POOMPUHAR COLLEGE (AUTONOMOUS)

(of the Tamil Nadu H.R & C.E Department)

(Accredited B+ By NAAC)

MELAIYUR 609 107

M.Sc SYLLABUS

(FROM THE ACADEMIC YEAR 2019-2020 ONWARDS)

PG & RESEARCH

DEPARTMENT OF MATHEMATICS

POOMPUHAR COLLEGE (AUTONOMOUS)
OF THE TAMIL NADU HR & CE DEPARTMENT
MELAIYUR - 609 107

M.Sc Mathematics – Course Structure under CBCS
(For the candidates admitted from the academic year 2019 -2020 onwards)

Semester	Course	Course Title	Ins. Hrs / Week	Credit	Exam Hrs	Marks		Total
						Int.	Ext	
I	Core Course – I (CC)	Linear Algebra	6	5	3	25	75	100
	Core Course – II (CC)	Real Analysis	6	5	3	25	75	100
	Core Course – III (CC)	Mathematical Statistics	6	4	3	25	75	100
	Core Course - IV (CC)	Ordinary Differential Equations	6	4	3	25	75	100
	Core Course – V (CC)	Calculus of Bounded Variations and Fourier Transforms	6	5	3	25	75	100
		Total	**30**	**23**				**500**
II	Core Course – VI (CC)	Complex Analysis	6	5	3	25	75	100
	Core Course – VII (CC)	Algebra	6	5	3	25	75	100
	Core Course – VIII (CC)	Topology	6	5	3	25	75	100
	Core Course – IX (CC)	Partial Differential Equations	6	5	3	25	75	100
	Elective – I	Any one from the list	6	4	3	25	75	100
		Total	**30**	**24**				**500**

Semester	Course	Course Title	Instr Hours /Week	Credit	Exam. Hours	Marks		Total
						Int	Ext	
III	Core Course X	Measure Theory and Integration	6	5	3	25	75	100
	Core Course XI	Functional Analysis	6	5	3	25	75	100
	Core Course XII	Classical Dynamics	6	4	3	25	75	100
	Elective II	Any one from the list	6	4	3	25	75	500
	Elective III	Any one from the list	6	4	3	25	75	100
		Total	**30**	**22**				**500**
IV	Core Course XIII	Differential Geometry	6	5	3	25	75	100
	Core Course XIV	Graph Theory	6	4	3	25	75	100
	Elective IV	Any one from the list	6	4	3	25	75	100
	Elective V	Any one from the list	6	4	3	25	75	100
	Project Work		6	4	3	25	75	100
		Total	**30**	**21**				**500**
		Grand Total	**120**	**90**				**2000**

ELECTIVES

ELECTIVE – I (ANY ONE)	
1	Non-linear Differential equations
2	Theory of numbers
3	Integral Equations
ELECTIVES II & III (ANY TWO)	
1	Stochastic Processes
2	Combinatorics
3	Tensor Analysis and Special Theory of Relativity
4	Mathematical Modelling
ELECTIVES IV & V (ANY TWO)	
1	Financial Mathematics
2	Stochastic Differential Equations
3	Optimization Techniques
4	Fuzzy Mathematics

Note:

Core Courses (include Theory & Project)

No. of Courses 15

Credit per Course 4 – 5

Total Credits 70

Elective Courses

No. of Courses 5

Credit per Course 4

Total Credits 20

	Internal	**External**
Theory	25	75

Project

Dissertation 80 Marks [2 reviews – 20+20 = 40 marks

Report Valuation] = 40 marks

Viva 20 Marks 20 marks

Passing Minimum in a Subject

CIA 50% (13 marks)

UE 50%(37 Marks)

Total 50 Marks

Programme Outcomes:

PO1: Disciplinary Knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of a postgraduate programme of study.

PO2: Ethical Value
Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities.

PO3: Individual and Team Leadership Skill
Capability to lead themselves and the team to achieve organizational goals.

PO4: Employability & Entrepreneurial Skill
Inculcate contemporary business practices to enhance employability skills in the competitive environment. Equip with skills and competencies to become an entrepreneur.

PO5: Contribution to Society
Succeed in career endeavors and contribute significantly to society.

Programme Specific Outcomes:

PSO1: Placement
Attain mastery in fundamental mathematical concepts like Algebra, Analysis, Geometry etc. so as to gain the ability to understand and deal with abstract concepts.

PSO 2: Entrepreneur
To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate start-ups and high potential organizations.

PSO3: Research and Development
Design and implement HR systems and practices grounded in researches that comply with employment laws, leading the organization towards growth and development.

PSO4: Contribution to Business World
To produce employable, ethical and innovative professionals to sustain in the dynamic business world.

PSO 5: Contribution to the Society
To contribute to the development of the society by collaborating with stakeholders for mutual benefit.

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Department of Mathematics
(For those who are joining in 2019 – 2020 and after)

Programme : M.Sc Mathematics	**Subject Code :**
Semester : I	**No of hours : 6**
Part III : Core Paper I	**No of credits : 5**

Title of the Paper: LINEAR ALGEBRA

Objectives:
1. To give the students a thorough knowledge of the various aspects of Linear Algebra.
2. To train the students in problem-solving as a preparatory for competitive exam.

Unit - I
Systems of linear Equations – Matrices and elementary row operations – Row - reduced echelon Matrices – Matrix multiplication – Invertible matrices – Vector spaces – Subspaces – Bases and dimension – Computations concerning subspaces.

Unit - II
The algebra of linear transformations – Isomorphism of vector spaces – Representations of linear transformations by matrices - Linearfunctionals- The double dual – The transpose of a linear transformation.

Unit - III
The algebra of polynomials – Lagrange Interpolation – Polynomial Ideals – The prime factorization of a polynomial, Commutative rings – Determinant functions – Permutations and the uniqueness of determinants – Additional properties of determinants.

Unit - IV
Characteristic values – Annihilating polynomials, Invariant subspaces – Simultaneous triangulation and simultaneous - Diagonalization – Direct-sum decompositions.

Unit - V
Invariant direct sums – The primary decomposition theorem – Cyclic subspaces – Cyclic decompositions and the rational form.

Text Book
[1] Kenneth Hoffman and Ray Kunze, Linear Algebra, Second Edition, Prentice – Hall of India Private Limited, New Delhi :1975.

Unit - I - Chapters 1 and 2 (Except sections 1.1, 2.4, 2.5)
Unit - II - Chapter 3
Unit - III - Chapter 4 and Chapter 5, Sections 5.1 to 5.4

Unit - IV - Chapter 6, Sections 6.1 to 6.6
Unit - V -Chapter 6, Sections 6.7 and 6.8 and Chapter 7, Sections 7.1, 7.2

Reference Books

[1] I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, New Delhi, 1975.
[2] I.S. Luther and I.B.S. Passi, Algebra, Vol.I – Groups, Vol.II- Rings, Narosa Publishing House (Vol.I – 1996, Vol.II- 1999)
[3] N. Jacobson, Basic Algebra, Vols. I & II, Freeman, 1980 (also published byHisdustan Publishing Company)

Signature of the Subject Experts: **Signature of the HOD**

COURSE OUTCOMES

Students will be introduced to and have the knowledge of many mathematical concepts, Examples and Counter Examples, Proof Techniques and Problem Solving studied in Linear Algebra such as

1) Systems of linear equations
2) The algebra of linear Equations
3) The algebra of Polynomials
4) Determinant functions
5) Diagonalization, Decompositions.

OUTCOMEMAPPING

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

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : I	**No of hours : 6**
Part III : Core Paper II	**No of credits : 5**

Title of the Paper:REAL ANALYSIS

Objectives:

1. To give the students a thorough knowledge of the various aspects of Real line and Metric Spaces which is imperative for any advanced learning in Pure Mathematics.
2. To train the students in problem-solving as a preparatory for competitive exams.

Unit –I

Basic Topology: Finite, Countable and Uncountable Sets – Metric spaces – Compact sets – Perfect sets – Connected sets.

