics via non-relativistic theories ar	nd methods.
Unit	Content	No. of. Hours
Ι	Introductory Concepts: The mechanical system - Generalized coordinates - Constraints - Virtual work - Energy and momentum.	10
II	Lagrange's equations:Derivation of Lagrange's equations - Examples - Integrals of the motion.	10
III	Hamilton's Equations: Hamilton's principle – Hamilton's equations.	10
IV	Hamilton - Jacobi theory: Hamilton's principal function - The Hamilton - Jacobi equation.	9
V	Canonical Transformations: Differential forms and generating functions - Lagrange and Poisson brackets.	9
References	 Text Book: Donald T. Greenwood, Classical Dynamics, 3rd Edition, Prentice-Hall New Delhi, 1990. 	ons Pvt., Ltd.,



	On completion of the course students should be able to do
	CO1: Discuss the basic concepts of nonrelativistic classical dynamics
Course	CO2: Apply Lagrange's equations to solve related mechanical problems
Outcomes	CO3: Analyse variational principle, Hamilton principle and Hamilton's equations
	CO4: Explain the derivation and application of Hamilton-Jacobi Equations
	CO5: Demonstrate the canonical transformations, Lagrange and Poisson brackets expressions

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	3	2	3
CO2	3	3	2	2	3
CO3	3	3	2	1	3
CO4	1	3	2	2	2
CO5	2	2	1	3	3

Semester	III	Course Code	21MATP03D2
Course Title	Control Theory		
No. of. Credits	3	No. of. contact hours per week	3
New Course/ Revised Course		If revised, Percentage of Revision effected (Minimum 20%)	
Category	Discipline Centric Elective		
Scope of the Course	Advanced Skill		
Cognitive Levels addressed by the course	 Learning to know observability, controllability, stability problems of linear and nonlinear control systems (K1) Understanding to design controllability and observability Grammian matrix for the linear and nonlinear system (K2) Apply the stability and stabilization for the various linear and nonlinear physical systems (K3) To analyse the uniform stability, asymptotic stability and optimal control of linear time varying, perturbed system and nonlinear systems. (K4) To design stabilization via linear feedback control for the unstable system (K6) 		
Course	The Course aims to introduce basic theories and methodologies required for analysing and		
Objective	designing advanced control systems.		



Unit	Content	No. of. Hours
Ι	Observability: Linear systems – Observability Grammian – Constant coefficient systems – Reconstruction kernel – Nonlinear Systems	10
II	Controllability: Linear systems – Controllability Grammian – Adjoint systems – Constant coefficient systems – Steering function – Nonlinear systems	10
III	Stability: Stability – Uniform stability – Asymptotic stability of linear Systems - Linear time varying systems – Perturbed linear systems – Nonlinear systems.	10
IV	Stabilizability: Stabilization via linear feedback control – Bass method – Controllable subspace –Stabilization with restricted feedback.	9
V	Optimal Control: Linear time varying systems with quadratic performance criteria – Matrix Riccati equation – Linear time invariant systems – Nonlinear Systems	9
References	Text Book:1. K. Balachandran & J. P. Dauer, Elements of Control Theory, Narosa, New	Delhi, 1999.
	 Reference Books: 1. R. Conti, Linear Differential Equations and Control, Academic Press, Lon 2. R.F. Curtain and A.J. Pritchard, Functional Analysis and Modern Appl Academic Press, New York, 1977. 3. J. Klamka, Controllability of Dynamical Systems, Kluwer Academic Publ 1991. 	ied Mathematics,
	E- Resources: 1. https://ocw.mit.edu/resources/res-6-010-electronic-feedback-systems-spr 2013/course-videos/ 2. https://nptel.ac.in/courses/108101037/	<u>ing-</u>
Course Outcomes	 On completion of the course students should be able to do CO1: Analyse linear and nonlinear control systems CO2: Evaluate observability problems of linear and nonlinear systems CO3: Analyse the stability of linear and nonlinear systems CO4: Apply the stability theory in control systems CO5: Model the optimal control problems in science & engineering 	

