THE GANDHIGRAM RURAL INSTITUTE
(DEEMED TO BE UNIVERSITY)
GANDHIGRAM -624302
CURRICULUM WITH OUTCOME BASED EDUCATION (OBE)

Name of the School	:	School of Sciences
Department	:	Department of Mathematics
Academic Programme offered	:	B.Sc. Mathematics, M.Sc. Mathematics, M. Phil. Mathematics and Ph. 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 Thinking
GA2: Mathematical Modeling Ability
GA3: 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.

Category	Course Code	Course Title	Number of Credits	Lecture Hours per week	Exam Duration (Hours)	Marks		
						C.F.A	E.S.E	Total
	Semester – I							
Core Course	18MATP0101	Algebra	4	4	3	40	60	100
	18MATP0102	Real Analysis	4	4	3	40	60	100
	18MATP0103	Numerical Analysis	4	4	3	40	60	100
	18MATP0104	Differential Equations	4	4	3	40	60	100
	18MATP0105	Discrete Mathematics	4	4	3	40	60	100
Value added course	18GTPP0001	Gandhi in Everyday Life	2	2	--	50	--	50

TOTAL			22					
	Semester – II							
Core Course	18MATP0206	Linear Algebra	4	4	3	40	60	100
	18MATP0207	Advanced Real Analysis	4	4	3	40	60	100
	18MATP0208	Mathematical Methods	4	4	3	40	60	100
	18MATP0209	Probability and Statistics	4	4	3	40	60	100
Electives		Non Major Elective	4	4	3	40	60	100
Value added course	18ENGP00C1	Communication and Soft Skills	2	2	--	50	--	50
TOTAL			22					
	Semester – III							
Core Course	18MATP0310	Topology	4	4	3	40	60	100
	18MATP0311	Measure Theory	4	4	3	40	60	100
	18MATP0312	Stochastic Processes	4	4	3	40	60	100
Electives	18MATP03EX	Major Elective	4	4	3	40	60	100
Modular Course	18MATP03MX	Modular Course	2	2	--	50	--	50
Compulsory Non Credit Course	18MATP03F1	Extension/ Field Visit	--	2	--	50	--	50
Extension	18EXNP03V1	Village Placement Programme	2	--	--	50	--	50
TOTAL			20					
	Semester – IV							
Core Course	18MATP0413	Complex Analysis	4	4	3	40	60	100
	18MATP0414	Functional Analysis	4	4	3	40	60	100
	18MATP0415	Classical Mechanics	4	4	3	40	60	100
Electives	18MATP04EX	Major Elective	4	4	3	40	60	100
	18MATP0416	Dissertation	6	12	--	75	75+50	200
Modular Course	18MATP04MX	Modular Course	2	2	--	50	--	50
Compulsory Non Credit Course	18MATP04F2	Extension/Field Visit	--	2	--	50	--	50
TOTAL			24					
GRAND TOTAL			88					

MAJOR ELECTIVES: (18MATP03EX)

Semester – III

1. 18MATP03E1 Optimization Techniques
2. 18MATP03E2 Control Theory
3. 18MATP03E3 Optimal Control
4. 18MATP03E4 Statistical Inference (Online)

Semester - IV

1. 18MATP04E5 Graph Theory
2. 18MATP04E6 Fractal Analysis
3. 18MATP04E7 Coding Theory
4. 18MATP04E8 Regression Analysis (Online)

MODULAR COURSES :
(18MATP03MX/18MATP04MX)

Semester – III

1. 18MATP03M1 Matlab & Latex
2. 18MATP03M2 Wavelet Analysis

Semester – IV

1. 18MATP04M3 Fuzzy Sets and Fuzzy Logic
2. 18MATP04M4 Neural Networks

Non Major Elective: 18MATP02N1 Numerical and Statistical Methods

ABSTRACT	
Course type	Total number of Courses
Core Course	16
Major Elective Course	02
Non-Major Elective Course	01
Modular Course	02
Compulsory Non Credit Course	02
Value added course	02
Extension	01

COURSE SYLLABUS

Course Code and Title	**18MATP0101 / ALGEBRA**		
Class	M.Sc.	Semester	First
	If revised, Percentage of Revision effected (Minimum 20%)	40%	
Cognitive Level	Recognizing some advances of theory of groups, extension fields, Galois theory (K1-Knowing) 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) Formulating some special types of rings, ideals (K6-Create)		
Course Objectives	To provide deep knowledge about various algebraic structures.		

UNIT	Content	No. of Hours
I	A counting principle - Cardinality of product of two subsets of a group - Normal subgroups and quotient groups - Homomorphisms Cauchy's theorem for abelian groups - Sylow's theorem for abelian groups - Correspondence theorem for groups - Automorphisms - Cayley's theorem - Permutation groups.	14
II	Another counting principle - Conjugate class - Class equation of a group - Applications - Cauchy's theorem - Sylow's theorems - Direct product - Finite abelian groups.	12
III	Euclidean rings - G.C.D - Unique Factorization Theorem - A particular Euclidean ring - Fermat's theorem - Polynomials over the rational field - Polynomial rings over commutative rings.	13
IV	Extension fields - Roots of polynomials - More about roots - Finite fields.	12
V	The elements of Galois theory - Solvability by radicals - Galois group over the rationals.	13
References	1. John. B. Fraleigh, **A First Course in Abstract Algebra**, 7th Edition, Addison-Wesley, 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**, American Mathematical Society, 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. **Web Resources:** https://onlinecourses.nptel.ac.in/noc18_ma15 https://onlinecourses.nptel.ac.in/noc18_ma16	
Course out comes	After successful completion of the course students will be able to CO1: Explain advances of the theory of groups. CO2: Use Sylow's theorems in the study of finite groups. 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.	

Mapping of COs with PSOs & POs:

CO/PO	PO					PSO					Mean Score of COs
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
CO1	3	2	3	1	2	3	2	2	1	3	2.2

CO2	3	2	3	1	2	3	1	2	1	3	2.1
CO3	3	2	2	1	1	3	2	1	1	2	1.9
CO4	3	3	2	1	3	3	3	1	1	3	2.3
CO5	3	2	3	2	2	3	3	2	1	3	2.4
Mean overall score											**2.18**

Course Code and Title	**18MATP0102 / REAL ANALYSIS**		
Class	M.Sc.	Semester	First
	If revised, Percentage of Revision effected (Minimum 20%)	25%	
Cognitive Level	Understanding the fundamentals of sets and axioms (K1 & K2-Remembering and understanding). Understanding the geometry of metric spaces and identifying open, closed, connected 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 functions (K3-Applying). Identifying differentiable functions and evaluate its derivatives (K4 & K5 – Analyzing and Evaluating)		
Course Objectives	To impart abstract concepts of real valued functions in detail.		

UNIT	**Content**	**No. of Hours**
I	Basic Topology: Finite - Countable and Uncountable sets - Metric spaces - Compact sets - Perfect sets - Connected sets.	13
II	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
III	Continuity: Limits of functions - Continuous functions - Continuity and compactness - Continuity and connectedness - Monotonic functions - Infinite limits and limits at infinity.	13
IV	Differentiation: The derivative of a real function - Mean value theorems - The continuity of derivatives - L'Hospital's rule - Derivatives of Higher order - Taylor's	11

	theorem - Differentiation of vector valued functions.	
V	The Riemann-Stieltjes integral: Definition and existence of the integral - Properties of the integral - Integration and differentiation - Integration of vector valued functions - Rectifiable curves.	11
References	**Text books:** 1. Walter Rudin, **Principles of Mathematical Analysis,** 3rd Edition, McGraw – Hill International Book Company, Singapore, (1982). Units 1-5: Chapters: 1 – 5 (Including Appendix of chapter 1). 2. Tom M. Apostol, **Mathematical Analysis**, Narosa Publishing House, New Delhi, 1997. 3. G. F. Simmons, **Introduction to Topology and Modern Analysis**, McGraw- Hill, New Delhi, 2004. 4. R. G. Bartle & D.R. Sherbert, **Introduction to Real Analysis**, John Wiley & Sons, New York, 1982. 5. Kenneth A. Ross, **Elementary Analysis: The theory of Calculus**, Springer, New York, 2004. 6. N. L. Carothers, **Real Analysis**, Cambridge University Press, UK, 2000. 7. S. C. Malik, **Mathematical Analysis**, Willey Eastern Ltd., New Delhi, 1985. 8. K. R. Stromberg, **An Introduction to Classical Real Analysis,** Wadsworth, 1981. **Web Resources:** http://nptel.ac.in/courses/109104124/ http://nptel.ac.in/courses/111101100/	
Course out comes	After successful completion of the course students will be able to CO1: Discuss various axioms and properties of real and complex numbers CO2: Analyze sets with its abstract properties CO3: Compile sequences and series along with its properties CO4: Predict existence of limit of functions CO5: Evaluate the derivative of real valued functions	

Mapping of COs with PSOs & POs:

CO/PO	PO					PSO					Mean Score of COs
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
CO1	3	1	3	2	2	3	2	3	2	1	2.3
CO2	3	2	3	2	2	3	2	3	1	2	2.3
CO3	3	2	3	3	2	3	3	2	2	2	2.5
CO4	3	2	3	2	2	3	3	2	1	2	2.3
CO5	3	2	3	3	2	3	3	2	1	2	2.4
Mean overall score											**2.36**

Course Code and Title	**18MATP0103 / NUMERICAL ANALYSIS**		
Class	M.Sc.	Semester	First
	If revised, Percentage of Revision effected (Minimum 20%)	30%	
Cognitive Level	Knowing large number numerical calculations (K1) Understanding numerical ability (K2) Applying algorithms numerically (K3)		
Course Objectives	To develop skills to solve many physical problems in an effective and efficient manner using different numerical techniques.		