Unit –II

Numerical Sequences and Series: Sequences – Convergence – Subsequences - Cauchy Sequences – Upper and Lower Limits - Some Special Sequences – Tests of convergence – Power series – Absolute convergence – Addition and multiplication of series – Rearrangements.

Unit –III

Continuity: Limits of functions – Continuous functions – Continuity and Compactness – Continuity and connectedness – Discontinuities – Monotonic functions – Infinite limits and limits at infinity. Differentiation: Derivative of a real function – Mean value Theorems - Intermediate value theorem for derivatives – L'Hospital Rule – Taylor's Theorem – Differentiation of vector valued functions.

Unit –IV

Riemann – Stieltjes Integral: Definition and Existence – Properties – Integration and Differentiation – Integration of vector valued functions **–**Rectifiable curves.

Unit –V

Sequences and Series of Functions: Uniform Convergence and Continuity – Uniform Convergence and Differentiation – Equicontinuous families of functions – The Stone – Weierstrass Theorem.

Text Books:

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

Unit – I -Chapters 2
Unit - II -Chapters 3
Unit - III -Chapter4 & 5
Unit - IV -Chapter 6
Unit - V -Chapter 7

Reference Books:

[1] Tom P. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.
[2] A.J. White, Real Analysis : An Introduction, Addison Wesley Publishing Co., Inc. 1968.
[3] Serge Lang, Analysis I & II, Addison-Wesley Publishing Company, Inc. 1969.

Signature of the Subject Experts: **Signature of the HOD**

COURSE OUTCOMES

Our successful completion of this course, students will be able to

1) Demonstrate an understanding the theory of function of bounded variations, sequence of functions, Riemann - Stieltjes integrals.
2) To apply the theory in the course to solve a variety of problems at an appropriate Level of difficulty.
3) Demonstrate skills in constructing rigorous mathematical analysis.
4) The student will gain confidence in proving theorems and solving problems.
5) Student will understand the generalized concept of Differential Calculus.

OUTCOME MAPPING

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

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : I	**No of hours : 6**
Part III : Core Paper III	**No of credits : 4**

Title of the Paper:MATHEMATICAL STATISTICS

Objectives:

1. To interpret the results of an inferential test and understand the limitations of each procedure.
2. To compute descriptive and inferential statistics using a calculator.

Unit- I

Chebyshev's inequality: Generalised form of Bienayme – Chebyshev inequality – Convergence in Probability – Weak law of large numbers: Bernoulli's law of large numbers ,Markoff's theorem, Khintchin's theorem – Borel Cantelli lemma.

Unit – II

Negative binomial distribution - Geometric distribution – Hyper geometric distribution.

Unit – III

Gamma distribution – Beta distribution of second kind – Beta distribution of first kind – The exponential distribution – Weibul distribution.

Unit - IV

Test of significance for large samples – Sampling of Attributes – Test for single proposition, difference of proposition - Test of significance for single mean, difference of mean, difference of standard deviations.

Unit - V

Theory of Estimation: Introduction – Characteristic of estimators: Consistency – unbiasedness – efficiency of estimators – minimum variance unbiased estimators – sufficiency – MUV and Black wellisation – Methods of estimation: Maximum likelihood estimators.

Text Books:

[1] S.C.Gupta, V.K.Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi, 2015.

Unit – I: Chapter 6, Section 6.13-6.16
Unit – II: Chapter 7, Section 7.4 – 7.6.

Unit –III: Chapter 8, Section 8.3 -8.6,8.8.
Unit – IV: Chapter 12, Section 12.8 – 12.15.
Unit –V: Chapter 15, Section 15.1 – 15.3.1.

Reference Books:

[1] Gupta, S.C, Fundamentals of Applied Statistics, S. Chand & Sons, New Delhi, 1993.

[2] Gupta, S.C, Statistical Methods, Sultan Chand, New Delhi, 2002.

[3] Speigal, M.R, Theory and Problems of Statistics, McGraw Hill Book Co., London, 1992.

Signature of the Subject Experts: **Signature of the HOD**

COURSE OUTCOMES

After completion of this course the student will be able to

1) Apply the concepts of random variables in real life situations.
2) Identify the type of statistical situation to which different distributions can be applied.
3) Calculate moments and their functions.
4) Explore knowledge in the various significance tests for statistical data.
5) Analyze statistical data using ANOVA.

OUTCOME MAPPING

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

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : I	**No of hours : 6**
Part III : Core Paper IV	**No of credits :4**

Title of the Paper: ORDINARY DIFFERENTIAL EQUATIONS

Objectives:

1. To give an in-depth knowledge of differential equations and their applications.
2. To study the existence, uniqueness, stability behaviour of the solutions of the ODE.

Unit -I

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

Unit - II

Regular Singular Points – Gauss's hypergeometric equation – The Point at infinity - Legendre Polynomials – Bessel functions – Properties of Legendre Polynomials and Bessel functions.

Unit - III

Linear systems of first order equations – Homogeneous equations with constant coefficients – The existence and uniqueness of solutions of initial value problem for first order ordinary differential equations.

Unit - IV

Oscillation theory and boundary value problems – Qualitative properties of solutions – Sturm comparison Theorems – Eigenvalues, Eigenfunctions and the vibrating string.

Unit - V

Nonlinear equations: Autonomous Systems – The phase plane and its phenomena – Types of critical points – Stability – Critical points and stability for linear systems.

Text Books:

[1] G.F. Simmons, Differential Equations with Applications and Historical Notes, TMH, New Delhi, 1984.

Unit –I: Chapter 3: Sections 15, 16, 19 and Chapter 5: Sections 25 to 27
Unit – II: Chapter 5: Sections 28 to 31 and Chapter 6: Sections 32 to 35
Unit –III: Chapter 7: Sections 37, 38 and Chapter 11: Section 55

Unit – IV: Chapter 4: Sections 22 to 24
Unit –V: Chapter 8: Sections 42

Reference Books:

[1] W.T. Reid, Ordinary Differential Equations, John Wiley & Sons, New York, 1971.
[2] E.A. Coddington and N. Levinson, Theory of Ordinary Differential Equaitons, McGraw Hill Publishing Company, New York, 1955.

Signature of the Subject Experts: **Signature of the HOD**

COURSE OUTCOMES

After successful completion of the course the student will be able to:

1) Understand the concept of Wronskian formula;
2) Understand the concept of initial value problems;
3) Understand the concept of Existence and uniqueness theorems;
4) Understand the Bessel Function;
5) Understand the Lipschitz condition;

OUTCOME MAPPING

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

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : I	**No of hours : 6**
Part III : Core Paper V	**No of credits : 5**

Title of the Paper:CALCULUS OF BOUNDED VARIATIONS AND FOURIER TRANSFORMS

Objectives:
1. To introduce the concept of calculus of variations and their applications.
2. To study the different types of transforms and their properties.

Unit -I

Calculus of Variations – Maxima and Minima – The simplest case – Natural boundary and transition conditions – Variational notation – More general case – Constraints and Lagrange Multipliers – Variable and points – Strum – Liouville Problems.

Unit -II

Fourier transform – Fourier sine and cosine transforms – Properties convolution – Solving intergral equations – Finite Fourier transform – Finite Fourier Sine and cosine transforms.

Unit -III

Application of Fourier Transforms in initial and boundary value problem– Application of infinite Fourier transforms – Choice of infinite sine or cosine transform examples – Application of finite Fourier transforms – Finite Fourier transforms of partial derivatives – Choice of finite sine or cosine transforms examples.

Unit - IV

Hankel Transforms: Inversion Formula for the Hankel transform – Some important results for Bessel functions- Linearity property examples Hankel Transform of the derivatives fo a function – Hankel transform of $d^2f / dx^2 + 1/x \; df / dx - n^2 / x^2 (f)$ - Parseval's Theorem examples.

Unit - V

The Finite HankelTransforms:Another form of Hankel Transform examples – Hankel transform of df / dx - Hankel Transform of $d^2 f / dx^2 + 1/x \; df / dx$ where P is the root of the equation Jn (ap) = 0 - Hankel Transform $d^2f / dx^2 + 1/x \; df / dx - n^2 / x^2 (f)$where P is the root of the equation Jn (ap) = 0 examples.