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	1	2	2
CO2	3	2	1	2	3
CO3	1	2	1	3	2
CO4	3	2	1	2	3
CO5	2	1	3	1	3



w.e.f.	2021-
2022	

Semester	ш	Course Code	21MATPO)3D3
Course Title	Optimal Control			
No. of. Credits	3	No. of. contact hours per week	3	
New Course/ Revised Course		If revised, Percentage of Revision effected (Minimum 20%)		
Category	Discipline Centric Elective			
Scope of the Course	Advanced Skill			
Cognitive Levels addressed by the course	 Learning to know optimal of a function/functional, basic variational problems, estrema of functions/ functionals, (K1) Understanding to design matrix Riccati equation, Pontryagin minimum principle, HJB equation (K2) LQR problem using HJB equation, Fuel optimal control system (K3) To analyse the constrained optimal control (K4) To design optimal control of system using dynamic programming (K6) 			
Course	The Course aims to introduce bas	_	required fo	r analyzing and
Objective	designing optimal control of dynamics	1		
Unit		Content		No. of. Hours
Ι	Basic Concepts-Optimal of a function and functional-The Basic variational problems: Fixed –End time fixed-end state system, Euler-Lagrange equation, Different cases for Euler –Lagrange equation- Extrema of functions with conditions: Direct Method- Lagrange Multiplier Method.		10	
II	Extrema of Functional with conditions-Variational approach to optimal control systems: Terminal Cost Problem-Different Types of Systems-10Sufficient Condition- Summary of variational approach.10		10	
III	Problem Formulation - Finite –Time Linear Quadratic Regulator-AnalyticSolution to the Matrix Differential Riccatic Equation-Infinite- Time LQR9System.			9
IV	ConstrainedSystem-PontryaginMinimumPrinciple-NecessaryConditions-DynamicProgramming:PrincipleofOptimality-OptimalcontrolUsingDynamicProgramming-OptimalControl ofContinuous-Time10Systems-TheHamilton – Jacobi-BellmanEquation-LQRSystemUsingH-J-BEquation.Image: Control of ContinuousImage: Control of ContinuousImage: Control of ContinuousImage: Control of ContinuousImage: Control of Continuous			
V	Constrained Optimal Control-TC Optimal Control Systems.	DC of a Double Integral Syste	em- Fuel-	9
References	Text Book: 1. D. S. Naidu: Optimal Control Unit 1: Chapter 2: Section: Unit 2: Chapter 2: Sections	2.1-2.3, 2.5		



	Unit 3: Chapter 3: Sections: 3.1-3.4			
	Unit 4: Chapter 6: Sections: 6.1-6.4 (except 6.3.3)			
	Unit 5: Chapter 7: Sections: 7.1-7.3			
	Reference Books:			
	1. F.L. Lewis, Optimal Control, John Wiley & Sons, Inc., New York, NY, 1986			
	2. M. Gopal, Modern Control System Theory, 2 nd Edition, New Age International, 1984.			
	3. E. B. Lee and L. Markus, Foundations of Optimal Control Theory, Robert E. Krteger			
	Publishing Company, Florida, 1968.			
	E- Resources:			
	1. <u>https://onlinecourses.nptel.ac.in/noc17_ee11/preview</u>			
	2. <u>http://nptel.ac.in/syllabus/101108057/</u>			
	On completion of the course students should be able to do			
	CO1: Determine the solutions of control system via Euler – Lagrange equation			
Course	CO2: Apply calculus of variations to solve the linear and nonlinear optimal control systems			
Outcomes	CO3: Outline the Linear Quadratic Optimal Control Systems			
	CO4: Employ Pontryagin Minimum principle for solving optimal control systems			
	CO5: Evaluate the solutions of constrained optimal control problems			

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	1	2	2
CO2	3	2	3	2	3
CO3	2	2	3	3	2
CO4	3	2	3	2	3
CO5	2	3	3	2	3

Semester	III	Course Code	21MATP03D4				
Course Title	Fractal Analysis						
No. of. Credits	3	No. of. contact hours per week	3				
New Course/		If revised, Percentage of					
Revised		Revision effected					
Course		(Minimum 20%)					
Category	Discipline Centric Elective						
Scope of the	Advenced Shill						
Course	Advanced Skill						