UNIT	**Content**	**No. of Hours**
I	Solving a system of simultaneous equations: Elimination method –The Gaussian elimination and Gauss – Jordan method-Iterative methods – Gauss Jacobi iteration – Gauss Seidel iteration -Pathology in Linear systems – Singular Matrices- Relaxationmethod.	13
II	Interpolation and curvefitting: Lagrangian polynomials- Divided differences – Interpolation with cubic spline – Bezeir Curves and B- Spline curves- Polynomial Approximation of Surfaces	13
III	Numerical differentiation and integration: Numerical differentiation – derivatives using Newton's forward and backward formula – Derivatives using Striling's formula – Maxima and Minima of Tabulated Function - Trapezoidal rule-Simpson's 1/3rd rule - 3/8 rule - Weddles's rule- Errors in quadrature formula.	13
IV	Numerical solution of ordinary differential equations: Introduction – Power series solution – Pointwise Method – The Taylor series method – Picard's method –Euler and modified Euler methods – Runge – Kutta methods.	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- Solution to Partial Differential Equations by Relaxation method.	12
References	1. Curtis. F. Gerald, Patrick & O. Wheatley, **Applied Numerical Analysis,** 5th Edition, 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,** Vikas publishing house, Pvt. Ltd, 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. **3.** M. K. Jain, S. R. K. Iyengar & R. K. Jain, **Numerical Methods for Scientific and Engineering Computation,** 3rd Edition, Wiley Eastern Edition, New Delhi, 2003. 4. R. L. Burden & J. Douglas Faires, **Numerical Analysis,** Thompson Books, USA, 2005. **Web Resources:** http://nptel.ac.in/courses/111107105/
Course out comes	After successful completion of the course students will be able to CO1: Apply different methods to solve the system of equations CO2: Realize the nature of different curves along with specified properties 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.

Mapping of COs with PSOs & POs:

CO/PO	PO					PSO					Mean Score of COs
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
CO1	2	2	3	2	3	3	3	3	1	2	2.4
CO2	3	2	3	2	2	3	3	3	3	2	2.6
CO3	3	3	2	1	3	2	2	3	3	3	2.5
CO4	3	2	3	2	3	3	3	2	3	1	2.5
CO5	2	3	2	1	3	1	2	3	3	3	2.3
Mean overall score											**2.46**

Course Code and Title	**18MATP0104 / DIFFERENTIAL EQUATIONS**		
Class	M.Sc.	Semester	First
	If revised, Percentage of Revision effected (Minimum 20%)	30%	
Cognitive Level	K-1 Identify various basic concepts on differentiations		

	K-2 Use to model differential systems K-3 To develop approximation methods and fixed point theorems to get solutions of differential equations K-4 Extend the results to higher order differential calculus K-5 To develop skills to obtain solutions partial differential equations	
Course Objectives	To study in-depth concepts and applications of differential equations.	
UNIT	**Content**	**No. of Hours**
I	Systems of linear differential equations: Introduction - Systems of first order equations - Model for arms competition between two nations - Existence and uniqueness theorem - Fundamental matrix - Non - homogeneous linear systems - Linear systems with constant coefficients - Linear systems with periodic coefficients.	13
II	Existence and uniqueness of solutions: Introduction - Successive approximations - Picard's theorem - Continuation and dependence of initial conditions - Existence of solutions in the large - Existence and uniqueness solutions of systems - Fixed point method.	12
III	Boundary value problem: Introduction - Strum Liouville problem - Green's function - Applications of boundary value problems - Picard's theorem.	13
IV	First order partial differential equations: Classification of Integrals - Linear equations of the first order - Pfafian differential equations - Compatible systems - Charpit's method - Jacobi's method - Integral surface through a given circle - Quasi - Linear Equation.	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 - Riemann's Method - 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:** 1. S. G. Deo, V. Lakshmikantham& V. Raghavendra, **Ordinary Differential Equations**, Second Edition, Tata McGraw-Hill publishing company Ltd, New Delhi, 2004. Unit 1 : Chapter 4: Sections 4.1 to 4.8. Unit 2 : Chapter 5 : Sections 5.1 to 5.9 Unit 3 : Chapter 7 : Sections 7.1 to 7.5. 2. T. Amarnath, **An Elementary Course in Partial Differential**	

	Equations, Narosa Publishers, New Delhi, 1997. Unit 4: Chapter 1: Sections 1.3 to 1.10 Unit 5:Chapter 2: Sections 2.1, 2.2, 2.3.1, 2.3.2, 2.3.3, 2.3.4, 2.3.5, 2.5.1, 2.5.2. 3. Earl. A. Coddington, **An Introduction to Ordinary Differential Equations**, Dover Publications, inc., 1990. G. F. Simmons, S. G. Krantz, **Differential Equations: Theory, Technique and Practice**, Tata McGraw Hill Book Company, New Delhi, India, 2007. Clive R. Chester, **Techniques in Partial Differential Equations**, McGraw-Hill, 1970 **Web source:** https://arxiv.org/abs/1706.06446 https://www.youtube.com/watch?v=PTvvoVLzVCE
Course out comes	After successful completion of the course students will be able to CO1: Formulate problems in Differential Equations. CO2: Apply basic concepts of both ordinary and partial differential equations in physical problems CO3: Explain various types of differentiations. CO4: Discuss problems in differential equations. CO5: Identify various partial differential equation models in Physics.

Mapping of COs with PSOs & POs:

CO/PO	PO					PSO					Mean Score of COs
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
CO1	1	3	2	3	2	2	2	2	2	3	2.2
CO2	2	1	2	2	1	2	3	2	2	2	1.9
CO3	3	2	3	2	1	0	2	1	2	3	1.9
CO4	2	1	2	1	3	1	2	2	1	3	1.8
CO5	3	1	2	2	2	1	2	2	2	2	1.9
Mean overall score											**1.94**

Course Code and Title	**18MATP0105 / DISCRETE MATHEMATICS**		
Class	M.Sc.	Semester	First
	If revised, Percentage of Revision effected (Minimum 20%)	30%	
Cognitive Level	K-1: Knowing the concepts of basic principles to solve the counting problems		

	K-2: Understanding the permutation and combinatorial problem K-3: Applying Inclusion-exclusion principle to real life problems. K-3: Evaluating number theoretical problems by using number theoretic functions	
Course Objectives	To impart various concepts about permutations, combinations and theory of numbers.	
UNIT	**Content**	**No. of Hours**
I	Four basic counting principles - Permutations of sets - Combinations (subsets) of sets - Permutations of multi sets - Combinations of multi sets - Pigeonhole principle: simple form - strong form - Pascal's formula- The binomial theorem - Unimodality of binomial coefficients - The multinomial theorem - Newton's binomial theorem.	14
II	The inclusion - exclusion principle - Combinations with repetition - Derangements - Some number sequences - Solving linear homogeneous recurrence relations and non-homogeneous recurrence relations - Generating functions - Recurrences and generating functions - Exponential generating functions.	13
III	Divisibility theory in the integers: Early number theory - The division algorithm - The greatest common divisor - The Euclidean algorithm -The Diophantine equation. Primes and their distributions: The fundamental theorem of arithmetic -The sieve of Eratosthenes	13
IV	The theory of congruence: Basic properties of congruence –Binary and Decimal representations of Integers - Linear congruence and the Chinese Reminder Theorem - Fermat’s Theorem: Fermat’s little theorem and pseudoprimes - Wilson’s theorem - The Fermat-Kraitchik factorization method.	12
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: The order of an integer modulo *n* - Primitive roots for primes - Composite numbers having primitive roots- Theory of Indices.	12
References	**Text Books:** 1. Richard A. Brualdi, **Introductory Combinatorics,** 5 th edition, Pearson Education Inc, England, 2010. Unit 1: Chapter 2: Sections 2.1 - 2.2. Chapter 3: Sections 3.1- 3.5. Chapter 5: Sections 5.1 – 5.2., 5.4-5.6 Unit 2: Chapter 6: Sections 6.1 - 6.3. Chapter 7: Sections 7.1 -7.5., 7.7. 2. 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 3.1 - 3.2. 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 - 7.4, Chapter 8: Sections 8.1 - 8.4. **References:** 1. C. Berg, **Principles of Combinatorics**, Academic Press, New York, 1971. 2. S. Lipschutz& M. Lipson, **Discrete Mathematics**, Tata McGraw-Hill Publishing Company, New Delhi, 2006. 3. J. Truss, **Discrete Mathematics for Computer Scientists**, Pearson Education Limited, England, 1999. 4. Tom. M. Apostol,**Introduction to Analytic Number Theory**, Springer, New Delhi, 1993. 5. Thomas Koshy, **Elementary Number Theory**, Elsevier, California 2005. 6. N. Robbins, **Beginning Number Theory**, 2nd Edition, Narosa Publishing House, New Delhi, 2007. **Web Resources:** 1. https://www.tutorialspoint.com/discrete_mathematics/ **2.** home.iitk.ac.in/~arlal/book/mth202.pdf
Course out comes	After successful completion of the course students will be able to CO1: Outline the ideas of permutations, combinations and its properties CO2: Apply the permutations and combinations to solve problems CO3: Predict the concepts of divisibility and related algorithms CO4: Analyze the properties of congruence relations CO5: Explain the number theoretic functions

Mapping of COs with PSOs & POs:

CO/PO	PO					PSO					Mean Score of COs
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
CO1	2	3	1	2	3	3	2	2	2	2	2.2
CO2	3	3	2	1	2	3	3	3	3	2	2.5
CO3	2	2	3	2	3	2	3	2	3	3	2.5
CO4	3	2	3	2	2	2	2	3	3	2	2.4
CO5	2	3	1	2	2	2	2	1	2	2	1.9
Mean overall score											2.3

Course Code and Title	**18MATP0206 LINEAR ALGEBRA**		
Class	M.Sc.	Semester	Second
	If revised, Percentage of Revision effected (Minimum 20%)	45%	

Cognitive Level	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 Objectives	To introduce some important concepts of vector spaces.	
UNIT	**Content**	**No. of Hours**
I	Vector spaces: Examples - Elementary basic concepts - Subspaces - Examples - Intersection, union and sum of subspaces - Direct sum of subspaces - quotient spaces - Linear independence and bases - Fundamental results - Dual spaces – Annihilators.	14
II	Linear Transformations: Types of linear transformations - Examples - kernel of a linear transformation - Fundamental theorem of linear transformation - 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 - Examples - Basic properties - Schwarz inequality - Orthogonality–orthonormal sets - examples and properties - 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	**Text Book:** 1. N. Herstein, **Topics in Algebra**, 2nd Edition, John Wiley & Sons, Singapore, 1993. Unit 1**:** Chapter 4: Sections 4.1, 4.2, 4.3. Unit 2**:** Chapter 6: Sections 6.1, 6.2, 6.3. Unit 3**:** Chapter 6: Sections 6.4, 6.5, 6.6. Unit 4: Chapter 4: Section 4.4, Chapter 6: Sections 6.8. Unit 5: Chapter 6: Sections 6.10, 6.11. **References:** 1. Vivek Sahai & Vikas Bist, Linear **Algebra**, Narosa Publishing House, 2002. 2. A. R. Rao & P. Bhimashankaram., **Linear Algebra**, Tata Mc Graw	

	Hill. 1992. 3. J. S. Golan, **Foundations of linear Algebra**, Kluwer Academic publisher, 1995. 4. Kenneth Hoffman & Ray Kunze, **Linear Algebra**, Prentice-Hall of India Pvt., 2004. 5. S. Kumaresan, **Linear Algebra: A Geometric Approach**, Prentice Hall of India, 2006. 6. Jin Ho Kwak & Sungpyo Hong, **Linear algebra**, Birkhauser, 2004. **Web Resources:** 1. https://onlinecourses.nptel.ac.in/noc18_ma16
Course out comes	After successful completion of the course students will be able to CO1: Identify the advances of vector spaces and linear transformations. CO2: Analyze 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.