Text Books :

[1] Ram P. Kanwal – Linerar integral equations Theory and practice Academic Press 1971.

[2] A.R.Vasishtha, R.K. Gupta, Integral Transforms, Krishna Prakashan media PVT Ltd, 2002.

Unit - I - Chapter 2 Sections 2.1 to 2.9 of [1]

Unit - II - Chapter 6 and 7 of [2]

Unit - III - Chapter 8 of [2]

Unit - IV - Chapter 9 of [2]

Unit - V - Chapter 10 of [2]

Reference Books

[1] LokenathDebnath.J, Integral Transforms and their applications, Third Edition, Chapman and Hall , CRC Press, 2014.

Signature of the Subject Experts: **Signature of the HOD**

COURSE OUTCOMES

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

1) Understand the terminologies that are used in the wavelets, from Fourier analysis to wavelet analysis.
2) Determine the concepts of the Fourier and Inverse Fourier Transforms.
3) Know the Wavelet Transforms and Time Frequency Analysis.
4) Learn the concepts on Cardinal Spline Analysis.
5) Study the Scaling Functions and Wavelets theory.

OUTCOME MAPPING

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

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Department of Mathematics

(For those who are joining in 2019 – 2020 and after)

Programme : M.Sc Mathematics	**Subject Code :**
Semester : II	**No of hours : 6**
Part III : Core Paper VI	**No of credits : 5**

Title of the Paper: COMPLEX ANALYSIS

Objectives:

1. To introduce the concept of calculus of variations and their applications.
2. To study the different types of transforms and their properties**.**

Unit - I

Fundamental theorems in complex integration:Line Integrals – Rectifiable Arcs – Line Integrals as Functions of Arcs – Cauchy's Theorem for a Rectangle – Cauchy's Theorem in a Disk; Cauchy's Integral Formula: The Index of a Point with Respect to a Closed Curve – The Integral Formula – Higher Derivatives.

Unit - II

Local Properties of Analytic Functions - Removable Singularities - Taylor's Theorem – Integral representation of the n^{th} term - Zeros and Poles – Algebraic order of f(z) – Essential Singularity - The Local Mapping – The Open Mapping Theorem - The Maximum Principle.

Unit - III

The General Form of Cauchy's Theorem:Chains and Cycles – Simple Connectivity – Homology – The General Statement of Cauchy's Theorem – Proof of Cauchy's Theorem – Locally Exact Differentials – Multiply Connected Regions; The Calculus of Residues: The Residue Theorem – The Argument Principle – Evaluation of Definite Integrals

Unit -IV

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

Unit- V

Simply periodic functions – Representation by exponentials – The Fourier Development – Functions of finite order – Doubly periodic functions – the Period Module – Uni-modular Transformations – The Canonical Basis – General Properties of Elliptic Functions.

Text Books:

[1] Lars V.Ahlfors, Complex Analysis, Third Ed. McGraw-Hill Book Company, Tokyo, 1979.

Unit – I : Chapter 4: 1.1-1.5, 2.1-2.3
Unit - II : Chapter 4: 3.1, 3.2, 3.3,3.4
Unit – III: Chapter 4: 4.1-4.7, 5.1-5.3
Unit –IV: Chapter 4: 6.1-6.5, and Chapter 5: 1.1-1.3
Unit – V: Chapter 7: 1.1 – 1.3, 2.1 – 2.4

Reference Books:

[1] Serge Lang, Complex Analysis, Addisn Wesley, 1977.
[2] S.Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, New Delhi, 1997.
[3] V.Karunakaran, Complex Analysis.

Signature of the Subject Experts: **Signature of the HOD**

COURSE OUTCOMES

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

1) To learn the concepts of Complex Integration.
2) Compute the Taylor's theorem, to determine the nature of the removableSingularities, zeros and poles.
3) Explain the convergence of power series and develop analytical capabilities in Taylor or Laurent series in a given domain;
4) Determine the concept of conformal mapping of polygons, to find Schwarz – Christoffel formula.
5) With this course students are prepared to learn about advance complex Analysis.

OUTCOME MAPPING

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

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Department of Mathematics

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : II	**No of hours : 6**
Part III : Core Paper VII	**No of credits : 5**

Title of the Paper:ALGEBRA

Objectives:

1. To give foundation in Algebraic structures like Group ,Rings.
2. To train the students in problem solving in Algebra.

Unit – I

A counting principle – Normal subgroups and quotient groups –Homomorphisms– Automorphisms.

Unit – II

Cayley's theorem – Permutation groups – Another counting principle –Sylow's theorem.

Unit - III

Ring Theory: Homomorphism of rings – Ideals and quotient rings – More ideals and quotient rings – Polynomial rings – Polynomials over the rational field – Polynomials over commutative rings.

Unit – IV

More about roots – Simple extensions- Separable extensions – Fixed fields - .Symmetric rational functions – Normal extensions – Galois groups – Fundamental theorem of Galois Theory.

Unit – V

Solvable groups – The commutator subgroup – Solvability by radicals – Finite fields – Wedderburn theorem.

Text Books:

[1] I.N. Herstein, Topics in Algebra, Second Edn, Wiley Eastern Limited.

Unit – I: Chapter 2,Sections 2.5 to 2.8
Unit – II: Chapter 2, Sections 2.9 to 2.12
Unit – III: Chapter 3, Sections 3.3, 3.4, 3.5, 3.9, 3.10, 3.11
Unit – IV: Chapter 5, Sections 5.5, 5.6
Unit – V - Chapter 5, Sections 5.7 and Chapter7: Sections 7.1, 7.2

Reference Books:

[1] Surjeetsingh ,QaziZamaeeruddin, Modern algebra, Vikas publishing house Pvt Ltd.
[2] Michael Artin, Algebra,Preantice- Hall of India, New Delhi, 1994.

Signature of the Subject Experts: **Signature of the HOD**

COURSE OUTCOMES

At the end of the course, the student will be able

1) To find the number of Sylow sub groups.
2) To find the number of non-Isomorphic Abelian groups.
3) To understand fields and roots of polynomials.
4) To find the splitting field, Galois group of the given polynomial.
5) To check whether the given polynomial is solvable by radicals or not.

OUTCOME MAPPING

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

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : II	**No of hours : 6**
Part III : Core Paper VIII	**No of credits : 5**

Title of the Paper: TOPOLOGY

Objectives:

1. To study the concepts concerned with properties that are preserved under continuous deformations of objects.
2. To train the students to develop analytical thinking and the study of continuity and connectivity.

Unit - I

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

Unit - II

Continuous functions: Continuous functions – the product topology – The metric topology – The metric topology continued.

Unit - III

Connectedness: Connected spaces– Connected subspaces of the Real line –Components and local connectedness.

Unit - IV

Compactness: Compact spaces – Compact subspaces of the Real line – Limit Point Compactness – Local compactness.

Unit - V

Countability and separation axioms: The countability axioms **–** The separation axioms **–** Normal spaces **–** The Urysohn Lemma.

Text Books:

[1] James R. Munkres, Topology (2nd Edition), Pearson Education Pvt. Ltd., New Delhi-2002. (Third Indian Reprint).

Unit - I -Chapter 2: Sections 12 to 17
Unit - II -Chapter 2 : Sections 18 to 21 (Omit Section 22)

Unit - III -Chapter 3 : Sections 23 to 25.
Unit - IV -Chapter 3 : Sections 26 to 29.
Unit - V -Chapter 4 : Sections 30 to 33

Reference Books:

[1] J. Dugundji, Topology, Prentice Hall of India, ,Ne\v Delhi, 1975.
[2] George F.Simmons, Introduction to Topology and Modern Analysis, TataMcGraw Hill Book Co., 1963.
[3] J.L. Kelly, General Topology, Van Nostrand, Reinhold Co., New York.
[4] L.Steen and J.Seeback, Counter examples in Topology, Holt, Rinchart and Winston, New York, 1970.