Cognitive Levels addressed by the course	 Knowing the Basic set theory, Functions and limits, Measures and mass distributions, Properties and problems of box-counting dimension (K1). Understanding the Hausdorff measure, Hausdorff dimension, Calculation of Hausdorff dimension and Techniques for calculating dimensions, self-similar and self-affine sets, and examples of number theory (K2). Applying the Densities-Structure of 1-sets-Tangents to s-sets. Projections of fractals, Projections of arbitrary sets-Projections of s-sets of integral dimension-Projections of arbitrary sets of integral dimension (K3). Recognize the concepts of fractal and Julia sets (K4). Investigating the product and intersection of fractals and Newton's method for solving polynomial equations (K5). 				
Course	The Course aims to introduce the basic mathematical techniques of fracta	al geometry for			
Objective	diverse applications.				
Unit	Content	No. of. Hours			
Ι	Mathematical background: Basic set theory-Functions and limits-Measures and mass distributions-Notes on probability theory. Box-counting dimensions: Box-counting dimensions-Properties and problems of box- counting dimension-Modified box-counting dimensions-Some other definitions of dimension.	10			
II	Hausdorff and packing measures and dimensions: Hausdorff measure- Hausdorff dimension- Calculation of Hausdorff dimension—simple examples- Equivalent definitions of Hausdorff dimension- and packing measures and dimensions-Finer definitions of dimension-Dimension prints- porosity. Techniques for calculating dimensions: Basic methods- Subsets of finite measure- Potential theoretic methods- Fourier transform method.	10			
III	Local structure of fractals: Densities-Structure of 1-sets-Tangents to s-sets. Projections of fractals: Projections of arbitrary sets-Projections of s-sets of integral dimension-Projections of arbitrary sets of integral dimension. Products of fractals: Product formulae. Intersections of fractals: Intersection formulae for fractals-Sets with large intersection.	10			
IV	Iterated function systems—self-similar and self-affine sets: Iterated function systems- Dimensions of self-similar sets- Some variations- Self-affine sets- Applications to encoding images-Zeta functions and complex dimensions. Examples from number theory: Distribution of digits of numbers- Continued fractions- Diophantine approximation.	9			
V	Graphs of functions: Dimensions of graphs- Autocorrelation of fractal functions. Iteration of complex functions—Julia sets: General theory of Julia sets- Quadratic functions—the Mandelbrot set- Julia sets of quadratic functions- Characterization of quasi-circles by dimension- Newton's method for solving polynomial equations. Random fractals: A random Cantor set- Fractal percolation.	9			

						
	Text Book:					
	1. Kenneth J. Falconer, Fractal Geometry: Mathematical Foundations and Applications,					
	John Wiley and Sons Ltd, Third edition, 2014.					
	Unit 1: Chapter 1: Sections: 1.1 to 1.4, Chapter 2: Sections: 2.1 to 2.4.					
DC	Unit 2: Chapter 3: Sections: 3.1 to 3.8, Chapter 4: Section: 4.1 to 4.4.					
References	Unit 3: Chapter 5: Sections: 5.1 to 5.3, Chapter 6: Sections: 6.1 to 6.3,					
	Chapter 7: Sections: 7.1 only, Chapter 8: Sections: 8.1 to 8.2.					
	Unit 4: Chapter 9: Sections: 9.1 to 9.6, Chapter 10: Sections: 10.1 to 10.3.					
	Unit 5: Chapter 11: Sections 11.1 to 11.2, Chapter 14: Sections: 14.1 to 14.5,					
	Chapter 15: Sections: 15.1 to 15.2.					
	Reference Books:					
	1. G. A. Edgar, Measure, Topology and Fractal Geometry, Springer – New York, 2008.					
	2. Kenneth J. Falconer, The Geometry of Fractals Sets, Cambridge University Press,					
	Cambridge, 1985.					
	3. Paul S. Addison, Fractals and Chaos: An Illustrated Course, Overseas Press, 2005.					
	4. Michael F. Barnsley, Fractals Everywhere, Academic Press Professional, 1988.					
	E- Resources:					
	On completion of the course students should be able to do					
	CO1: Outline the basic concepts of measure and box-counting dimension.					
Course	CO2: Identify the Hausdorff and packing measures and dimensions.					
Outcomes	CO3: Determine the product and intersection of fractals.					
	CO4: Explain the self-similar and self-affine sets, and examples of number theory.					
	CO5: Analyse the concepts of fractal and Julia sets.					