Mapping of COs with PSOs & POs:

CO/PO	PO					PSO					Mean Score of COs
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
CO1	3	2	2	1	3	3	3	3	1	3	2.4
CO2	3	3	2	1	3	3	3	3	1	3	2.5
CO3	3	3	2	1	3	3	3	2	1	3	2.4
CO4	3	3	3	1	3	3	2	2	1	3	2.4
CO5	3	3	3	1	3	3	3	3	1	3	2.6
Mean overall score											**2.46**

Course Code and Title	**18MATP0207 / ADVANCED REAL ANALYSIS**		
Class	M.Sc.	Semester	Second
	If revised, Percentage of Revision effected (Minimum 20%)	25%	
Cognitive Level	Interpreting the geometry of integrals and evaluating the integral values (K4 & K5 – Analyzing and Evaluating). Understanding the concepts of uniform convergence and apply them to evaluate the derivatives and integrals (K2 & K3 -Remembering and Applying). Understanding the concepts trigonometric functions and applying them to study Fourier series. (K2 & K3-Understanding and Applying).		

	Understanding the concepts of functions of several variables and evaluating the derivatives of multi-variable functions (K2 & K5 Understanding and Evaluating) Applying Implicit function theorem to Identifying solutions of differential equations (K3 & K6 – Applying and Creating).	
Course Objectives	To introduce the concept of integration of real-valued functions, sequences and series of functions.	
UNIT	**Content**	**No. of Hours**
I	Sequences and series of functions: Discussion of Main problem - Uniform Convergence - Uniform convergence and continuity - Uniform convergence and Integration - Uniform convergence and differentiation - Equicontinuous families of functions - The Stone - Weierstrass theorem.	13
II	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.	12
III	Functions of several variables: Linear transformations - Differentiation - The contraction principle - The inverse function theorem.	13
IV	The implicit function theorem - The rank theorem - Determinants - Derivatives of higher order - Differentiation of integrals.	13
V	Integration of Differential forms: Integration - Primitive Mappings-Partitions of unity - Change of variables - Differential forms Simplexes and chains - Stroke's Theorem - Closed forms and Exact forms - Vector Analysis	13
References	**Text Book:** 1. Walter Rudin, **Principles of Mathematical Analysis,** 3rd Edition, McGraw – Hill International Book Company, Singapore, 1982. Unit 1: Chapter 7, Unit 2: Chapter 8, Unit 3,4 : Chapter 9 . Unit 5, Chapter-10. **References:** 1. Tom M. Apostol, **Mathematical Analysis**, Narosa Publishing House, New Delhi, India, 1997. 2. G. F. Simmons, **Introduction to Topology and Modern Analysis**, 3rd Ed., McGraw- Hill, New Delhi, 2004. 3. S. C. Malik, **Mathematical Analysis**, Wiley Eastern Ltd., New Delhi, 1985. 4. N. L. Carothers, **Real Analysis**, Cambridge University Press, UK, 2000. **Web Resources:** **1.** http://nptel.ac.in/courses/109104124/ **2.** https://onlinecourses.nptel.ac.in/noc18_ma10	

Course out comes	After successful completion of the course students will be able to CO1: Discuss the integrals of a bounded function on a closed bounded interval CO2: Compile the sequences and series of functions and uniformity in its convergence CO3: Identify various mathematical functions CO4: Evaluate the derivative of functions of multiple variables CO5: Compute higher order derivatives for vector valued functions

Mapping of COs with PSOs & POs:

CO/PO	PO					PSO					Mean Score of COs
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
CO1	3	2	3	3	2	3	2	3	2	1	2.4
CO2	3	2	3	2	3	3	3	2	2	2	2.5
CO3	3	2	2	2	3	3	3	2	1	2	2.3
CO4	2	3	3	3	3	3	3	2	2	2	2.6
CO5	3	2	3	2	3	3	3	2	1	2	2.4
Mean overall score											**2.44**

Course Code and Title	**18MATP0208 / MATHEMATICAL METHODS**		
Class	M.Sc.	Semester	Second
	If revised, Percentage of Revision effected (Minimum 20%)	25%	
Cognitive Level	Knowing different methods of transformations (K-1) Understanding the in build techniques of calculations (K-2) Applying various transformations to reality (K-3)		
Course Objectives	To learn various integral equations, transformation techniques and its applications.		

UNIT	**Content**	**No. of Hours**
I	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	13

	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- Volterra integral equation of the first kind – Solution of Volterra integral equation of the first kind.	12
III	Classical Fredholm theory – Introduction - Fredholm's first fundamental theorem - Problems based on Fredholm's first fundamental theorem - Fredholm's second fundamental theorem - Fredholm's third fundamental theorem – Including proof.	12
IV	Singular integral equations - The solution of Abel's integral equation - Some general form of Abel's singular integral equation - Problem- Applications of integral equation The Cauchy integrals – Plemelj Formulas – Poincare – Bertrand transformation Formula 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.	14
V	Fourier Transforms - Definition- Inversion theorem - Fourier sine and cosine transform - Fourier transforms of derivatives - Convolution theorem - Parsevel's relation for Fourier transform and problems on self-reciprocal.	13
References	**Text Books:** 1. M. D. Raisinghania, **Integral Equations and boundary value Problems**, Third Revised edition, S. Chand & Company Ltd. New Delhi. 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 Mc Graw Hill, New Delhi, 1974. **References:** 1. J. K. Goyal & K. P. Gupta, **Laplace and Fourier Transforms,** 12th Edition, Pragati Prakashan Meerukt, 2000.	

	2. W. V. Lovitt, **Linear Integral equations,** Dover Publications, New York, 1950. **Web Sources:** **1.** http://nptel.ac.in/courses/111107103/ **2.** https://onlinecourses.nptel.ac.in/noc18_ma12
Course out comes	After successful completion of the course students will be able to CO1: Apply the various concepts of integral equations in various problems CO2: Discuss the solutions of various integral equations CO3: Assess various theorems with proof techniques that will motivate to develop further CO4: Create different functions based on applications CO5: Apply different transformation techniques in solving problems.

Mapping of COs with PSOs & POs:

CO/PO	PO					PSO					Mean Score of COs
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
CO1	3	2	3	2	3	3	3	2	2	3	2.6
CO2	2	3	3	3	2	3	3	3	2	3	2.7
CO3	2	3	3	3	3	1	1	3	2	3	2.4
CO4	1	2	2	3	3	2	3	2	3	2	2.3
CO5	2	3	3	2	2	3	2	1	3	3	2.4
Mean overall score											

Course Code and Title	**18MATP0209 / PROBABILITY AND STATISTICS**		
Class	M.Sc.	Semester	Second
	If revised, Percentage of Revision effected (Minimum 20%)	35%	
Cognitive Level	K-1: Knowing the concepts of probability, random variables and distribution K-2: Understanding the special distributions K-3: Applying central limit theorem for limiting problems in statistics K-4: Evaluating the measure of quality of estimators.		
Course Objectives	To learn the advanced theory of probability and some statistical techniques.		

UNIT	Content	No. of Hours
I	Introduction to probability and distributions - The probability set function - Conditional probability and independence - Random variables of the discrete type - Random variables of the continuous type.	13
II	Expectation of a random variable - Some special expectations - Chebyshev's inequality. Some Special Distributions: The Binomial and related distributions - The Poisson distribution - The Uniform distribution - The Gamma and Chi-Square distributions - The normal distribution - The bivariate normal distribution - The beta distribution - Student's t- distribution - F-distribution-Expectation of Functions.	14
III	Limiting Distributions: Convergence in distribution; Bounded in Probability - Δ- Method - Convergence in probability - Limiting moment generating function - The central limit theorem.	12
IV	Estimation Theory: Introduction - Unbiased estimators - Efficiency - Consistency - Sufficiency - The method of moments - The method of maximum likelihood - Bayesian estimation. Sufficient Statistics: Measure of quality of estimators - A sufficient statistic for a parameter - Properties of a sufficient statistics - Completeness and uniqueness.	13
V	Analysis of Variance: Introduction - One-way Designs - Randomized block designs - Factorial experiments-analysis of variance - Experimental design - Two-way analysis of variance without interaction - Two-way analysis of variance with interaction.	12
References	**Text Books:** 1. Robert V. Hogg & Allen T. Craig, **Introduction to Mathematical Statistics**, 5th Edition, Pearson Education, Singapore, 2002. Unit 1: Chapter1: Sections 1.1 to 1.7 Unit 2: Chapter 1: Sections 1.8 to 1.10, Chapter 3: Sections 3.1 to 3.5, Chapter 4: Section4.1 Unit 3: Chapter 5: Sections 4.2 to 4.4 Unit 4: Chapter 7: Sections 7.1 to 7.4 2. Irwin Miller &Marylees Miller, **John E. Freund'sMathematical Statistics**, 6th Edition, Pearson Education, New Delhi, 2002. Unit 2: Chapter 6: Section 6.2, Unit 4: Chapter 10: Sections 10.1 to 10.5 & 10.7 to 10.9 Unit 5: Chapter 15: Sections 15.1 to 15.5 **References:** 1. MarekFisz, **Probability Theory and Mathematical Statistics**, John Wiley, 1963. 2. John E. Freund, **Mathematical Statistics**, 5th edition, Prentice Hall India, 1994. 3. S.M. Ross, **Introduction to Probability Models**, Academic Press,	

	India, 2000. **Web Resources:** 1. https://onlinecourses.nptel.ac.in/noc18_ma19 2. https://onlinecourses.nptel.ac.in/noc18_ma22
Course out comes	After successful completion of the course students will 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 situation, and use it to compute expectation and variance. 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: Identify situations where one-way ANOVA is and is not appropriate.