Signature of the Subject Experts: **Signature of the HOD**

COURSE OUTCOMES

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

1) Define and illustrate the concept of topological spaces and continuous functions.
2) Prove a selection of theorems concerning topological space, continuous functions, product topologies, and quotient topologies.
3) Define and illustrate the concept of product of topologies and illustrate the concepts of the separation axioms.
4) Define connectedness and compactness, and prove a selection of related theorems.
5) Describe different examples distinguishing general, geometric, and algebraic topology.

OUTCOME MAPPING

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

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : II	**No of hours : 6**
Part III : Core Paper IX	**No of credits :5**

Title of the Paper: PARTIAL DIFFERENTIAL EQUATIONS

Objectives:

1. To give an in-depth knowledge of solving partial differential equations and apply them in scientific and engineering problems.
2. To study the other aspects of PDE.

Unit - I

First order P.D.E. – Curves and surfaces – Genesis of first order P.D.E. – Classification of integrals – Linear equations of the first order – Pfaffian differential equations – Compatible systems – Charpit's method – Jacobi's method

Unit -II

Integral surfaces through a given curve – Quasi-Linear equations – Non-linear first order P.D.E.

Unit -III

Second order P.D.E.: Genesis of second order P.D.E. – Classification of second order P.D.E. One-dimensional Wave equation – Vibrations of an infinite string – Vibrations of a semi-infinite string – Vibrations of a string of finite length.

Unit -IV

Laplace's equation: Boundary value problems – Maximum and minimum principles – The Cauchy problem – The Dirichlet problem for the upper half plane – The Neumann problem for the upper half plane – The Dirichletinterior problem for a circle - The Dirichlet exterior problem for a circle – The Neumann problem for a circle – The Dirichlet problem for a ectangle – Harnack's theorem – Laplace's equation – Green's function.

Unit - V

Heat conduction problem – Heat conduction – Infinite rod case – Heat conduction finite rod case – Duhamel's principle – Wave equation – Heat conduction equation

Text Book

[1] T.Amarnath,An Elementary Course in Partial Differential Equations,Narosa, 1997.

Unit - I -Chapter 1: Sections 1.1 to1.8
Unit - II -Chapter 1: Sections 1.9 to1.11
Unit - III -Chapter 2: Sections 2.1, 2.2, 2.3.1, 2.3.2, 2.3.3.
Unit - IV -Chapter 2: Sections 2.4 to 2.4.11
Unit - V -Chapter 2: Sections 2.5 to 2.6.2

Reference Books

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

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COURSE OUTCOMES

On successful completion of the course, the student will be able to:

1) Solve various types of first order PDE.
2) Solve various types of second order PDE.
3) Solve Elliptic differential equation.
4) Solve Parabolic differential equation.
5) Solve Hyperbolic differential equation

OUTCOME MAPPING

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

POOMPUHAR COLLEGE (AUTONOMOUS)

of the Tamil Nadu HR & CE Department

Department of Mathematics

(For those who are joining in 2019 – 2020 and after)

Programme : M.Sc Mathematics	**Subject Code :**
Semester : III	**No of hours : 6**
Part III : Core Paper X	**No of credits : 5**

Title of the Paper: MEASURE THEORY AND INTEGRATION

Objectives:

1. To generalize the concept of integration using measures.
2. To develop the concept o f analysis in abstract situations.

Unit - I

Measure on Real line – Lebesgue outer measure – Measurable sets – Regularity – Measurable function –Borel and Lebesgue measurability.

Unit - II

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

Unit - 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.

Unit - IV

Convergence in measure – Almost uniform convergence – Signed measures and Halindecompostion – The Jordan decomposition.

Unit - V

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

Text Books:

[1] G.De Barra, Measure Theory and Integration, New age international(p) Limited.

Unit - I	-Chapter II: Sections 2.1 to 2.5
Unit - II	-Chapter III: Sections 3.1 to 3.4
Unit - III	-Chapter V: Sections 5.1 to 5.6
Unit - IV	-Chapter VII: Sections 7.1 and 7.2, Chapter VIII: Sections 8.1 and 8.2
Unit - V	-Chapter X: Sections 10.1 and 10.2

Reference Books:

[1] Measure and Integration, by M.E. Munroe, Addison - Wesley Publishing Company, Second Edition, 1971.
[2] P.K. Jain, V.P. Gupta, Lebesgue Measure and Integration, New Age International Pvt Limited Publishers, New Delhi, 1986. (Reprint 2000)
[3] Richard L. Wheeden and AntoniZygmund, Measure and Integral: An Introduction to Real Analysis, Marcel Dekker Inc. 1977.
[4] Inder, K. Rana, An Introduction to Measure and Integration, Narosa Publishing House, New Delhi, 1997.

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COURSE OUTCOMES

Students will be able to get knowledge of many mathematical concepts

1) Examples and counter examples
2) Problem solving techniques
3) Understand the fundamental studies in measurable sets, measurable functions and convergence in measure.
4) Student will understand the generalized concept of convergence in measure.
5) Student will understand the measurability in a product space.

OUTCOME MAPPING

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

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Department of Mathematics

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : III	**No of hours : 6**
Part III : Core Paper XI	**No of credits : 5**

Title of the Paper: FUNCTIONAL ANALYSIS

Objectives:

1. To study the three structure theorems of Functional Analysis viz., Hahn-Banach theorem, Open mapping theorem and Uniform boundedness principle.
2. To introduce Hilbert spaces and operator theory leading to the spectral theory ofoperators on a Hilbert space.

Unit - I

Algebraic Systems: Groups – Rings –The structure of rings Linear spaces –The dimension of a linear space –Linear transformations –Algebras Banach Spaces : The definition and some examples Continuous linear transformations –The Hahn-Banach theorem – The natural imbedding of N in N** – The open mapping theorem –The conjugate of an operator.

Unit - II

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

Unit - III

Finite-Dimensional Spectral Theory: Matrices –Determinants and the spectrum of an operator – The spectral theorem –A survey of the situation.

Unit - IV

General Preliminaries on Banach Algebras: The definition and some examples Regular and singular elements – Topological divisors of zero– The spectrum– The formula for the spectral radius – The radical and semi-simplicity.

Unit - V

The Structure of Commutative BanachAlgebras : The Gelfand mapping – Applications of the formula $r(x) = \lim \| x^n \|^{1/n}$ - Involutions in Banach Algebras – The Gelfand-Neumark theorem.

Text Books:

[1] G.F.Simmons,Introduction to Topology and Modern Analysis, McGraw-Hill International Ed. 1963.

Unit - I - Chapters 8 and 9
Unit - II - Chapter 10
Unit - III - Chapter 11
Unit - IV - Chapter 12
Unit -V - Chapter 13

Reference Books:

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

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COURSE OUTCOMES

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

1) Appreciate how ideas from different areas of mathematics combine to produce new tools that are more powerful than would otherwise be possible.
2) Understand how functional analysis underpins modern analysis.
3) Develop their mathematical intuition and problem-solving capabilities, especially in predicting the space in which the solution of a partial differential equation belongs to.
4) Learn advanced analysis in terms of Sobolev spaces, Besov spaces, Orlicz spaces and other distributional spaces.
5) Definition and examples of Banach Algebras – To understand the Regular and simple elements, radical and semi-simplicity

OUTCOME MAPPING

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

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : III	**No of hours : 6**
Part III : Core Paper XII	**No of credits : 4**

Title of the Paper: CLASSICAL DYNAMICS

Objectives:

1. To introduce the notion of Tensor and study its properties.
2. To study the theory of relativity.

Unit I

Introductory concepts: The mechanical system – Generalised Coordinates – constraints – virtual work – energy and momentum.

Unit II

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

Unit III

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

Unit IV

Hamilton's equation: Hamilton's principle – Hamilton's equations – other variational principles – phase space.

Unit V

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

Text Books:

[1] Donald T. Greenwood, Classical Dynamic, PHI Pvt. Ltd., New Delhi – 1985.