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2
CO2	1	3	2	3	3
CO3	3	3	1	3	2
CO4	2	3	3	3	3
CO5	3	2	1	3	3

Semester	п	Course Code	21MATP02G1				
Course Title	Numerical and Statistical Methods						
No. of. Credits	3	No. of. contact hours per week	3				
New Course/		If revised, Percentage of					
Revised		Revision effected					
Course		(Minimum 20%)					



w.e.f. 2021-2022

Category	Generic Elective	
Scope of the Course	Advanced Skill	
Cognitive Levels addressed by the course	 Understanding the concept of Curve Fitting and finding the solutions of a equations (K1 & K2). Understanding the concept of Interpolation and Integration (K2 & K4). Evaluating the measures of central tendencies and measures of dispersion Applying correlation and regression ideas to solve many real life problem Evaluating the probability of various problems and analysing distribution 	a (K4 & K5). as (K3).
Course Objective	The Course aims to impart basic concepts and skills in the applications of vari and Statistical Methods.	ous Numerical
Unit	Content	No. of. Hours
Ι	Curve Fitting: Methods of Least Squares- Fitting Straight Line- Fitting a Parabola – Fitting an Exponential Curve. Solution of Numerical and Transcendental Equations: The Bisection method- Method of False Position. Solution of Simultaneous Linear Algebraic Equations: Gauss Elimination Method- Gauss Jordan Method – Jacobi Method of Iteration – Gauss Seidal Method.	10
II	Interpolation: Difference Tables – Newton's Forward and Backward Interpolation Formula for Equal Intervals – Lagrange's Interpolation Formula for Unequal Intervals. Numerical Integration: Trapezoidal Rule – Simpson's 1/3 rd Rule and Simpson's 3/8 th Rule.	10
III	Frequency Distribution – Diagramatic Graphical Presentation of Frequency Distributions – Measures of Central Value – Arithmetic Mean – Median – Mode Geometric Mean – Harmonic Mean – Standard Deviation – Coefficient of Variance – Moments – Skewness – Kurtosis.	10
IV	Correlation – Scatter Diagram – Karl Pearson's Coefficient of Correlation – Correlation Coefficient for a Bivariate frequency Distribution – Rank Correlation Coefficient – Regression – Regression Lines.	9
V	Probability – Introduction – Calculation of Probability – Conditional Probability – Bayes' Theorem – Mathematical Expectation – Theoretical Distributions – Binomial Distribution – Poisson Distribution.	9
References	 Text Book: 1. M.K. Venkataraman, Numerical Methods in Science and Engineering Publishing Co., Madras, 1987, Unit 1 & Unit 2. 2. Arumugam S. Issac, Statistics, SCI Tech Publications, Chennai, 2011, Unit 3: Chapters 1,2,3,4 Unit 4: Chapter 6 Unit 5: Chapter 11, Chapter 12- Secs. 12.1-12.4, Chapter 13- Secs. 13.1,13 	-



	Reference Books:
	1. M.K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical Methods for Scientific and Engineering
	Computation, Willey Eastern Limited, New Delhi, 2003.
	2. S.S. Sastry, Introductory Methods of Numerical Analysis, 4th Edition, Prentice – Hall of
	India, New Delhi, 2010.
	E- Resources:
	On completion of the course students should be able to do
	CO1: Discuss various types of curve fitting and finding solutions to algebraic equations.
Course	CO2: Analyse interpolation and various integral method to solve many problems.
Outcomes	CO3: Apply measures of central tendencies to real life problems.
	CO4: Realize the applications of correlation and regression.
	CO5: Outline the techniques of probability theory and distributions.