Mapping of COs with PSOs & POs:

CO/PO	PO					PSO					Mean Score of COs
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
CO1	3	2	1	2	2	2	3	2	2	2	2.1
CO2	3	2	1	2	2	1	3	1	3	2	2.0
CO3	2	2	1	2	3	2	3	2	2	2	2.1
CO4	3	2	1	2	2	2	3	1	2	2	2.0
CO5	3	2	1	1	2	1	3	1	2	2	1.8
Mean overall score											**2.0**

Course Code and Title	**18MATP0310 / TOPOLOGY**		
Class	M.Sc.	Semester	Third
	If revised, Percentage of Revision effected (Minimum 20%)	45%	
Cognitive Level	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 -Analyze).		

	Building new topological spaces, connected spaces, compact spaces, normal spaces, regular spaces and Hausdorff space from the existing topological spaces (K6 - Create)	
Course Objectives	To introduce the fundamental concepts of topology and study the properties of topological spaces**.**	
UNIT	**Content**	**No. of Hours**
I	Topological spaces -Basis for a topology - The order topology - The product topology on X × Y – The subspace topology - Closed sets and limit.	14
II	Continuous functions **-** The product topology - The metric topology.	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's metrization theorem –Tietz extension theorem - The Tychonoff theorem.	14
References	**Text Book:** James R. Munkres**, Topology**, 2nd Edition, Pearson Education, Delhi, 2006. Unit 1: Chapter 2: Sections 2.1- 2.6 Unit 2: Chapter 2: Sections 2.7-2.10 Unit 3: Chapter 3: Sections 3.1, 3.2, 3.4, 3.5 Unit 4: Chapter 4: Sections 3.6, 4.1-4.2 Unit 5: Chapters 4: Sections 4.3, 4.4, 4.5, 4.6, Chapter 5: 5.1. **References:** 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, 1983. 6. J. L. Kelly, **General Topology,** Springer-Verlag, New York, 1975 7. James Dudunji**, Topology,** Allyn and Bacon, New Delhi, 1966.	
Course out comes	After successful completion of the course students will be able to CO1: Discuss several constructions of topological spaces CO2: Analyze various properties of topological spaces 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	

Mapping of COs with PSOs & POs:

CO/PO	PO					PSO					Mean Score of COs
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
CO1	3	2	2	1	3	3	3	3	1	2	2.3
CO2	3	3	2	1	3	3	3	3	1	3	2.4
CO3	3	2	2	1	2	3	3	3	2	2	2.3
CO4	3	3	2	1	3	3	3	3	1	2	2.4
Mean overall score											**2.35**

Course Code and Title	**18MATP0311 / MEASURE THEORY**		
Class	M.Sc.	Semester	Third
	If revised, Percentage of Revision effected (Minimum 20%)	25%	
Cognitive Level	Understanding the basic concepts of measurable sets and functions by applying open sets (K2 & K3 – Understanding and Applying). Interpreting geometrically the Lebesgue integration and evaluate it (K4 & K5 –Analyzing and Evaluating). Understanding the Lebesgue integration on general spaces by applying Lebegue integration on real line. (K3 & K6-Applying and Creating). Understanding the concepts convergence of Lebesgue integrable functions(K1 & K2 – Remembering and Understanding) Generalization of Legebsge measure (K6 – Creating).		
Course Objectives	To introduce the fundamentals of measure and integration on the real line.		

UNIT	**Content**	**No. of Hours**
I	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	13

	functions - Jensen's inequality - The inequalities of Holder and Minkowski - Completeness of L $^{p}(\mu)$.	
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 - Measure and Integration in a Product Space - Measurabili1y in a Product Space - The Product Measure and Fubini's Theorem.	12
References	**Text Book:** 1. G.de Barra, **Measure Theory and Integration,** Ist Edition, New Age International Publishers, 2003. Unit 1 : Sections 2.1, 2.2, 2.3, 2.4, 2.5 Unit 2 : Sections 3.1, 3.2, 3.3, 3.4 Unit 3 : Sections 5.1, 5.2, 5.3, 5.4, 5.5, 5.6 Unit 4 : Sections 6.1, 6.2, 6.3, 6.4, 6.5 Unit 5 : Sections 8.1, 8.2, 8.3,8.4, Section 10.1, 10.2 **References:** 1. H. L. Royden, **Real analysis**, 3rd Ed., Prentice Hall of India, New Delhi, 2005. 2. I. K. Rana, **An Introduction to Measure and Integration**, Narosa Publishing House, New Delhi, 1999. 3. D.L. Cohn, **Measure Theory**, Birkhauser, Switzerland,1980. 4. E. Hewitt & K. R. Stromberg, **Real and Abstract Analysis**, Wiley Verlag, 1966. **Web Resources:** 1. http://nptel.ac.in/courses/111101100/	
Course out comes	After successful completion of the course students will be able to CO1: Outline the concept of Lebesgue measure and integration. CO2: Interpret the geometric meaning of measurable functions and integration. CO3: Formulate the relationships between Riemann and Lebesgue integrals. CO4: Describe the importance and applications of measure theory in other branches of Mathematics. CO5: Apply the techniques of measure theory to evaluate integrals.	

Mapping of COs with PSOs & POs:

CO/PO	PO					PSO					Mean Score of COs
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
CO1	3	2	3	2	2	3	2	3	1	2	2.3
CO2	3	2	3	2	3	3	2	2	2	2	2.4
CO3	3	2	3	2	3	3	3	2	1	2	2.4
CO4	3	3	3	1	2	3	2	1	2	2	1.9

CO5	3	2	3	1	3	3	2	2	1	1	1.9
Mean overall score											**2.18**

Course Code and Title	**18MATP0312 / STOCHASTIC PROCESSES**		
Class	M.Sc.	Semester	Third
	If revised, Percentage of Revision effected (Minimum 20%)	35%	
Cognitive Level	Knowing about the stochastic processes, higher transition probabilities and stochastic processes in queuing systems (Knowing-K1) Understanding the in-depth knowledge about stationary stochastic processes and Markov chains.(Understanding - K2) Applying the concept of Markov processes to real life problems. (Applying – K3) Analyses the solving technique for stochastic processes in queuing systems.(Analyzing – K4) Create new problems in queuing theory models. (Creating – K6)		
Course Objectives	To introduce a wide variety of stochastic processes and their applications.		

UNIT	Content	No. of Hours
I	Definition of stochastic processes - Markov chains: Definition - order of a markov chain - Higher transition probabilities - Generalization of Independent Bernoulli: Sequence of chain - Dependent Trials - Trials classification of states and chains.	13
II	Markov Process with discrete state space: Poisson process and related distributions - Properties of Poisson process - Generalizations of Poisson processes - Birth and death processes - Continuous time Markov chains - Randomization	13
III	Markov processes with continuous state space: Introduction - Brownian motion - Weiner process and differential equations for it - Kolmogorov equations - First passage time distribution for Weiner process : Distribution of the maximum of a Wiener Process - Distribution of the first time to a fixed point - Ornstein - Uhlenbech process.	13
IV	Branching Processes: Introduction - Properties of generating functions of Branching processs - Probability of Extinction - Distribution of the total number of progeny - Continuous - Time Markov branching process - Age dependent branching process: Bellman - Harris process.	13

V	Stochastic Processes in Queueing Systems: Concepts - Queueing model M/M1 - transient behavior of M/M/1 model - Birth and death process in Queueing theory : M/M/1 - Model related distributions - M/M/∞ - M/M/S/S - Loss system - M/M/S/M	12
References	**Text Book:** 1. J. Medhi, **Stochastic Processes**, 4th Edition, New age international Private limited, New Delhi, 2006. Unit 1: Chapter 2: Sections 2.1 - 2.4, Unit 2: Chapter 4: Sections 3.1 - 3.6. Unit 3: Chapter 5: Sections 4.1 - 4.6. Unit 4: Chapter 9: Sections 9.1to 9.4, 9.7. Unit 5: Chapter 10: Sections 10.1 - 10.4. **References:** 1. K. Basu, **Introduction to Stochastic Process**, Narosa Publishing House, New Delhi, 2003. 2. Goswami& B. V. Rao, **A Course in Applied Stochastic Processes**, Hindustan Book Agency, New Delhi, 2006. 3. G. Grimmett& D. Stirzaker, **Probability and Random Processes**, 3rd Ed., Oxford University Press, New York, 2001. **Web Resources:** 1) https://nptel.ac.in/courses/111102014/ 2) https://nptel.ac.in/courses/111103022/	
Course out comes	After successful completion of the course students will be able to CO1: Discuss about Stationary Stochastic Processes and Markov chains. CO2: Distinguish the Markov Process with discrete state space and continuous state space CO3: Demonstrate Brownian Motions and its properties CO4: Outline branching processes and age dependent branching process CO5: Apply stochastic processes in queuing systems	

Mapping of COs with PSOs & POs:

CO/PO	PO					PSO					Mean Score of COs
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
CO1	3	2	0	3	1	3	2	1	2	3	2.0
CO2	1	3	3	2	3	2	2	2	3	2	2.3
CO3	2	1	2	2	3	2	2	3	2	2	2.1
CO4	1	3	3	2	3	1	2	2	3	3	2.2
CO5	1	3	2	2	3	2	3	2	3	3	2.4
Mean overall score											**2.2**

<table>
<tr><td>Course Code and Title</td><td colspan="3">18MATP0413 / COMPLEX ANALYSIS</td></tr>
<tr><td rowspan="2">Class</td><td>M.Sc.</td><td>Semester</td><td>Four</td></tr>
<tr><td>If revised, Percentage of Revision effected
(Minimum 20%)</td><td colspan="2">25%</td></tr>
<tr><td>Cognitive Level</td><td colspan="3">Know the concept of bilinear transformations, power series, operations of power series, conformal mappings, singularities and residues. (K-1)

Understand the importance of analytic functions, the uniform convergence of a series, the Cauchy’s inequality and applications and argument principles (K-2)

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 (K-3)

Analyze the analyticity of a function (K-4)
Evaluate the values of real integrals (K-5)

