DEPARTMENT OF MATHEMATICS

M.Sc. (MATHEMATICS)

(Students admitted during 2019-2020 Onwards)

(Under CBCS with Outcome Based Education (OBE) Pattern)

SYLLABUS

III & IV SEMESTER

GOBI ARTS & SCIENCE COLLEGE

(Govt. Aided Autonomous Co-educational Institution, Affiliated to Bharathiar University, Coimbatore, Accredited with 'A' Grade by NAAC (4th cycle) and Recognised as a STAR College by DBT, Government of India)

KARATTADIPALAYAM POST,

GOBICHETTIPALAYAM - 638453

ERODE DISTRICT.

BLOOM'S TAXONOMY BASED ASSESSMENT PATTERN

K1-Remember; **K2**- Understanding; **K3**- Apply; **K4**-Analyze; **K5**- Evaluate

I. END OF SEMESTER (EOS) EXAMINATIONS

1. Theory: 60 Marks

Knowledge Level	Section	Marks	Description	Total
K1	A (Answer All)	10 × 1 = 10	MCQ	60
K2	B (Either or Pattern)	5 × 4 = 20	Short answers	
K3 & K4	C (Answer 3 out of 5)	3 × 10 = 30	Descriptive/Detailed	

2. Practical Examinations: 60 Marks

Knowledge Level	Section		Total
	Practical	Record work	
K3	50	10	60
K4			
K5			

II. CONTINUOUS INTERNAL ASSESSMENT (CIA):

1. Test – I & II: 30 Marks (Theory)

Knowledge Level	Section	Marks	Description	Total
K1	A (Answer All)	10 × 1 = 10	MCQ	30
K2	B (Answer 2 out of 3)	2 × 5 = 10	Short answers	
K3 & K4	C (Answer 1 out of 2)	1 × 10 = 10	Descriptive/Detailed	

2. Test –III: (Model Exam)

Knowledge Level	Section	Marks	Description	Total
K1	A (Answer All)	10 × 1 = 10	MCQ	60 Marks converted to 40 Marks
K2	B (Either or Pattern)	5 × 4 = 20	Short answers	
K3 & K4	C (Answer 3 out of 5)	3 × 10 = 30	Descriptive/Detailed	

3. Practical Internal Assessment: 40 Marks

Knowledge Level	Components		Calculation	Lab Performance	Total
K3, K4, K5	Test 1	30	$\frac{\text{Test 1 + Test 2}}{2}$	10	40
	Test 2	30			

Components of Continuous Internal Assessment (CIA)

Components		Calculation	CIA Total
Test 1 & Test 2	30	$30 + 40 + 30 = \frac{100 \times 40}{100} = 40$	40
Test 3	40		
Assignment+ Seminar+ Quiz / GD / Poster Presentation / Book Review / Field Visit Report	10+10+10 = 30		

Programme Code:	M.Sc.	**Programme Title:**	Mathematics	
Course Code:	19P3MA11	**Course Title:**	**Batch:**	2019
Total Hours:	90	Topology	**Semester:**	III
			Credits:	5.0

Course Objective

The course aims

- To introduce the fundamental concepts of topology.
- To study the properties of topological spaces.

Course Outcomes (CO)

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

Knowledge Level	CO Number	Course Outcome
K1	**CO1**	Acquire knowledge about several constructions of topological spaces.
K2	**CO2**	Understanding box topology, product topology, metric topology.
K3	**CO3**	Apply the results of topology to determine the connectedness, compactness of topological spaces.
K4	**CO4**	Investigate the connectedness and compactness in various fields.
K5	**CO5**	Building new topological spaces, connected spaces, compact spaces, normal spaces, regular spaces and Hausdorff space from the existing topological spaces.

K1 – Remember; **K2 –** Understanding; **K3 –** Apply; **K4 –** Analyze; **K5 –** Evaluate

SYLLABUS		
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.	**18**
II	Continuous functions - The product topology - The metric topology.	**18**
III	Connected spaces - Connected subspaces of the real line - Compact spaces - Compact subspaces of the real line.	**18**
IV	Limit point compactness - The countability and separation axioms: The countability axioms - The separation axioms.	**18**
V	Normal spaces - The Urysohn's lemma - The Urysohn'smetrization theorem - Tietz extension theorem - The Tychonoff theorem.	**18**

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: Chapter 4: Sections 4.3, 4.4, 4.5, 4.6, and Chapter 5: 5.1

Reference Books:

1. G. F. Simmons, **Introduction to Topology and Modern Analysis**, Tata McGraw-Hill Education Pvt. Ltd., New Delhi, 2016.
2. B. Mendelson, **Introduction to Topology**, CBS Publishers, Delhi, 1985.
3. Sze- Tsen Hu, **Introduction to General Topology**, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1966.

E-references:

1. https://onlinecourses.nptel.ac.in/
2. https://nptel.ac.in/courses/111106054/

Mapping with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	H	M	L	L
CO2	S	H	L	L	L
CO3	S	S	M	M	M
CO4	S	S	M	H	H
CO5	S	H	H	S	S

S-Strong; **H**-High; **M**- Medium; **L**- Low

Programme Code:	M.Sc.	Programme Title:	Mathematics	
Course Code:	19P3MA12	Course Title:	Batch:	2019
Total Hours:	90	Functional Analysis	Semester:	III
			Credits:	5.0

Course Objective

The course aims

- To imparts as depth in analysis of normed linear Spaces, Banach Spaces, and Hilbert Spaces etc. Further the course analyses various properties of continuous linear functional, continuous linear operators and closed linear operators.