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	1	2
CO2	3	3	3	3	2
CO3	2	2	3	3	3
CO4	3	3	2	3	1
CO5	1	2	3	3	3

Semester	II	Course Code	21MATP02G2					
Course Title	Coding Theory							
No. of. Credits	3	No. of. contact hours per week	3					
New Course/ Revised Course		If revised, Percentage of Revision effected (Minimum 20%)						
Category	Generic Elective							
Scope of the Course	Advanced Skill							
Cognitive Levels addressed by the course	 Describing the fundamentals of error detection, correction and decoding techniques in communication channels (K1 – Knowing) Estimate the various bounds for the linear codes and explain the Hamming codes, Golay codes (K2 – Understanding) Applying Syndrome decoding technique to decode linear codes (K3- Applying) Constructing BCH codes using generator polynomials, generating matrix and parity check matrix (K6-Create) 							

Course Objective	The Course aims to introduce the elements of coding theory and its application	ons				
Unit	Content	No. of. Hours				
Ι	Error detection, Correction and decoding: Communication channels – Maximum likelihood decoding – Hamming distance – Nearest neighbourhood minimum distance decoding – Distance of a code.	10				
II	Linear codes: Linear codes – Self orthogonal codes – Self dual codes – Bases for linear codes – Generator matrix and parity check matrix – Enconding with a linear code – Decoding of linear codes – Syndrome decoding.	10				
III	Bounds in coding theory: The main coding theory problem – lower bounds - Sphere covering bound – Gilbert Varshamov bound – Binary Hamming codes – q-ary Hamming codes – Golay codes – Singleton bound and MDS codes – Plotkin bound.					
IV	Cyclic codes: Definitions – Generator polynomials – Generator matrix and parity check matrix – Decoding of Cyclic codes.	9				
V	Special cyclic codes: BCH codes – Parameters of BCH codes – Decoding of BCH codes – Reed Solomon codes.	9				
References	 Text Book: 1. San Ling and Chaoping Xing , Coding Theory: A first course, Cambridge University Press, 2004. Unit 1: Sections 2.1, 2.2, 2.3, 2.4, 2.5 Unit 2: Sections 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8 Unit 3: Sections 5.1, 5.2, 5.3, 5.4, 5.5, Unit 4: Sections 7.1, 7.2, 7.3, 7.4 Unit 5: Sections 8.1, 8.2. 					
	 Reference Books: 1. S. Lin &D. J. Costello, Jr., Error Control Coding: Fundamentals and Applie Prentice-Hall, Inc., New Jersey, 1983. 2. Vera Pless, Introduction to the Theory of Error Correcting Codes, W York, 1982. 3. E. R Berlekamp, Algebriac Coding Theory, Mc Graw-Hill, 1968. 4. H. Hill, A First Course in Coding Theory, OUP, 1986. E- Resources: 					
Course Outcomes	 E- Resources: On completion of the course students should be able to do CO1: Discuss the basic concepts of coding theory. CO2: Analyse the importance of finite fields in the design of codes. CO3: Predict and correct the errors occur in communication channels with the help of methods of coding theory. CO4: Apply the tools of linear algebra to construct special type of codes. CO5: Apply algebraic techniques in designing efficient and reliable data transmission methods. 					

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2
CO2	3	3	3	1	3
CO3	3	3	3	2	2
CO4	3	3	3	2	1
CO5	3	3	1	3	2

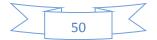
Semester	III	Course Code 21M	IATP03M1		
Course Title	Calculus of Variations				
No. of. Credits	2	No. of. contact hours per 2 week			
New Course/		If revised, Percentage of			
Revised		Revision effected			
Course		(Minimum 20%)			
Category	Modular Course				
Scope of the Course	Advanced Skill				
Cognitive	• compute Euler's equation	and geodesics (K-2)			
Levels	• Describe the functional involving higher order derivatives (K-1).				
addressed by	• Estimate approximate solution to various boundary value problems (K-2).				
the course					
Course	This course treats the foundations of calculus of variations and gives example on some				
Objective	applications within physics and engineering science.				
Unit		No. of. Hours			
Ι	Functionals – Euler's equation – Isoperimetric problems – Sev involving higher order derivative				
Ш	Approximate solution of boundary value problems – Rayleigh Ritz method– Weighted residual method – Galerkin's method – Hamilton's principle –16Lagrange's equation.				
References	 Text Book: 1. B.S. Grewal, Higher Engineering Mathematics, 43rd edition, Khanna publishers, New Delhi, 2015. Reference Books: F.B. Hildebrand, "Methods of Applied Mathematics", Prentice-Hall of India Pvt., New Delhi, 1968. 2. A.S. Gupta, "Calculus of Variations with Application", Prentice-Hall of India, New Delhi, 2005. 				