Create a model based on real life situations and apply these complex techniques to solve it and create new theoretical concepts or an extension of the existing one.(K-5)</td></tr>
<tr><td>Course Objectives</td><td colspan="3">To impart various concepts about the analytic functions in the complex plane.</td></tr>
<tr><td>UNIT</td><td colspan="2">Content</td><td>No. of Hours</td></tr>
<tr><td>I</td><td colspan="2">Analytic Functions: Cauchy–Riemann equation – Analyticity - Harmonic functions - Positive Harmonic Functions - Bilinear transformations and mappings: Basic mappings - Linear fractional transformations-Other Mappings.</td><td>14</td></tr>
<tr><td>II</td><td colspan="2">Power Series: Sequences revisited - Uniform convergence - Maclaurin and Taylor Series - Operations on power series –Infinite Products-Weierstrass’ Product Theorem.</td><td>13</td></tr>
<tr><td>III</td><td colspan="2">Complex Integration and Cauchy’s Theorem: Curves – Parameterizations - Line Integrals - Cauchy’s Theorem.</td><td>13</td></tr>
<tr><td>IV</td><td colspan="2">Applications of Cauchy’s Theorem: Cauchy’s integral formula - Cauchy’s inequality and applications - Maximum modulus theorem.</td><td>12</td></tr>
<tr><td>V</td><td colspan="2">Laurent series and the residue theorem: Laurent Series - Classification of singularities - Evaluation of real integrals - Argument principle-Comparison with Analytic Functions</td><td>12</td></tr>
<tr><td>References</td><td colspan="3">Text Book:
S. Ponnusamy & Herb Silverman, Complex Variables with Applications, Birkhauser, Boston, 2006
Unit 1: Chapter 5: Sections 5.1, 5.2, 5.3, Chapter 3: Sections 3.1, 3.2, Chapter 10 : 10.3
Unit 2: Chapter 6: Sections 6.1, 6.2, 6.3, 6.4 Chapter 12: Section 12.1,</td></tr>
</table>

	12.2 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, Chapter 10 : 10.1 **References:** S. Ponnusamy, **Foundations of Complex analysis**, 2 nd edition , Narosa Pub., 2005. T. W. Gamlelin, **Complex Analysis**, Springer-Verlag, New York, 2001. V. Karunakaran, **Complex Analysis**, Narosa Publishing House, New Delhi, 2002. R.V. Churchill & J. W. Brown, **Complex Variables & Applications**, Mc.Graw Hill, 1990. John. B. Conway, **Functions of One Complex Variable**, Narosa Pub. House, 2002. Elias M. Stein & Rami Shakarchi, **Complex analysis**, Princeton University Press, 2003. B. P. Palka, **An Introduction to Complex Function Theory**, Springer-Verlag, New York 1991. Lars. V. Ahlfors, **Complex Analysis**, 3rd edition, McGraw Hill book company, International Edition 1979.
Course out comes	After successful completion of the course students will be able to 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 many contour integrals CO5: Classify the singularities and residues of complex functions

Mapping of COs with PSOs & POs:

CO/PO	PO					PSO					Mean Score of COs
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
CO1	3	3	3	3	2	2	1	2	1	2	2.2
CO2	3	3	3	3	3	3	2	2	1	2	2.5
CO3	3	3	2	3	3	3	2	2	1	2	2.4
CO4	3	3	3	3	3	3	2	2	1	1	2.4
CO5	3	2	3	2	3	2	2	1	2	2	2.2
Mean overall score											**2.34**

Course Code and Title	**18MATP0414 / FUNCTIONAL ANALYSIS**		
Class	M.Sc.	Semester	Fourth
	If revised, Percentage of Revision effected (Minimum 20%)	30%	

Cognitive Level	Know the concept of normed linear spaces, bounded linear operators, the difference between Schauder basis and Hamel basis, separability. (K-1) Understand the importance of normed linear spaces, Hiene-Borel theorem and Riesz lemma, Hahn-Banach extension theorem (K-2) Apply the concept of norm in various other fields of Mathematics (K-3) Analyze the boundedness of different kinds of operators (K-4) Evaluate the norm of different kinds of operators (K-5) Create new theoretical concept (K-6)	
Course Objectives	To introduce basics of functional analysis with special emphasis on Hilbert and Banach space theory.	
UNIT	**Content**	**No. of Hours**
I	Norm on a linear space - Examples of normed Linear spaces - Seminorms and quotient spaces - Measurable functions and L^p spaces - Product space and graph norm - Inner product spaces - Semi - inner product and sesquilinear form - Banach spaces.	14
II	Incomplete normed linear spaces - Completion of normed linear spaces - Some properties of Banach spaces - Baire category theorem (statement only) - Schauder basis and separability - Heine-Borel theorem and Riesz lemma - Best approximation theorems - Projection theorem	13
III	Operators on normed linear spaces - Bounded operators - Some basic results and examples - The space B(X,Y) - Norm on B(X,Y) - Riesz representation theorem - Convergence sequence of operators - Completeness of B(X,Y) - Orthonormal sets and Orthonormal Bases-Bessel's inequality - Fourier expansion and Parseval's formula - Riesz-Fischer theorem.	13
IV	Hahn-Banach theorem and its consequences - The extension theorem – Consequences-On uniqueness of extension - Separation theorem.	12
V	Uniform boundedness principle - Its consequences-Some Application: On divergence of Lagrange Interpolation - On divergence of Fourier Series - Closed graph theorem and its consequences - Bounded inverse theorem - Open mapping theorem - A stability result for operator equations.	12
References	**Text Book**: 1. M. Thamban Nair, **Functional Analysis - A First Course**, Prentice Hall of India Pvt. Ltd., New Delhi, 2010. Unit 1: Chapter 2: Sections 2.1, 2.1.1-2.1.6, 2.2 Unit 2: Chapter 2: Sections 2.1, 2.2.1.,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, 3.4.1,	

	Chapter 4: Sections 4.1, 4.2, 4.3, 4.4. Unit 4: Chapter 5: Sections 5, 5.1 - 5.4. Unit 5: Chapter 6: Sections 6.1, 6.2.1, 6.2.3, Chapter 7: Sections 7.1, 7.2, 7.3, 7.3.1. **References:** 1. B. V. Limaye, **Functional Analysis**, New Age International Pvt. Ltd, 1996. 2. H. Siddiqi, **Functional Analysis with Applications**, Tata McGraw-Hill Pub., 1986. 3. S. Ponnusamy, **Foundations of Functional Analysis**, Narosa Publishing House, 2002. 4. Kreyszig, **Introductory Functional Analysis with Applications**, John Wiley & Sons, 2006.
Course out comes	After successful completion of the course students will be able to CO1: Outline the normed linear spaces and Banach spaces CO2: Discuss about the completion of normed linear spaces CO3: Apply various operators on Banach spaces CO4: Demonstrate the consequences of Hahn-Banach theorem CO5: Critique the closed graph theorem and stability result for operator

Mapping of COs with PSOs & POs:

CO/PO	PO					PSO					Mean Score of COs
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
CO1	3	2	2	3	3	3	2	3	2	2	2.5
CO2	3	2	3	2	3	3	2	2	3	2	2.5
CO3	3	3	2	3	3	3	2	3	3	2	2.7
CO4	3	3	2	3	3	3	2	3	2	2	2.6
CO5	3	2	2	3	2	3	3	2	2	2	2.4
Mean overall score											**2.54**

Course Code and Title	**18MATP0415 / CLASSICAL MECHANICS**		
Class	M.Sc.	Semester	Four
	If revised, Percentage of Revision effected (Minimum 20%)	85%	
Cognitive Level	To know about the concepts of mechanical system, potential and kinetic energies, Lagrangian function and momentum, generating functions, Hamilton - Jacobi equation (Knowing – K1) Understanding how to formulate differential equations of motion of a system and to solve by variational principle, Hamilton's principle and		

	the derivation of HJB equations (Understanding – K2, Applying K-3) Lagrange's equations apply to solve physical problems and the Hamilton–Jacobi method employees to solve problems of differential equation in three-dimensional space (Applying – K3) To analyze about the variational principles, differential forms, generating functions, canonical transformations and special transformations (Analyzing – K4)	
Course Objectives	To study the system dynamics via non-relativistic theories and methods.	
UNIT	**Content**	**No. of Hours**
I	Introductory Concepts: The mechanical system - Generalized coordinates – Constraints: Holonomic Constraints – Nonholonomic Constraints – Unilateral Constraints - Virtual work –Virtual Displacement – Virtual Work – Principle of virtual work – D'Alembert's Principle – Generalized Force - - Energy and momentum: Potential Energy – Work and Kinetic Energy – Conservation of Energy – Equilibrium and Stability – Kinetic Energy of a System – Angular Momentum – Generalized Momentum.	13
II	Lagrange's equations:Derivation of lagrange's equations – Form of the Equations of Motion – Nonholonomic Systems - Examples - Integrals of the motion – Ignorable coordinates – The Routhian function – Conservative systems – Natural Systems – Liouville's Systems - Examples.	13
III	Hamilton's Equations: Hamilton's principle – Constrained Stationary values – Stationary value of a definite integral – Examples –Hamilton's principle – Nonholonomic systems - The Multiplier Rule– Hamilton's equations – Other variational principles.	13
IV	Hamilton - Jacobi theory: Hamilton's principal function - The Hamilton - Jacobi equation - Separability.	13
V	Canonical Transformations: Differential forms and generating functions - Special transformations - Lagrange and Poisson brackets.	12

eferences	**Text Book:** 1. Donald T. Greenwood, **Classical Dynamics**, 3rd Edition, Prentice-Hall Private Limited, New Delhi, 1990. Unit 1: Sections 1.1 to 1.5 Unit 2: Sections 2.1 to 2.3 Unit 3: Sections 4.1 to 4.3 Unit 4: Sections 5.1 to 5.3 Unit 5: Sections 6.1 to 6.3 **References:** 1. P. N. Singhal and S. Sareen, **A Text Book on Mechanics**, Anmol Publications Pvt., Ltd., New Delhi, 2000. 2. Goldstein, Charles Poole, John Safko, **Classical Mechanics**, Pearson Education , 2002. **Web Resources:** https://onlinecourses.nptel.ac.in/noc17_ph07/preview https://ocw.mit.edu/courses/physics/8-01sc-classical-mechanics-fall-2016/syllabus/ http://www.astro.caltech.edu/~golwala/ph106ab/ph106ab_notes.pdf
Course out comes	After successful completion of the course students will be able to CO1: Discuss the basic concepts of nonrelativistic classical dynamics CO2: Apply Lagrange's equations to solve related mechanical problems CO3: Analyze 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