Unit – I : Chapter 1: Sections 1.1 to 1.5
Unit – II: Chapter 2: Sections 2.1 to 2.4
Unit – II: Chapter 3: Sections 3.1 to 3.4
Unit – IV: Chapter 4: Sections 4.1 to 4.4
Unit – V: Chapter 5: Sections 5.1 to 5.3

Reference Books:

[1] H. Goldstein, Classical Mechanics, (2nd Edition), Narosa Publishing House, New Delhi.

[2] Narayan Chandra Rana&PromodSharad Chandra Joag, Classical Mechanics, Tata McGrawHill, 1991.

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COURSE OUTCOMES

1) Be able to solve the Lagrange's equations for simple configurations using various methods
2) Be able to understand the concept of Hamilton Jacobi Theory.
3) Be able to understand the concept canonical Transformations
4) To develop skills in formulating and solving physics problems
5) Able to get idea of dynamical systems are of relatively recent origin, the concept of motion in phase- space and its geometrical depiction is simple

OUTCOME MAPPING

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

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : IV	**No of hours : 6**
Part III : Core Paper XIII	**No of credits : 5**

Title of the Paper: DIFFERENTIAL GEOMETRY

Objectives:
1. To introduce the notion of surfaces and their properties.
2. To study geodesics and differential geometry of surfaces.

Unit - I

Space curves: Definition of a space curve – Arc length – Tangent – Normal and binormal– Curvature and torsion – Contact between curves and surfaces–Tangent surface– Involutes and evolutes– Intrinsic equations – Fundamental existence theorem for space curves– Helices.

Unit - II

Intrinsic properties of a surface: Definition of a surface –- Curves on a surface – Surface of revolution – Helicoids – Metric – Direction coefficients –Families of curves– Isometric correspondence – Intrinsic properties.

Unit - III

Geodesics: Geodesics – Canonical geodesic equations – Normal property of geodesic – Existence Theorems – Geodesic parallels – Geodesies curvature–Gauss– Bonnet Theorem – Gaussian curvature – Surface of constant curvature.

Unit - IV

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

Unit - V

Differential geometry of surfaces: Compact surfaces whose points are umbilics– Hilbert's lemma – Compact surface of constant Gaussian curvature –Complete surface and their characterization – Hilbert's Theorem – Conjugate points on geodesics.

Text Books:

[1]T.J. Willmore, An Introduction to Differential Geometry, Oxford UniversityPress, (17th Impression) New Delhi 2002.(Indian Print).

Unit - I - Chapter I: Sections 1 to 9.
Unit - II - Chapter II: Sections 1 to 9.;
Unit - III - Chapter II: Sections 10 to 18.
Unit - IV - Chapter III: Sections 1 to 8.;
Unit - V - Chapter IV : Sections 1 to 8

Reference Books:

[1] Struik, D.T. Lectures on Classical Differential Geometry. Addison – Wesley. Mass. 1950.
[2] Kobayashi S. and Nomizu. K. Foundations of Differential Geometry. Interscience Publishers, 1963.
[3] WihelmKlingenberg: A course in Differential Geometry, Graduate Texts in Mathematics, Springer Verlag, 1978.

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COURSE OUTCOMES

1) Understand the concept of a space curve in 3D and compute the curvature and torsion of space curves.
2) Understand the fundamental existence theorem.
3) Find geodesics equation on a surface.
4) Understand surfaces of constant curvature , Dini's and Tissot' theorems
5) Determine the second fundamental form, compact surface, Hilbert's lemma.

OUTCOME MAPPING

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

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : IV	**No of hours : 6**
Part III : Core Paper XIV	**No of credits : 4**

Title of the Paper: GRAPH THEORY

Objectives:

1. To give a rigorous study of the basic concepts of Graph Theory.
2. To study the applications of Graph Theory in other disciplines.

Unit -I

Graphs, subgraphs and Trees: Graphs and simple graphs – Graph isomorphism – The Incidence and Adjacency matrices –Subgraphs– Vertex degrees – Paths and connection – Cycles – Trees – Cut edges and Bonds – Cut vertices.

Unit - II

Connectivity, Euler tours and Hamilton Cycles: Connectivity – Blocks – Euler tours – Hamilton cycles.

Unit - III

Matchings, Edge Colourings : Matchings–Matchings and coverings in bipartite graphs – Edge chromatic number –Vizing's theorem.

Unit - IV

Independent sets and Cliques, Vertex colourings : Independent sets –Ramsey's theorem – Chromatic number – Brooks' theorem – Chromatic polynomials.

Unit - V

Planar graphs: Plane and planar graphs – Dual graphs – Euler's formula – The Five-colour Theorem – The Four-colour conjecture;

Text Books:

[1] J.A.Bondy and U.S.A. Murthy, Graph Theory and Applications, Macmillan, London, 1976.

Unit - I	- Chapter 1 (Section 1.1 -1.7), Chapter 2 (Section 2.1 -2.3)
Unit - II	- Chapter 3 (Section 3.1 - 3.2), Chapter 4 (Section 4.1 - 4.2)
Unit - III	- Chapter 5 (Section 5.1 - 5.2), Chapter 6 (Section 6.1 - 6.2)
Unit - IV	- Chapter 7 (Section 7.1 - 7.2), Chapter 8 (Section 8.1 - 8.2, 8.4)
Unit - V	- Chapter 9 (Section 9.1- 9.3, 9.6)

Reference Books:

[1] J.Clark and D.A.Holton, A First look at Graph Theory, Allied Publishers, New Delhi, 1995.
[2] R. Gould. Graph Theory, Benjamin/Cummings, Menlo Park, 1989.
[3] A.Gibbons, Algorithmic Graph Theory, Cambridge University Press, Cambridge, 1989.
[4] R.J..Wilson, and J.J.Watkins, Graphs: An Introductory Approach, John Wiley and Sons, NewYork, 1989.
[5] S.A.Choudum, A First Course in Graph Theory, MacMillan India Ltd. 1987.
[6] R.Balakrishnan and K.Ranganathan, A Text Book of Graph Theory, Springer, New York, 2012.

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COURSE OUTCOMES

After completion of this course the student will be able to

1) Understand the basics of graph theory and their various properties.
2) Develop Models using graphs and to solve the problems algorithmically.
3) Apply graph theory concepts to solve real world applications like routing, TSP/traffic control, etc.
4) Analyse the significance of graph theory in different engineering disciplines.
5) Understand the applications of duality and planarity o graphs.

OUTCOME MAPPING

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

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : II	**No of hours : 6**
Part III : Elective I	**No of credits : 4**

Title of the Paper: NON LINEAR DIFFERENTIAL EQUATIONS

Objectives:

1. To study Nonlinear DE and its properties.
2. To study oscillation and stability properties of the solutions.

Unit - I

First Order Systems In Two Variables And Linearization: The general phase plane- some population models - Linear approximation at equilibrium points - Linear systems in matrix form.

Unit - II

Averaging Methods: An energy balance method for limit cycles - Amplitude and frequency estimates - slowly varying amplitudes - nearly periodic solutions - periodic solutions: harmony balance - Equivalent linear equation by harmonic balance -Accuracy of a period estimate.

Unit - III

Perturbation Methods: Outline of the direct method - Forced Oscillations far from resonance - Forced Oscillations near .resonance with Weak excitation - Amplitude equation for undamped pendulum - Amplitude Perturbation for the pendulum equation -Lindstedt's Method - Forced oscillation of a self - excited equation - The Perturbation Method and Fourier series.

Unit - IV

Linear Systems: Time Varying Systems - Constant coefficient System - Periodic Coefficients - Floquet Theory - Wronskian.

Unit - V

Stability: Poincare stability - solutions, paths and norms - Liapunov stability Stability of linear systems - Comparison theorem for the zero solutions of nearly - linear systems.

Text Books:

[1] Nonlinear Ordinary Differential EquationsByD.W.Jordan, &P.Smith, Clarendon Press, Oxford, 1977.

Reference Books:

[1] Differential Equations by G.F.Simmons, Tata McGraw Hill, NewDelhi (1979)
[2] Ordinary Differential Equations and Stability Theory ByD.A.Sanchez, Freeman (1968).
[3] Notes on Nonlinear Systems by J.K.Aggarwal, Van Nostrand, 1972.