	E- Resources:
	On completion of the course students should be able to do
	CO1: Give an account of the foundations of calculus of variations and its applications in
Course	Mathematics and Physics.
Outcomes	CO2: Describe the brachistochrone problem mathematically and solve it.
	CO3: Solve isoperimetric problems of standard type.

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	3	2	2	3
CO2	2	1	3	1	2
CO3	2	2	2	3	1

Semester	ш	Course Code	21MATP03M1			
Course Title	Wavelet Analysis					
No. of. Credits	3	No. of. contact hours per week	3			
New Course/ Revised Course Category	 Modular Course	If revised, Percentage of Revision effected (Minimum 20%)				
Scope of the Course	Advanced Skill					
Cognitive Levels addressed by the course	 K-1. Knowing the basic concepts of Wavelets, Approximation and the Perception of Reality, Information Gained from Measurement, Functions and their Representations, Multi-resolution Representation, Positional Notation for Numbers, Music Notation as a Metaphor for Wavelet Series, Wavelet Phase Space. K-2. Identifying the Algebra and Geometry of Wavelet Matrices, Wavelet Matrices-Haar Wavelet Matrices, The Algebraic and Geometric structure of the Space of Wavelet Matrices 					
Course Objective	The Course aims to impart skills in	n the various applications of wa	velet analysis.			

Unit	Content	No. of. Hours				
Ι	The New Mathematical Engineering: Introduction-Trial and Error in the Twenty-First Century-Active Mathematics-The Three types of Bandwidth- Good Approximations: Approximation and the Perception of Reality- Information Gained from Measurement-Functions and their Representations-Wavelets: A Positional Notation for Functions: Multiresolution Representation-The Democratization of Arithmetic: Positional Notation for Numbers-Music Notation as a Metaphor for Wavelet Series-Wavelet Phase Space.					
II	Algebra and Geometry of Wavelet Matrices: Introduction-Wavelet Matrices-Haar Wavelet Matrices-The Algebraic and Geometric structure of the Space of Wavelet Matrices- Wavelet Matrix Series and Discrete Orthonormal Expansions- One-Dimensional Wavelet Systems: Introduction-The Scaling Equation-Wavelet Systems-Recent Developments: Multiwavelets and Lifting.	16				
References	Text Book: 1. Howard L. Resnikoff Raymond & O. Wells, Jr., Wavelet Analysis- The Scalable Structure of Information, Springer, New Delhi, 2004. Unit 1: Chapter 1: Sections: 1.1 to 1.4, Chapter 2: Sections: 2.1 to 2.3, Chapter 3: Sections 3.1 to 3.4. Unit 2:.Chapter 2: Sections: 4.1 to 4.5. Unit 3: Chapter 5: Sections: 5.1 to 5.4. Unit 4: Chapter 6: Sections: 6.1 to 6.6.					
	 Unit 5: Chapter 7: Sections 7.1 to 7.4, Chapter 13: Sections: 13.1 to Reference Books: L. Prasad & S.S. Iyengar, Wavelet Analysis with Applications to Processing, CRC Press, New York, 1997. Geroge Buchman, Lawrence Narichi, & Edward Beckenstein, Fouri Wavelet Analysis, Springer-Verlag, New York, Inc-2000. E- Resources: 	Image				
Course Outcomes	E- Resources:On completion of the course students should be able to doCO1: Describe the basic concepts of WaveletsCO2: Identify the Algebra and Geometry of Wavelet MatricesCO3: Classify One-Dimensional Wavelet SystemsCO4: Determine the solutions of One-Dimensional Wavelet SystemsCO5: Analyze the concepts of Higher-Dimensional Wavelet Systems					



PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	2	3	1
CO2	1	3	3	1	3
CO3	3	2	1	3	3
CO4	2	1	2	2	3
CO5	2	3	2	3	2