Mapping of COs with PSOs & POs:

CO/PO	PO					PSO					Mean Score of COs
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
CO1	1	2	1	3	3	2	0	3	2	3	2.0
CO2	2	2	1	2	3	3	3	2	2	3	2.3
CO3	2	2	3	3	2	3	3	2	1	3	2.4
CO4	1	2	3	3	3	1	3	2	2	2	2.2
CO5	2	3	3	3	2	2	2	0	3	3	2.3
Mean overall score											**2.24**

<table>
<tr><td>Course Code and Title</td><td colspan="3">18MATP03E1 / OPTIMIZATION TECHNIQUES</td></tr>
<tr><td rowspan="2">Class</td><td>M.Sc.</td><td>Semester</td><td>Four</td></tr>
<tr><td>If revised, Percentage of Revision effected
(Minimum 20%)</td><td colspan="2">50%</td></tr>
<tr><td>Cognitive Level</td><td colspan="3">K-1. Knowing the basic properties of convex function, Linear and non-linear programming Fibonacci method – Golden Section Method, Multi-dimensional constrained optimization and Dynamic Programming.
K-2. Understanding the cutting plane method, Transportation and Assignment problems, direct root method, Hooks and Jeeves method.
K-3. Applying the Revised simplex method – Duality concept – Dual simplex methods to solve linear programming problems. Applying Lagrange's multiplier method – Kuhn-Tucker conditions to solve the constrained non-linear programming problems.
K4: Testing whether the solution is unique or not for one dimensional optimization using convexity.
K5: Investigating the Non-linear programming problems in different type of optimizations methods.
K6. Formulating some new iterative algorithms to solve Non-linear programming problems by using classical differential calculus.</td></tr>
<tr><td>Course Objectives</td><td colspan="3">To impart the mathematical modelling skills through different methods of optimization.</td></tr>
<tr><td>UNIT</td><td colspan="2">Content</td><td>No. of Hours</td></tr>
<tr><td>I</td><td colspan="2">Introduction to convex set and convex function – Linear Programming problems: Simplex method – Revised simplex method – Duality concept – Dual simplex method.
Goal Programming: Introduction - Categorization of Goal Programming – Formulation of Linear Goal Programming Problem</td><td>14</td></tr>
<tr><td>II</td><td colspan="2">Integer Linear Programming: Introduction – Pure and Mixed Integer Programming Problems -Branch – and Bound method – cutting plane method – Zero – Fractional Cut Method – All Integer LPP- Branch and Bound Method – Transportation and Assignment problems.
Sequencing Problem: Introduction - Problem of Sequencing – Basic Terms used in Sequencing – Processing 'n' Jobs through Two Machines– Processing 'n' Jobs through k Machines- Processing 2 Jobs through k machines</td><td>14</td></tr>
<tr><td>III</td><td colspan="2">Introduction to convex set and convex function – Linear Programming problems: Simplex method – Revised simplex method – Duality concept – Dual simplex method.</td><td>12</td></tr>
<tr><td>IV</td><td colspan="2">Multi-dimensional constrained optimization: Lagranges multiplier method – Kuhn-Tucker conditions – Hessian Matrix Method – Wolfe's method – Beal's method.</td><td>12</td></tr>
</table>

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:** 1. H. A. Taha, **Operations Research – An Introduction**, 8th Edition, Prentice – Hall of India, New Delhi, 2006. Unit 1: 3.3, 4.4, 7.1, 7.2 Unit 2: Chapter 5 and Section 9.2 2. S. S. Rao, **Engineering Optimization**, 3rd Edition, New Age International Pvt. Ltd., Publishers, Delhi, 1998. Unit 3: Chapter 5 (Sections 5.1 – 5.12), Chapter 6 (Sections 6.4, 6.6, 6.12.2, 6.13) Unit 4: Chapter 2 (Sections 2.4, 2.5) 3. Kanti Swarup, Gupta P. K. & Man Mohan, **Operations Research**, S. Chand & Sons, New Delhi, 1995. Unit 4: Chapter 28 (Sections 28.3, 28.5, 28.6) Unit 5: Chapter 28 (Sections 28.7, 28.8) **References:** 1. J. K. Sharma, **Operations Research Theory & Applications**, Macmillan India Ltd., New Delhi, 2006. 2. G. Srinivasan, **Operations Research: Principles & Applications,** Prentice Hall of India, New Delhi, India, 2007. **Web Resources:** **1.** http://nptel.ac.in/courses/111107104/	
Course out comes	After successful completion of the course students will be able to CO1: Formulate Linear Programming problems and determine its solutions CO2: Discuss Integer Linear Programming problems CO3: Compute one dimensional optimization and Multidimensional unconstrained optimization problems Co4: Apply Multi-dimensional constrained optimization problems in Industries. CO5: Expertise in solving Geometric and Dynamic Programming problems	

Mapping of COs with PSOs & POs:

CO/PO	PO					PSO					Mean Score of Cos
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
CO1	2	3	2	1	2	1	3	2	3	3	2.2
CO2	1	2	2	2	1	1	3	2	3	3	2.0
CO3	2	2	1	1	2	2	3	2	3	3	2.1
CO4	1	2	2	1	2	1	3	2	3	3	2.0
CO5	1	2	3	1	3	2	3	2	3	3	2.3
Mean overall score											**2.12**

Course Code and Title	**18MATP03E2 / CONTROL THEORY**		
Class	M.Sc.	Semester	Third
Cognitive Level	Learning to know observability, controllability, stability problems of linear and nonlinear control systems (Knowing -K1) Understanding to design controllability and observability Gramian matrix for the linear and nonlinear system(Understanding- K2) Apply the stability and stabilization for the various linear and nonlinear physical systems (Applying -K3) To analyse the uniform stability, asymptotic stability and optimal control of linear time varying, perturbed system and nonlinear systems. (Analysing- K4) To design stabilization via linear feedback control for the unstable system (Create- K6)		
Course Objectives	To introduce basic theories and methodologies required for analyzing and designing advanced control systems		

UNIT	**Content**	**No. of Hours**
I	Observability: Linear systems – Observability Grammian – Constant coefficient systems – Reconstruction kernel – Nonlinear Systems	14
II	Controllability: Linear systems – Controllability Grammian – Adjoint systems – Constant coefficient systems – Steering function – Nonlinear systems	14
III	Stability: Stability – Uniform stability – Asymptotic stability of linear Systems - Linear time varying systems – Perturbed linear systems – Nonlinear systems	12
IV	Stabilizability: Stabilization via linear feedback control – Bass method – Controllable subspace –Stabilization with restricted feedback	12
V	Optimal Control: Linear time varying systems with quadratic performance criteria – Matrix Riccati equation – Linear time invariant systems – Nonlinear Systems	12

References	**Text Book:** 1. K. Balachandran & J. P. Dauer, **Elements of Control Theory,** Narosa, New Delhi, 1999. **References:** 1. Linear Differential Equations and Control by R.Conti, Academic Press, London, 1976. 2. Functional Analysis and Modern Applied Mathematics by R.F.Curtain and A.J.Pritchard, Academic Press, New York, 1977. 3. Controllability of Dynamical Systems by J.Klamka, Kluwer Academic Publisher, Dordrecht, 1991.

	Web Resources: **https://ocw.mit.edu/resources/res-6-010-electronic-feedback-systems-spring-2013/course-videos/** **https://nptel.ac.in/courses/108101037/**
Course out comes	After successful completion of the course students will be able to CO1: Analyze linear and nonlinear control systems CO2: Evaluate observability problems of linear and nonlinear systems CO3: Analyze the stability of linear and nonlinear systems CO4: Apply the stability theory in control systems CO5: Model the optimal control problems in science & engineering

Mapping of COs with PSOs & POs:

CO/PO	PO					PSO					Mean Score of COs
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
CO1	2	3	2	1	2	2	3	1	2	2	2.0
CO2	3	2	1	2	3	3	2	1	2	3	2.2
CO3	2	3	3	2	2	0	2	1	3	2	2.0
CO4	3	2	1	3	2	3	2	1	2	3	2.2
CO5	3	2	2	1	3	2	1	3	1	3	2.1
Mean overall score											**2.1**

Course Code and Title	**18MATP03E3 / OPTIMAL CONTROL**			
Class	M.Sc.	Semester	Third	
Cognitive Level	Learning to know optimal of a function/functional, basic variational problems, estrema of functions/functionals, (Knowing -K1) Understanding to design matrix Riccati equation, Pontryagin minimum principle, HJB equation(Understanding- K2) LQR problem using HJB equation, Fuel optimal control system(Applying - K3) To analyse the constrained optimal control (Analysing- K4) To design optimal control of system using dynamic programming(Create- K6)			
Course Objectives	To introduce basic theories and methodologies required for analyzing and designing optimal control of dynamical systems			
UNIT	**Content**			**No. of Hours**
I	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			14

II	Extrema of Functional with conditions-Variational approach to optimal control systems: Terminal Cost Problem-Different Types of Systems- Sufficient Condition- Summary of variational approach	14
III	Problem Formulation - Finite –Time Linear Quadratic Regulator-Analytic Solution to the Matrix Differential Riccatic Equation-Infinite- Time LQR System	12
IV	Constrained System- Pontryagin Minimum Principle-Necessary Conditions- Dynamic Programming: Principle of Optimality –Optimal control Using Dynamic Programming-Optimal Control of Continuous-Time Systems- The Hamilton – Jacobi- Bellman Equation- LQR System Using H-J-B Equation	12
V	Constrained Optimal Control-TOC of a Double Integral System- Fuel-Optimal Control Systems.	12
References	**Text Book:** 1. D. S. Naidu: **Optimal Control Systems**, CRC Press, 2002. Unit-I: Chapter 2: Section: 2.1-2.3, 2.5 Unit-II: Chapter 2: Sections: 2.6-2.8 Unit-III: Chapter 3: Sections: 3.1-3.4 Unit-IV: Chapter 6: Sections: 6.1-6.4 (except 6.3.3) Unit-V: Chapter 7: Sections: 7.1-7.3 **References:** 1. F.L.Lewis, **Optimal Control**, John Wiley & Sons, Inc., New York, NY, 1986 2. M.Gopal, **Modern Control System Theory**, 2nd Edition, New Age International, 1984. 3. E. B. Lee and L. Markus, Foundations of Optimal Control Theory, Robert E. Krteger Publishing Company, Florida, 1968. 4. Web link: https://onlinecourses.nptel.ac.in/noc17_ee11/preview **Web Resources:** **https://onlinecourses.nptel.ac.in/noc17_ee11/preview** **http://nptel.ac.in/syllabus/101108057/**	
Course out comes	After successful completion of the course students will be able to CO1: Determine the solutions of control system via Euler – Lagrange equation CO2: Apply calculus of variations to solve the linear and nonlinear optimal control systems 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	