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COURSE OUTCOMES

After successful completion of the course the student will be able to:

1) Understand the concept of linearization;
2) Understand the concept of Averaging Methods;
3) Understand the concept of Perturbation Methods;
4) Understand the Linear Systems;
5) Understand the Stability;

OUTCOME MAPPING

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

POOMPUHAR COLLEGE (AUTONOMOUS)
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Programme : M.Sc Mathematics	**Subject Code :**
Semester : II	**No of hours : 6**
Part III : Elective II	**No of credits : 4**

Title of the Paper: THEORY OF NUMBERS

Objectives:

1. To expose the students to the charm, niceties and nuances in the world of numbers.
2. To highlight some of the Applications of the Theory of Numbers.

UNIT I

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

UNIT II

Techniques of numerical calculations – Public key cryptography – Prime power Moduli – Primitive roots and power residues –Congruences of degree two.

UNIT III

Number theory from an algebraic viewpoint – Groups, rings and fields – Quadratic Residues- The Legendre symbol (a/r) where r is an odd prime – Quadratic reciprocity – The Jacobi Symbol (P/q) where q is an odd positive integer.

UNIT IV

Binary Quadratic Forms – Equivalence and reduction of binary quadratic forms – Sums of three squares – Positive definite binary quadratic forms – Greatest integer function – Arithmetic functions – The Mobius inversion formula – Recurrence functions – Combinatorial number theory.

UNIT V

Diophantine equations – The equation ax+by=c – Simultaneous linear diophantine equations – Pythagorean triangles – Assorted examples.

Text Books:

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

Unit - I - Chapter 1 and Chapter 2, Sections 2.1 to 2.3
Unit - II - Chapter 2, Sections 2.4 to 2.9

Unit - III - Chapter 2, Sections 2.10, 2.11 and Chapter 3, Sections 3.1 to 3.3
Unit - IV - Chapter 3, Sections 3.4 to 3.7 and Chapter 4
Unit - V - Chapter 5, Sections 5.1 to 5.4

Reference Books:

[1] David M. Burton, Elementary Number Theory, W.M.C. Brown Publishers, Dubuque, Lawa, 1989.
[2] George Andrews, Theory of Numbers.
[3] Fundamentals of Number Theory, William.J. Leveque, Addison-Wesley Publishing Company, Phillipines, 1977.

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COURSE OUTCOMES

1) Students able to understand the divisibility and Euclidean algorithm.
2) Students able to understand quadratics residues and reciprocity.
3) Students able to understand Number theory from an algebraic viewpoint.
4) Students able to understand Binary Quadratic Forms.
5) Students able to solve Diophantine equations.

OUTCOME MAPPING

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

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Programme : M.Sc Mathematics **Subject Code :**
Semester : II **No of hours : 6**
Part III : Elective III **No of credits : 4**
Title of the Paper: INTEGRAL EQUATIONS

Objectives:

1. To study the integral equations and to know the what is the relationship between and ordinary differential equations.
2. To solve the linear and non – linear integral equations by various methods.

Unit I

Introductory concepts: Abel's Problems – Integral Equation – Linear and non – linear integral equations – Fredholm integral equation – Volterra integral equation – Singular integral equation – Special kinds of kernels – Integral equation of the convolution type – iterated kernels or functions – Resolvent kernel or reciprocal kernel – Eigenvalues, Eigenfunctions – Leibnit's rule of differentiation under integral sign – an important formula for converting a multiple integral into a single ordinary integral – regularity conditions – the inner or scalar product of two functions – solution of an integral equation.

Unit II

Conditions of Ordinary Differential Equations into Integral Equations: Introduction – Initial value problem – method of converting an initial value problem into Volterra integral equation – Alternative method of converting an initial value problem into a Volterra integral equation – Boundary value problem – method of converting a boundary value problem into Fredholm integral equation.

Unit III

Fredholm Integral Equations of the Second Kind with Separable Kernels: Solutions of Fredholm Integral equations of the second kind with separable kernels – Fredholm alternative – Fredholm theorem – Fredholm alternative theorem.

Unit IV

Method of Successive Approximations : Introduction – iterated kernels or functions – Resolvent kernel – Theorem – Solution of Fredholm integral equation – Solution of Volterra integral equation – Solution of Fredholm integral equation – some important theorems – reciprocal functions.

Unit V

Solution of Volterra Integral Equations: Theorem – examples of Volterra integral equation of the second kind by successive approximation – equation of second kind when its kernel is of some particular forms – equation of second kind by reducing to differential equation – equation of first kind – solution.

Text Books:

[1] M.D. Raisinghania, Integral Equations and Boundary Value Problems, S. Chand & Company Pvt. Ltd., New Delhi, 2014 (Revised Fourth Edition)

Unit I	Chapter 1	:	Sections 1.1 to 1.18
Unit II	Chapter 2 & 3	:	Sections 2.1 to 2.6 & 3.1 to 3.3
Unit III	Chapter 4	:	Sections 4.1 to 4.5
Unit IV	Chapter 5	:	Sections 5.1 to 5.10
Unit V	Chapter 5	:	Sections 5.11 to 5.17

Reference Books

[1] M. Rahman, Integral Equations And Their Applications, WIT Press, Boston, 2007.
[2] Ram P. Kanwal, Linear Integral Equations – Theory And Techniques, Academic Press, New York, 1971.

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COURSE OUTCOMES

1) UnderstandtoGeneratingthespecialfunctionssuchasLegendrefunctionsandBessel‟s functions, basic properties, solving in differential equations.
2) Understand to solve the boundary value problems in such as a two and three dimension heat flow by using Fourier series.
3) Acquire a basic knowledge in Fourier transform of properties, Derivatives and its application of Differential Equations.
4) AcquireabasicknowledgeinLaplacetransformofproperties,Derivatives and its application of Differential Equations.
5) Apply the acquired knowledge in solving applied problems

OUTCOME MAPPING

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

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : III	**No of hours : 6**
Part III : Elective IV	**No of credits : 4**

Title of the Paper: STOCHASTIC PROCESSES

Objectives:

1. To understand the stochastic models for many real life probabilistic situations.
2. To learn the well-known models like birth-death and queuing to reorient the knowledge of stochastic processes.

Unit - I

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

Unit - II

Markov chains**:** Classification of states and chains – Determination of higher transition probabilities – Stability of a Markov system – Reducible chains –Markov chains with continuous state space.

Unit - III

Markov processes with discrete state space: Poisson processes and their extensions – Poisson process and related distribution – Generalization of poisson process – Birth and death process – Markov processes with discrete state space (continuous time Markov Chains).

Unit - IV

Renewal processes and theory: Renewal process – Renewal processes in continuous time – Renewal equation – Stopping time – Wald's equation –Renewal theorems.

Unit - V

Stochastic processes in queuing – Queuing system – General concepts – The queuing model M/M/1 – Steady state behaviour– Transient behaviour of M/M/1 Model – Non-Markovian models – The model GI/M/1.

Text Books:

[1] J. Medhi, Stochastic Processes, Howard M. Taylor - Second edition.

Unit - I - Chapter II, Sections 2.1 to 2.3, Chapter III, Sections 3.1 to 3.3

Unit - II - Chapter III, Sections 3.4 to 3.6, 3.8, 3.9 and 3.11

Unit - III - Chapter IV, Sections 4.1 to 4.5
Unit - IV - Chapter VI, Sections 6.1 to 6.5
Unit - V - Chapter III, Sections 10.1 to 10.3, 10.7, 10.8 (Except 10.2.3 & 10.2.3.1)

Reference Books:

[1] Samuel Korlin, Howard M. Taylor, A first course in stochastic processes, II Edn.
[2] Narayan Bhat, Elements of Applied Stochastic Processes,
[3] Srinivasan and Metha, Stochastic Processes, N.V. Prabhu, Macmillan (NY), Stochastic Processes.