Semester	IV	Course Code	21MATPO	94M3	
Course Title	Introduction to SciLab				
No. of. Credits	3	No. of. contact hours per week	3		
New Course/ Revised Course	New Course If revised, Percentage of Revision effected (Minimum 20%)				
Category	Modular Course				
Scope of the Course	Skill Development				
Cognitive Levels addressed by the course	 Remembering basic tools on Creating real variables, comp Computing matrix operation Creating 2D graphs using function 	olex numbers and matrices (K-6) s (K-5)			
Course Objective	The Course aims to make an overview of SciLab features.				
Unit	Content			No. of. Hours	
Ι	Overview of SciLab - How to g SciLab demonstrations and mac Processing- Creating Real Varial Booleans – Complex Numbers Dynamic Variables- Matrices Accessing Elements of Matrice Operations- Conjugate trans Multiplication of two vectors C floating point integers - More linear algebra features	eros – The Console – The Edit oles - Elementary mathematical f – Integers – Floating Points – – Create Matrices of Real V s- Matrices are dynamic – El pose and non-conjugate tra omparing two real matrices - I	or – Batch functions – - Strings – Variables – lementwise anspose – Issues with	16	
II	Looping and branching: The if	efining functions - Function vels in the call stack - The return se - Plotting - 2D plot - Conto	libraries - 1 statement	16	

References	Text Book:					
	1. Michael Baudin, Introduction to Scilab, The Scilab Consortium, Digiteo, 2010.					
	Reference Books:					
	1. Stephen L. Campbell, Jean-Philippe Chancelier, Ramine Nikoukhah, Modeling and					
	Simulation in Scilab/Scicos with Scicos Lab 4.4, Springer-Verlag New York, 2006.					
	2. Eike Rietsch, An Introduction to Scilab from a Matlab User's Point of View, INRIA					
	France, 2010.					
	E- Resources:					
	1. <u>http://www.openeering.com/scilab_tutorials</u>					
	On completion of the course students should be able to					
	CO1: perform arithmetic operations on real numbers, complex numbers and matrices					
Course	CO2: solve system of linear equations					
Outcomes	CO3: construct loop and functions for iterative problems					
	CO4: apply SciLab tools in numerical simulations of mathematical modelling					
	CO5: plot graph of functions					

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	2	2	3	2
CO3	3	1	3	2	1
CO4	2	3	2	2	3
CO5	3	1	2	3	2

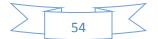
Semester	IV	Course Code	21MATP04M4			
Course Title	Neural Networks					
No. of. Credits	3	No. of. contact hours per week	3			
New Course/		If revised, Percentage of				
Revised		Revision effected				
Course		(Minimum 20%)				
Category	Modular Course					
Scope of the Course	Advanced Skill					
Cognitive Levels addressed by the course	 Know the concept of Neural Network and its various types, Functioning of artificial neural network and Neuron modelling. Understand the concept of Dynamic Neural Units, Models, and circuits of isolated DNUs. 					

Course	The Course aims to introduce the main fundamental principles and techn	-				
Objective	network systems and investigate the principal neural network models and app	network systems and investigate the principal neural network models and applications.				
Unit	Content	No. of. Hours				
I	Architectures: Introduction to Neural Network-Applications of neural network-Biological neural networks-Artificial neural networks-Functioning of artificial neural network-Neuron modelling.	16				
П	Dynamic Neural Units (DNUs): Nonlinear models and dynamics-Models of dynamic neural units-Models and circuits of isolated DNUs-Neuron with excitatory and inhibitory dynamics.	16				
References	 Text Book: 1. A. Anto Spiritus Kingsly, Neural network and fuzzy logic compublications, Chennai, 2009. 2. Madan M. Gupta, Liang Jin & Noriyasu Homma, Static and dynamic neuronal John Wiley and sons, INC., Publication, 2003. Unit 1: Chapters: 1.1—1.6.2 –Text book 1 Unit 2: Chapters: 8.1—8.3—Text book 2 					
	Reference Books:					
	E- Resources:					
Course Outcomes	On completion of the course students should be able to do CO1: Explain various types of neural networks and its implementations CO2: Design nonlinear models and dynamics of neurons CO3: Analyse Neural Networks and its applications in information theory					

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	1	2	2
CO2	3	2	1	2	3
CO3	2	3	1	2	2