Mapping of COs with PSOs & POs:

CO/PO	PO					PSO					Mean Score of COs
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
CO1	3	3	2	1	2	2	3	1	2	2	2.1
CO2	3	2	3	2	3	3	2	3	2	3	2.6
CO3	2	3	3	2	2	2	2	3	3	2	2.4
CO4	3	2	3	3	2	3	2	3	2	3	2.6
CO5	3	2	2	3	3	2	3	3	2	3	2.7
Mean overall score											**2.48**

Course Code and Title	**18MATP04E5 / GRAPH THEORY**		
Class	M.Sc.	Semester	Fourth
	If revised, Percentage of Revision effected (Minimum 20%)	45%	
Cognitive Level	Knowing different types of graphs (K1) Understanding various representation of different structures (K2) Applying solutions to real life problems (K3) Mapping of COs with PSOs & POs:		
Course Objectives	To impart the different concepts of theory of graphs		
UNIT	**Content**	**No. of Hours**	
I	Basic results - Basic concepts - Sub graphs - Degrees of vertices - Paths and connectedness - Automorphism of simple graphs - line graphs - Operations on graphs - Directed graphs: Introduction – Basic Concepts – Tournaments.	14	
II	Connectivity - Vertex cut and edge cut - Connectivity and edge connectivity- Menger's Theorem. 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 - Vertex colorings - Critical graphs. Planarity: Introduction - Planar and Non Planar graphs - Euler formula and its consequences - K_5 and $K_{3,3}$ are non- planar - Dual of a plane graph – The four color theorem	12	

	and the Heawood five color theorem.	
V	Dominating sets in graphs - Various real life applications - Bounds on the domination number - Bounds in terms of order - Degree and packing - Bounds in terms of order and size - Bounds in terms of Independence and covering – Product graphs andVizing's Conjecture.	13
References	**Text Books:** 1. R. Balakrishnan & K. Ranganathan, **A Text Book of Graph Theory,** Springer-Verlag New York, Inc, 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, **Fundamental of Domination in Graphs,** INC New York, 1998. Unit 5: Chapter 1, Chapter 2: Sections: 2.1-2.4 **References:** 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., 1976.	
Course out comes	After successful completion of the course students will be able to CO1: Identify various operations on graphs CO2: Classify different types of graphs and their applications CO3: Analyze 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	

Mapping of COs with PSOs & POs:

CO/PO	PO					PSO					Mean Score of COs
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
CO1	2	3	2	1	3	3	2	2	1	3	2.2
CO2	3	2	3	3	2	1	3	2	3	2	2.4
CO3	3	2	3	1	2	2	3	3	2	2	2.3
CO4	3	3	2	2	3	3	2	1	3	3	2.5
CO5	3	1	2	3	2	3	3	3	2	1	2.3
Mean overall score											**2.34**

Course Code and Title	**18MATP04E6 / FRACTAL ANALYSIS**		
Class	M.Sc.	Semester	Fourth
Cognitive Level	K-1. Knowing the Basic set theory, Functions and limits, Measures and mass distributions, Properties and problems of box-counting dimension. K-2. 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. K-3. 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. K- 4: recognize the concepts of fractal and Julia sets. K- 5: Investigating the product and intersection of fractals and Newton's method for solving polynomial equations.		
Course Objectives	To introduce the basic mathematical techniques of fractal geometry for diverse applications		
UNIT	**Content**		**No. of Hours**
I	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		14
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 methods		13
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		12
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		12
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		13

	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	
References	**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. Unit 2: Chapter 3: Sections: 3.1 to 3.8, Chapter 4: Section: 4.1 to 4.4. 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. **References:** 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.	
Course out comes	After successful completion of the course students will be able to CO1: Outline the basic concepts of measure and box-counting dimension. CO2: Identify the Hausdorff and packing measures and dimensions. CO3: Determine the product and intersection of fractals. CO4: Explain the self-similar and self-affine sets, and examples of number theory. CO5: Analyze the concepts of fractal and Julia sets.	

Mapping of COs with PSOs & POs:

CO/PO	PO					PSO					Mean Score of Cos
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
CO1	3	1	3	2	2	3	2	2	2	2	2.2
CO2	1	2	2	2	1	1	3	2	3	3	2.0
CO3	3	2	2	2	1	3	3	1	3	2	2.2
CO4	2	3	2	2	1	2	3	3	3	3	2.4
CO5	2	3	2	3	2	3	2	1	3	3	2.4
Mean overall score											**2.24**

Course Code and Title	**18MATP04E7/ CODING THEORY**		
Class	M.Sc.	Semester	Fourth
Cognitive Level	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 Objectives	To introduce the elements of coding theory and its applications		
UNIT	**Content**	**No. of Hours**	
I	Error detection, Correction and decoding: Communication channels – Maximum likelihood decoding – Hamming distance – Nearest neighborhood minimum distance decoding – Distance of a code	12	
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	14	
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	13	
IV	Cyclic codes: Definitions – Generator polynomials – Generator matrix and parity check matrix – Decoding of Cyclic codes	13	
V	Special cyclic codes: BCH codes – Parameters of BCH codes – Decoding of BCH codes – Reed Solomon codes	12	
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 **References:** 1. S. Lin &D. J. Costello, Jr**., Error Control Coding: Fundamentals and Applications**,Prentice-Hall, Inc., New Jersey, 1983. 2. Vera Pless**, Introduction to the Theory of Error Correcting Codes**, Wiley, New York, 1982**.**		

	3. E. R Berlekamp, **Algebriac Coding Theory**, Mc Graw-Hill, 1968. 4. H. Hill**, A First Course in Coding Theory**, OUP, 1986.
Course out comes	After successful completion of the course students will be able to CO1: Discuss the basic concepts of coding theory. CO2: Analyze 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.

Mapping of COs with PSOs & POs:

CO/PO	PO					PSO					Mean Score of COs
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
CO1	3	2	1	2	3	3	3	1	3	2	2.3
CO2	3	3	2	1	3	3	3	3	1	3	2.4
CO3	3	2	1	2	2	3	3	3	2	2	2.3
CO4	3	2	3	1	3	3	3	3	2	1	2.4
CO5											
Mean overall score											**2.35**

Course Code and Title	**18MATP03M1 / MATLAB & LATEX**		
Class	M.Sc.	Semester	Third
Cognitive Level	To know about the basic commands, mathematical operators and arrays, functions and handling matrices through matlab (Cognitive – Knowing & Understanding - K1&K2) Constructing and writing M-file program to solve and plot 2D and 3D graphics for various problems (Applying – K3) Knowing and using document class commands in Latex program for writing documents(Knowing and Understanding – K1 & K2) Designing the page style with using latex comments and creating and accessing arrays and matrices (Applying and Creating – K3 &K6)		
Course Objectives	To impart the programming concepts of matlab and preparation of mathematical documents, articles using LaTex		
UNIT	**Content**	**No. of Hours**	
I	Introduction – Starting - Closing matlab – Types of matlab windows – Data types - Assignment statements. System	6	

	commands and mathematical operators: Saving and loading files – Workspace – Mathematical operators – Relational, binary and logical operators.	
II	Handling of arrays: Creating - Accessing arrays - Mathematical operations on arrays: Addition, multiplication of single and multiple arrays – Relational and logical operations on arrays – Operations on sets. Handling of matrices: Creating – Accessing – Length – Size – Maximum – Minimum – Mean – Expanding and reducing size – Reshaping – Shifting – Sorting – Special matrices – Mathematical operations on matrices	6
III	Basic programming in MATLAB - M-File functions: Creating – Running - Handling variables - Types of functions - Cell arrays - Structures. File I/O handling. Graphics: 2D graphics – 3D graphics – Specialized graphs – Saving and printing figures	6
IV	Document layout and organization – Document class - Page style - Parts of the document - Text formatting - TeX and its offspring, what's different in latex 2 and basics of LaTeX file	7
V	Commands and environments-command names and arguments – Environments - Declarations - Lengths - Special characters - Fragile commands - Table of contents - Fine – Tuning text - Word division - Labeling, referencing, displayed text – Changing font - Centering and identifying, lists, generalized lists, theorem like declarations, tabular stops, boxes	7
References	**Text Books:** 1. Y. Kirani Singh & B. B. Chaudhuri**, MATLAB Programming**, Prentice-Hall of India Pvt. Ltd, New Delhi, 2008. 2. Desmond. J. Higham & Nicholas J. Hiham, **MATLAB Guide,** 2nd edition, SIAM, 2005. **Reference:** 1. H. Kopka & P. W. Daly, **A Guideline to LaTeX** , Third edition, Addison – Wesley, London, 1999. **Web Resources:** https://www.udemy.com/learn-latex/ https://freevideolectures.com/course/3186/matlab http://www.learningmatlab.com/videos/	
Course out comes	After successful completion of the course students will be able to CO1: Employ Matlab programme for interactive computations. CO2: Design 2D and 3D graphs. CO3: Apply the programming techniques to solve problems at advanced level. CO4: Compare richness of Latex with M.S word for documentation. CO5: Create documentation using mathematical symbols, graphs and Tables	

Mapping of COs with PSOs & POs:

CO/PO	PO					PSO					Mean Score of COs
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
CO1	2	2	1	3	1	2	1	2	3	3	2.0
CO2	3	1	2	3	3	3	2	2	2	3	2.4
CO3	2	2	2	3	3	1	3	3	0	2	2.2
CO4	2	1	2	3	2	2	3	3	2	3	2.2
CO5	2	2	1	2	3	2	3	2	2	2	2.1
Mean overall score											**2.16**