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COURSE OUTCOMES

At the end of the course, the student will be able to

1) working knowledge related to the problems of uncertainty.
2) a basic knowledge for doing research in this area.
3) Classify Poisson, Markov and birth and death process.
4) Understand the Markov chains and Markov processes.
5) Understand Renewal process.

OUTCOME MAPPING

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

POOMPUHAR COLLEGE (AUTONOMOUS)

of the Tamil Nadu HR & CE Department

Department of Mathematics

(For those who are joining in 2019 – 2020 and after)

Programme : M.Sc Mathematics	**Subject Code :**
Semester : III	**No of hours : 6**
Part III : Elective V	**No of credits : 4**

Title of the Paper: COMBINATORICS

Objectives:

1. To introduce the notion of different types of distributions of objects and generating functions.
2. To study the Polya's enumeration theorems.

UNIT I

Unit - I

Permutations and combinations - distributions of distinct objects - distributions of non distinct objects - Stirlings formula.

Unit - II

Generating functions. - generating function for combinations - enumerators for permutations - distributions of distinct objects into non-distinct cells - partitions of integers - the Ferrers graphs - elementary relations.

Unit - III

Recurrence relation - linear recurrence relations with constant coefficients solutions, by the technique of generating functions - a special class of nonlinear difference equations - recurrence relations with two indices.

Unit - IV

The principle of inclusion and exclusion - general formula - permutations with restriction on relative positions - derangements - the rook polynomials -permutations with forbidden positions.

Unit - V

Polya's theory of counting - equivalence classes under a permutation group Burnside theorem - equivalence classes of functions - weights and inventories of functions - Polya' s fundamental theorem - generation of Polya's theorem

Text Books:

[1] C.L. Liu - Introduction of Combinatorial Mathematics, McGraw Hill, Chapters 1 to 5.

Reference Books:

[1] Marshall Hall. Jr., Combinatorial Theory.

[2] H.J. Rayser, Combinatorial Mathematics, Cams, Mathematical Monograph, No.14.

Signature of the Subject Experts: **Signature of the HOD**

COURSE OUTCOMES

After completion of this course the student will be able to

1) Understand how Lattices can be used as a tool and mathematical model in the study of networks and circuits.
2) Construct mathematical arguments using logical connectives and quantifiers.
3) Apply codes to develop Mathematical Models.
4) Explore Applications of crypto systems in modern technology.
5) Learn how to work with some of the discrete structures which include semi-groups and its applications.

OUTCOME MAPPING

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

POOMPUHAR COLLEGE (AUTONOMOUS)
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Programme : M.Sc Mathematics	**Subject Code :**
Semester : III	**No of hours : 6**
Part III : Elective VI	**No of credits : 4**

Title of the Paper: TENSOR ANALYSIS AND SPECIAL THEORY OF RELATIVITY

Objectives:

1. To introduce the notion of Tensor and study its properties.
2. To study the theory of relativity.

Unit - I

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

Unit - II

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

Unit - III

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

Unit - IV

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

Unit - V

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

Text Books:

[1]I.S. Sokolnikoff, Tensor Analysis, John Wiley and Sons, New York, 1964.

[2]D. Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985.

Unit - I - Chapter 2, Sections 18 to 28 of [1]
Unit - II - Chapter 2, Sections 29 to 37 of [1]
Unit - III - Chapter 2, Section 38 to 41 of [1]
Unit - IV - Chapter 7, Sections 7.1 and 7.2 of [2]
Unit - V - Chapter 7, Sections 7.3 and 7.4 of [2]

Reference Books:

[1] J.L. Synge and A.Schild, Tensor Calculus, Toronto, 1949.

[2]A.S. Eddington, The Mathematical Theory of Relativity, Cambridge University Press, 1930.

[3] P.G. Bergman, An Introduction to Theory of Relativity, New york, 1942.

[4]C.E. Weatherburn, Riemannian Geometry and Tensor Calculus, Cambridge, 1938.

Signature of the Subject Experts: **Signature of the HOD**

COURSE OUTCOMES

On successful completion of the course, the students will beable to

1) Understand Special Theory of Relativity terminologies and principle.
2) Discuss special theory of relativity concepts of Laurent‟s transformationequations, Einstein train – Time dilation – Longitudinal contraction.
3) To learn the Relativistic Kinematics concepts of Invariant interval -Proper time and proper distance, Twin paradox, Addition of velocities andRelativistic Doppler effect.
4) To Understand the Relativistic Dynamics ideas of Momentum-Energyfour vector, Conservation of energy, Lagrangian and Hamiltonian formulations
5) To Study the application of theory relativistic dynamics on AcceleratedSystems, Rocket with constant acceleration and Rocket with constant thrust.

OUTCOME MAPPING

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

POOMPUHAR COLLEGE (AUTONOMOUS)
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Programme : M.Sc Mathematics	**Subject Code :**
Semester : III	**No of hours : 6**
Part III : Elective VII	**No of credits : 4**

Title of the Paper: MATHEMATICAL MODELLING

Objectives:

1. To study the different mathematical models in ODE and Difference equations.
2. To study graph theoretical models.

Unit - I

Mathematical Modelling through Ordinary Differential Equations of First order : Linear Growth and Decay Models - Non-Linear Growth and Decay Models - Compartment Models - Dynamics problems - Geometrical problems.

Unit - II

Mathematical Modelling through Systems of Ordinary Differential Equations of First Order : Population Dynamics - Epidemics - Compartment Models - Economics - Medicine, Arms Race, Battles and International Trade -Dynamics.

Unit - III

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

Unit - IV

Mathematical Modelling through Difference Equations : Simple Models -Basic Theory of Linear Difference Equations with Constant Coefficients -Economics and Finance - Population Dynamics and Genetics - Probability Theory.

Unit - V

Mathematical Modelling through Graphs : Situations that can be Modelled through Graphs - Mathematical Modelling in Terms of Directed Graphs, Signed Graphs, Weighted Digraphs and Unoriented Graphs.

Text Books :

[1]J.N. Kapur, Mathematical Modelling, Wiley Eastern Limited, Revised Edition, New Delhi, 1988.

Unit – I - Chapter 2
Unit – II - Chapter 3
Unit – III - Chapter 4
Unit – IV - Chapter 5
Unit – V - Chapter 7

Reference Books:

1. J. N. Kapur, Mathematical Models in Biology and Medicine, Affiliated East -West Press Pvt. Limited, New Delhi, 1981.

Signature of the Subject Experts: **Signature of the HOD**

COURSE OUTCOMES

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

1) To learn the concepts of Mathematical Modelling Techniques.
2) To understand the ideas of Mathematical Modelling through ODE of first order.
3) To develop the Mathematical Models through systems of ODE of first order.
4) To know the techniques of Mathematical Modelling through Difference equations.
5) To study the Mathematical Models through Differential - Difference equations

OUTCOME MAPPING

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

POOMPUHAR COLLEGE (AUTONOMOUS)

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Department of Mathematics

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : IV	**No of hours : 6**
Part III : Elective VIII	**No of credits : 4**

Title of the Paper: FINANCIAL MATHEMATICS

Objectives:

1. To study financial mathematics through various models.
2. To study the various aspects of financial mathematics.

Unit - I

Single period models: Definitions from Finance - Pricing a forward - One-step Binary Model - a ternary Model - Characterization of no arbitrage - Risk-Neutral Probability Measure

Unit - II

Binomial trees and discrete parameter martingales: Multi-period Binary model - American Options - Discrete parameter martingales and Markov processes - Martingale Theorems - Binomial Representation Theorem -Overturn to Continuous models.

Unit - III

Brownian motion: Definition of the process - Levy's Construction of Brownian Motion - The Reflection Principle and Scaling - Martingales in Continuous time.

Unit - IV

Stochastic calculus: Non-differentiability of Stock prices - Stochastic Integration - Ito's formula - Integration by parts and Stochastic Fubini Theorem -Girsanov Theorem - Brownian Martingale Representation Theorem - Geometric Brownian Motion - The Feynman - Kac Representation

Unit - V

Block-scholes model: Basic Block-Scholes Model - Block-Scholes price and hedge for European Options - Foreign Exchange - Dividends - Bonds -Market price of risk.