Semester	II	Course Code	21MATP02VA1	
Course Title	Numerical Methods for Engineers			
No. of. Credits	2	No. of. contact hours per week	2	
New Course/ Revised Course	New Course	If revised, Percentage of Revision effected (Minimum 20%)		
Category	Valued Added Course			
Scope of the Course	Skill Developmen	nt		

Cognitive Levels addressed by the course	 Remembering the basic rules of finding the square and square root of numbers (K-1) Understanding the Vedic Sutras and apply them to find Square and square root of numbers. (K-2 & K-3) Remembering the basic rules of finding the cube and cubic root of numbers (K-1) Understanding the Vedic Sutras and apply them to find Cube and Cubic root of numbers. (K-2 & K-3) 				
Course Objective	The Course aims to impart skills on solving numerical problems.				
Unit	Content	No. of. Hours			
I	Introduction & Approximations : Motivation and Applications- Accuracy and precision-Truncation and round-off errors- Binary Number System- Error propagation- Linear Systems and Equations - Matrix representation- Cramer's rule- Gauss Elimination- Matrix Inversion- LU Decomposition-Linear Systems and Equations - Iterative Methods- Relaxation Methods- Eigen Values.	16			
II	Algebraic Equations: Bracketing Methods -Introduction to Algebraic Equations-Bracketing methods: Bisection, Reguli-Falsi- Algebraic Equations: Open Methods Secant- Fixed point iteration- Newton-Raphson- Multivariate Newton's method-Numerical Differentiation-Numerical differentiation- error analysis- higher order formulae - Integration and Integral Equations Trapezoidal rules-Simpson's rules- Quadrature.	16			
References	 Text Books 1. S. K. Gupta, Numerical Methods for Engineers, New Age International, 1995 Reference Books: S.C. Chapra and R. P. Canale, Numerical Methods for Engineers, 5th Ed., McGraw Hill, 2006. E- Resources: 				
Course Outcomes	1. <u>https://nptel.ac.in/courses/127/106/127106019/</u> On completion of the course students should be able to CO1: solve system of equations using various methods CO2: solve algebraic equations using various methods CO3: compute differentiation and integration approximately.				



PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	1	2	3
CO2	1	1	2	3	2
CO3	2	2	1	2	3

Semester	II	Course Code	21M/	ATP02VA2	
Course Title	Mathematics for Competitive Examinations				
No. of. Credits	2	No. of. contact hours per week		2	
New Course/ Revised Course	New Course	If revised, Percentage of Revision effected (Minimum 20%)			
Category	Valued Added Course				
Scope of the Course	Skill Developmen	Skill Development			
Cognitive Levels addressed by the course	 Remembering the basic rules of number system and fractions and apply them to solve simplification problems (K-1 & K-3) Understanding the Polynomials, quadradic equations, sequence and series and apply them to solve problems in competitive exams. (K-2 & K-3) Analyse profit /loss in a particular investment (K-4) Understanding the Vedic Sutras and apply them to find Cube and Cubic root of numbers. (K-2 & K-3) 				
Course Objective	The Course aims to impart skills on solving numerical problems.				
Unit	Content			No. of. Hours	
Ι	•	system-Fraction-Simplification- Approximate values- ties-Polynomials-Quadradic equations-Sequence and 16			
II	Average-RatioandProportions-Problemsrelatedtoages-Percentage-ProfitandLoss-Partnership-Simpleinterestand16Compound interest-Time and WorkImage: Compound interestImage: Compound interestImage: Compound interest				
References	 Text Books: 1. Gautam Puri, Quantitative Aptitude for Competitive Examinations, G K Publications Pvt Ltd, Noida, 2017. Reference Books: R.S. Agarwal, Quantitative Aptitude, Revised and Enlarged Edition, S. Chand & Company Ltd., New Delhi, 2017. 				

	E- Resources:
Course Outcomes	On completion of the course students should be able to
	CO1: solve problems related to number systems, fractions, inequalities and
	sequence and series.
	CO2: solve problems related to ratio and proportions, ages and percentage.
	CO3: Solve problems related to simple interest and compound interest and time and
	work.

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	1	2	3
CO2	1	2	2	1	2
CO3	1	2	1	2	3