Course Code and Title	**18MATP03M2 / WAVELET ANALYSIS**		
Class	M.Sc.	Semester	Third
	If revised, Percentage of Revision effected (Minimum 20%)	35%	
Cognitive Level	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. K-3. Classifying One-Dimensional Wavelet Systems such as the Scaling Equation and Wavelet Systems. Investigating Multi-wavelets and Lifting. K-4. Realizing the Examples of One-Dimensional Wavelet Systems with Universal Scaling Functions K-5. Recognizing the concepts of Higher-Dimensional Wavelet Systems and Understanding Compression.		
Course Objectives	To impart skills in the various applications of wavelet analysis		
UNIT	**Content**	**No. of Hours**	
I	The New Mathematical Engineering:Introduction- Basic definitions – Types of Wavelet-Real life applications-families - The Three types of Bandwidth-Good Approximations: Approximation- Perception -Information Gained from Measurement-Functions and their Representations-Wavelets: A Positional Notation for Functions: Multiresolution	14	

	Representation-The Democratization of Arithmetic: Positional Notation for Numbers-Music Notation as a Metaphor for Wavelet Series-Wavelet Phase Space-Applications	
II	Algebra and Geometry of Wavelet Matrices: Introduction-Wavelet Matrices-Types- HaarWavelet Matrices-The Algebraic and Geometric structure of the Space of Wavelet Matrices- Wavelet Matrix Series and Discrete Orthonormal Expansions-Simple examples.	13
III	One-Dimensional Wavelet Systems: Introduction-The Scaling Equation-Wavelet Systems-Recent Developments: Multiwavelets and Lifting-real life applications.	12
IV	Examples of One-Dimensional Wavelet Systems: Introductionto the Examples-Universal Scaling Functions-Types of wavelet systems - Orthonormal Wavelet Systems-Flat Wavelets-Polynomial- Regular and Smooth Wavelets-bio wavelets - Fourier-Polynomial Wavelet Matrices.	12
V	Higher-Dimensional Wavelet Systems: Introduction-Scaling Functions-Scaling Tiles-Orthonormal Wavelet Bases-Wavelet Data Compression: Understanding Compression-Image Compression-Resizing-Transform Image Compression Systems-Wavelet Image Compression-Embedded Coding and the Wavelet-wavelet filters - Difference-Reduction Compression Algorithm-Multiresolution Audio Compression-Denoising Algorithms-methods-image compression using software.	13
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 13.7. **References:** 1. L.Prasad & S.S.Iyengar, **Wavelet Analysis with Applications to Image Processing,** CRC Press, New York, 1997. Geroge Buchman, Lawrence Narichi, & Edward Beckenstein, **Fourier and Wavelet Analysis**, Springer-Verlag, New York, Inc-2000.	
Course out comes	After successful completion of the course students will be able to CO1: Describe the basic concepts of Wavelets CO2: Identify the Algebra and Geometry of Wavelet Matrices CO3: Classify One-Dimensional Wavelet Systems CO4: Determine the solutions of One-Dimensional Wavelet Systems CO5: Analyze the concepts of Higher-Dimensional Wavelet Systems	

Mapping of COs with PSOs & POs:

CO/PO	PO					PSO					Mean Score of Cos
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
CO1	2	3	3	2	3	2	3	2	3	1	2.4
CO2	2	3	1	3	1	1	3	3	1	3	2.1
CO3	1	2	1	1	3	3	2	1	3	3	2.0
CO4	1	2	2	3	2	2	1	2	2	3	2.0
CO5	1	3	3	3	3	2	3	2	3	2	2.5
Mean overall score											**2.2**

Course Code and Title	**18MATP04M3 / FUZZY SETS AND FUZZY LOGIC**	
Class	M.Sc.	Semester: Fourth
Cognitive Level	K-1 Identify various definitions of Crisp set, Fuzzy set and Operations K-2Utilize fuzzy inference rules K-3 Study the applications of fuzzy logic based on inference rules	
Course Objectives	To develop many problem solving skills in fuzzy system	
UNIT	**Content**	**No. of Hours**
I	Crisp sets- fuzzy sets basic types and basic concepts-Fuzzy sets versus crisp sets- additional Properties of alpha-cuts-b representations of Fuzzy sets, Extension principle for fuzzy sets-Operation on fuzzy sets- types of operations-fuzzy complements- fuzzy intersections t-forms fuzzy unions t-conforms-combinations of operations- aggregation operation.	16
II	Fuzzy Logic- Multivalve logic- fuzzy propositions- fuzzy quantifiers- Linguistic Hedges- inference from conditional fuzzy propositions- inference from conditional and qualified propositions- inference from quantified propositions – applications	16
References	**Text Book:** George J.Klir&Bo Yunan, Fuzzy sets and Fuzzy logic Theory & applications, PHI Learning Private Limited- New Delhi 2013. **References:** Bandemer. H & W. Nather, Fuzzy Data Analysis, Kluwer, Boston, New York 1992. **Web source**: http://uni-obuda.hu/users/fuller.robert/fuzs.html https://www.quora.com/What-are-some-good-online-resources-to-learn-fuzzy-logic	

Course out comes	After successful completion of the course students will be able to CO1: Compile the fundamental operations of fuzzy sets and operations CO2: Analyze the basic concepts of fuzzy sets and fuzzy logic CO3: Solve the complex problems on inference and fuzzy propositions

Mapping of COs with PSOs & POs:

CO/PO	PO			PSO			Mean Score of COs
	1	**2**	**3**	**1**	**2**	**3**	
CO1	2	2	1	2	2	2	1.8
CO2	1	2	2	2	2	3	2.0
CO3	2	1	2	2	2	1	1.7
Mean overall score							**1.83**

Course Code and Title	**18MATP04M4 / NEURAL NETWORKS**		
Class	M.Sc.	Semester	Fourth
	If revised, Percentage of Revision effected (Minimum 20%)	50%	
Cognitive Level	Know the concept of Neural Network and its various types, Functioning of artificial neural network and Neuron modeling. Understand the concept of Dynamic Neural Units, Models and circuits of isolated DNUs.		
Course Objectives	To introduce the main fundamental principles and techniques of neural network systems and investigate the principal neural network models and applications		
UNIT	**Content**	**No. of Hours**	
I	Neural Network- Basics -Types - Applications of neural network-Biological neural networks-Artificial neural networks-artificial neural network-Fuzzy neural system - Neuron modeling-Neuron approximation	16	
II	Nonlinear models -dynamics-Models of dynamic neural units - circuits of isolated DNUs - Neuron with excitatory and inhibitory dynamics- Some extension-properties - Neuron with Multiple Nonlinear Feedback	16	
References	**Text Books:** 1. A. AntoSpiritusKingsly, **Neural network and fuzzy logic control**,Anuradha publications, Chennai, 2009. 2. Madan M. Gupta, Liang Jin &Noriyasu Homma, **Static and Dynamic neural networks**, A 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
Course out comes	After successful completion of the course students will be able to CO1: Explain various types of neural networks and its implementations CO2: Design nonlinear models and dynamics of neurons CO3: Analyze Neural Networks and its applications in information theory

Mapping of COs with PSOs & POs:

CO/PO	PO					PSO					Mean Score of COs
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
CO1	2	3	2	1	2	2	3	1	2	2	2.0
CO2	3	2	1	2	3	3	2	1	2	3	2.2
Mean overall score											**2.1**

Course Code and Title	**18MATP02N1 / NUMERICAL AND STATISTICAL METHODS**		
Class	M.Sc.	Semester	Second
	If revised, Percentage of Revision effected (Minimum 20%)	35%	
Cognitive Level	Understanding the concept of Curve Fitting and finding the solutions of algebraic equations (K1 & K2-Remembering and understanding). Understanding the concept of Interpolation and Integration (K2 & K4 - Remembering and Analyzing). Evaluating the measures of central tendencies and measures of dispersion (K4 & K5-Analyzing and Evaluating). Applying correlation and regression ideas to solve many real life problems (K3-Applying). Evaluating the probability of various problems and analyzing distributions (K4 & K5 – Analyzing and Evaluating)		
Course Objectives	To impart basic concepts and skills in the applications of various Numerical and Statistical Methods.		
UNIT	**Content**	**No. of Hours**	
I	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-	14	

	Method of False Position. Solution of Simultaneous Linear Algebraic Equations: Gauss Elimination Method-Gauss Jordan Method – Jacobi Method of Iteration – Gauss Seidal Method.	
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 1/3rd Rule and Simpson's 3/8th Rule.	12
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.	13
IV	Correlation – Scatter Diagram – Karl Pearson's Coefficient of Correlation – Correlation Coefficient for a Bivariate frequency Distribution – Rank Correlation Coefficient – Regression – Regression Lines – Correlation Coefficient for a Bivariate Frequency Distribution	13
V	Probability – Introduction – Calculation of Probability – Conditional Probability – Bayes' Theorem – Mathematical Expectation - Mathematical Expectation of Continuous Random Variable – Moment Generating Function – Characteristic Function - Theoretical Distributions – Binomial Distribution – Poisson Distribution – Normal Distribution	13
References	**Text Books:** 1. M.K. Venkataraman, Numerical Methods in Science and Engineering, 2/e, National Publishing Co., Madras, 1987, Unit 1 & Unit 2. 2. Arumugam S. Issac, Statistics, SCITech Publications, 2011. Unit 3: Chapters 1,2,3,4 Unit 4: Chapter 6 Unit 5: Chapter 11 Chapter 12- Sec: 12.1 - 12.6, Chapter 13- Sec: 13.1 - 13.3. **References:** 1. M.K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical Methods for Scientific and Engineering Computation, Willey Eastern Limited, 2003. 2. S.S. Sastry, Introductory Methods of Numerical Analysis, Prentice – Hall of India, 2010, 4th Edition.	
Course out comes	After successful completion of the course students will be able to CO1: Discuss various types of curve fitting and finding solutions to	

	algebraic equations. CO2: Analyze interpolation and various integral method to solve many problems. 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.

Mapping of COs with PSOs & POs:

CO/PO	PO					PSO					Mean Score of COs
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	
CO1	2	2	3	2	3	3	3	3	1	2	2.4
CO2	3	2	3	2	2	3	3	3	3	2	2.6
CO3	3	3	2	1	3	2	2	3	3	3	2.5
CO4	3	2	3	2	3	3	3	2	3	1	2.5
CO5	2	3	2	1	3	1	2	3	3	3	2.3
Mean overall score											**2.46**