Text Books:

[1] Alison Etheridge, A Course in Financial Calculus, Cambridge University Press, Cambridge, 2002.

Reference Books:

[1] Martin Boxte and Andrew Rennie, Financial Calculus: An Introduction to Derivatives Pricing, Cambridge University Press, Cambridge, 1996.

[2] Damien Lamberton and Bernard Lapeyre, (Translated by Nicolas Rabeau and FarancoisMantion),

[3] Introduction to Stochastic Calculus Applied to Finance, Chapman and Hall, 1996.

[4] MarekMusiela and MarekRutkowski, Martingale Methods in Financial Modeling, Springer Verlag, New York, 1988.

[5] Robert J.Elliottand P.Ekkehard Kopp, Mathematics of Financial Markets. Springer Verlag, New York, 2001 (3rd Printing).

Signature of the Subject Experts: **Signature of the HOD**

COURSE OUTCOMES

1) UnderstandSingle period models.
2) UnderstandBinomial trees and discrete parameter martingales.
3) Acquireabasicknowledgeof Brownian motion.
4) Acquireabasicknowledge of stochastic calculus.
5) Apply the acquired knowledge in Block-scholes model.

OUTCOME MAPPING

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

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : IV	**No of hours : 6**
Part III : Elective IX	**No of credits : 4**

Title of the Paper: STOCHASTIC DIFFERENTIAL EQUATIONS

Objectives:

1. To provide an introduction to stochastic differential equation from applied point of view.
2. To introduce solution methods for the analysis of the theoretical properties of the equations.

Unit – I

Introduction: Stochastic Analogs of Classical Differential Equations – FilteringProblems – Stochastic Approach to Deterministic Boundary Value Problems – Optimal Stopping – Stochastic Control and Mathematical Finance – Some mathematical preliminaries - Probability Spaces, Random Variables and Stochastic Processes and an Important Example - Brownian Motion.

Unit – II

Ito Integrals: Construction of the Ito integral - Some Properties of the Ito Integral - Extensions of the Ito Integral.

Unit – III

The Ito formula and the Martingale Representation Theorem: The 1- dimentional Ito Formula - The Multi dimensional Ito Formula - the Martingale Representation Theorem. Stochastic Differential Equations: Examples and Some Solution Methods - An Existence and Uniqueness Result and Weak and Strong Solutions.

Unit – IV

The Filtering problem: Introduction, The 1-dimentional Linear Filtering Problem - the Multi- dimentional Linear Filtering Problem.

Unit – V

Diffusions: Basic Properties - The Markov Property - the Strong Markov Property - the Generator of an Ito Diffusion - theDynkin Formula - the Characteristic Operator.

Text Book

[1] BerntOksendal,Stochastic Differential Equations - An Introduction with Applications,Sixth Edition, Springer-Verlag, Heidelberg, 2003.

Unit - I - Chapter 1 and 2
Unit – II - Chapter 3
Unit – III - Chapter 4 and 5
Unit – IV - Chapter 6
Unit - V - Chapter 7.

Signature of the Subject Experts: **Signature of the HOD**

COURSE OUTCOMES

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

1) To learn the concepts of stochastic differential equation.
2) To understand the ideas of Ito Integrals.
3) To develop the Stochastic Models through systems of ODE of first order.
4) To know the techniques of Stochastic Modeling through Difference equations.
5) To study the Mathematical Models through Differential - Difference equations

OUTCOME MAPPING

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

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : IV	**No of hours : 6**
Part III : Elective X	**No of credits : 4**

Title of the Paper: OPTIMIZATION TECHNIQUES

Objectives:

1. To enlighten the students in the field of operations research.
2. To help the students to apply OR techniques in business and management problems.

Unit - I

Integer linearprogramming.

Unit - II

Dynamic (Multistage) programming.

Unit - III

Decision analysis and Games.

Unit - IV

Inventory Models.

Unit - V

Non-Linear Programming algorithms.

Text Books:

[1]Hamdy A. Taha, Operations Research (7^{th}Edn.), McGraw Hill Publications, New Delhi, 2007.

Unit - I	- Chapter 8, Sections 8.1 to 8.5
Unit - II	- Chapter 9, Sections 9.1 to 9.5
Unit - III	- Chapter 11, Sections 11.1 to 11.4
Unit - IV	- Chapter 11, Sections 13.1 to 13.4
Unit - V	- Chapter 19, Sections 19.1,19.2

Reference Books:

[1]O.L. Mangasarian, Non Linear Programming, McGraw Hill, New York.
[2]Mokther S. Bazaraa and C.M. Shetty, Non Linear Programming, Theoryand Algorithms, Willy, New York.
[3] Prem Kumar Gupta and D.S. Hira, Operations Research : An Introduction ,S. Chand and

Co., Ltd. New Delhi.
[4]S.S. Rao, Optimization Theory and Applications, Wiley Eastern Limited,New Delhi.

Signature of the Subject Experts: **Signature of the HOD**

COURSE OUTCOMES

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

1) Ability to apply the theory of optimization methods and algorithms to develop and For solving various types of optimization problems.
2) Ability to go in research by applying optimization techniques in real value problems
3) Analyze decision making under certainty and uncertainty by game theory.
4) Understand unconstrained and constrained optimization problems.
5) Understand Non-Linear programming problems.

OUTCOME MAPPING

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

POOMPUHAR COLLEGE (AUTONOMOUS)

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Programme : M.Sc Mathematics	**Subject Code :**
Semester : IV	**No of hours : 6**
Part III : Elective XI	**No of credits : 4**

Title of the Paper: FUZZY MATHEMATICS

Objectives:

1) To introduce the concept of fuzzy theory and study its application in real problems.
2) To study the uncertainty environment through the fuzzy sets that incorporates imprecision and subjectivity into the model formulation and solution process.

Unit - I

Fuzzy sets – Basic types – Basic concepts – α-cuts – Additional properties of α-cuts – Extension principle for fuzzy sets.

Unit - II

Operations on fuzzy sets – Types of operations – Fuzzy complements – t-Norms – Fuzzy unions – Combinations of operations.

Unit - III

Fuzzy arithmetic – Fuzzy numbers – Arithmetic operations on intervals – Arithmetic operations on fuzzy numbers.

Unit - IV

Fuzzy relations – Binary fuzzy relations – Fuzzy equivalence relations – Fuzzy compatibility relations – Fuzzy ordering relations – Fuzzy morphisms.

Unit - V

Fuzzy relation equations – General discussion – Problem partitioning – Solution method – Fuzzy relation equations based on Sup-i Compositions - Fuzzy relation equations based on inf-ω_i compositions.

Text Books:

[1] George J.Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic, Prentice Hall of India, New Delhi, 2004.

Unit - I - Chapter I, Sections 1.3, 1.4 and Chapter II, Sections, 2.1, 2.3
Unit - II - Chapter II
Unit - III - Chapter IV, sections 4.1, 4.3, 4.4

Unit - IV - Chapter V, Sections 5.3, 5.5 to 5.8
Unit - V - Chapter VI, Sections, 6.1 to 6.5

Reference Books:

[1] H.J. Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers Limited, New Delhi, 1991.
[2] G.J. Klir and B. Yuan, Fuzzy Sets and Fuzzy Logic, Prentice Hall of India, New Delhi, 1995.

Signature of the Subject Experts: **Signature of the HOD**

COURSE OUTCOMES

At the completion of the Course, the Students will able to

1) Understand the concepts of Fuzzy sets and its types – Characteristics – Significance of the paradigm shift.
2) Be able to distinguish between the crisp set and fuzzy set concepts through the learned differences between the crisp set characteristic function and the fuzzy set membership function.
3) To know Fuzzy intersection – t-norms, fuzzy unions – t-conorms. Combinations of operations – Aggregation operations.
4) Apply the concept of a fuzzy number and apply in real world problems.
5) Student practice to construct various methods of fuzzy sets using sample data.

OUTCOME MAPPING

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