Course Outcomes (CO)

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

Knowledge Level	CO Number	Course Outcome
K3	CO1	Study continuous linear transformations and the Hahn- Banach theorem.
K2,K3	CO2	Understand the Open mapping theorem and its applications.
K1,K2	CO3	Obtain Orthogonal complements, Orthonormal sets and Conjugate space.
K2	CO4	Understand the relevance of operator theory.
K4	CO5	Discuss determinants and the spectrum of an operator.

K1 – Remember; **K2 –** Understanding; **K3 –** Apply; **K4 –** Analyze; **K5 –** Evaluate

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**BanachSpaces** The definition and sum examples- continuous linear transformations - The Hahn Banach theorem	**18**
II	The Open Mapping theorem; The natural imbedding of N in N^{**}. -The Open Mapping theorem – the conjugate of an operator	**18**
III	**Hilbert Spaces :** The definition and some properties- Orthogonal complements- Orthogonal sets-The conjugate space H^{*}	**18**
IV	Operator theory: The adjoint of an operator –Self- adjoint operators-Normal and unitary operators- Projections	**18**
V	Finite –Dimensional Spectral theory Matrices –Determinants and the spectrum of an operator–the spectral theorem- A survey of the situation.	**18**

Text Book:

George F-Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Book Co.

Unit I
Unit II
Unit III
Unit IV
Unit V

Reference Books:

1. Functional Analysis-A First Course, M.Thamban Nair, Prentice Hall of India Pvt. Ltd.
2. Foundations of Functional Analysis by S.Ponnusamy Alpha Science International Ltd.
3. Functional analysis and application by Abul Hasan Siddiqi, Springer.

E-references:

1. https://Bookstore.ams.org>gsm-191
2. https://nptel.ac.in>courses

Mapping with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	H	M	M	M
CO2	H	S	M	H	M
CO3	M	M	M	M	M
CO4	H	S	M	M	M
CO5	M	M	M	H	M

S-Strong; **H**-High; **M**- Medium; **L**- Low

Programme Code:	M.Sc.	**Programme Title:**	Mathematics	
Course Code:	19P3MA13	**Course Title:**	**Batch:**	2019
Total Hours:	90	Fluid Dynamics	**Semester:**	III
			Credits:	3.0

Course Objective

The course aims

- To know and understand the physical properties of fluid and its consequence on fluid flow.
- To apply the basic applied mathematical tools that support fluid dynamics.
- To state the conservation principles of mass, linear momentum and energy for fluid flow.

Course Outcomes (CO)

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

Knowledge Level	CO Number	Course Outcome
K2	**CO1**	Understand the application of Mathematics in Physics oriented subjects namely Fluid Dynamics.
K3	**CO2**	Know the general description of fluid mechanics and fluid properties.
K3	**CO3**	Apply differential and integral equations to derive all fluid dynamics equations such as Navier Stokes equation, Bernoulli's equation regarding physical properties of fluid.
K4	**CO4**	Realize the significance of the Reynold's number and various types of flow of fluids.

K1 – Remember; **K2 –** Understanding; **K3 –** Apply; **K4 –** Analyze; **K5 –** Evaluate

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	General Description of Fluid Mechanics – Continum Mechanics and properties methods of describing fluid motion – Translation rotation and Rate of Deformation – Stream lines path lines and Streak lines – Vorticity. Chapter – I Sections 1.1 to 1.3 Chapter - II Sections 3.1 to 3.5	**18**
II	Nature of Stresses – Transformation of stress components – Nature of Strains – Transformation of the rate of strain – Relation between stress and Rate of Strain – The Equation of Continuity – Conservation of mass – Equations of motions (Navier Stokes equations) – Conservation of Momentum – The energy Equation – Conservation of Energy. Chapter – IV Sections 4.1 to 4.5 Chapter – V Sections 5.1 to 5.3	**18**
III	<u>Two and Three dimensional flow</u> Equations of continuity – Eulerian equation of Motions – Circulation Theorems – velocity potential irrotational flow – Integration of Equations of motions Bernoulli's equation – The momentum theorems – The momentum theorems – The moment of momentum theorem – Simple flows – Laplace's equation – Stream function in two dimensional motions – Stream functions in three dimensional motions – Two dimensional flow examples – Three dimensional auxillary symmetric flow examples. Chapter – VII Sections 7.1 to 7.9 and 7.11 to 7.13	**18**

IV	Viscous flow Similarity of flows – Reynold's number – Viscosity from the point of view of the Kinetic theory – Flow between parallel flat plates – Couette Flow – Plane Poiseuille flow steady flow in pipes – Hagen -Poiseuille flow – Flow between coaxial cylinders – Flow between two Concentric rotating cylinders – Hydrodynamics of Bearing Lubrications. Chapter – VIII Sections 8.1 to 8.5 and 8.6 b	**18**
V	The Boundary layer Properties of Navier Stokes Equations – Boundary layer concept – The Boundary layer equations in two dimensional flow – The boundary layer along a Flat plate – The Blassius solutions – Shearing stress and boundary layer thickness – Boundary layer on a surface with pressure gradient – Momentum integral theorems for the Boundary layer. Chapter – IX Sections 9.1 to 9.5	**18**

Text Book:

Foundations of Fluid Mechanics by S.W.Yuan, Prentice Hall of India, New Delhi, 1986.

Reference Books:

1. Text book of Fluid Dynamics, F.Chorlton, CBS Publishers and Distributors Pvt. Ltd., Reprint 2004.
2. Fluid Mechanics, David Pnueli and Chaim Gutfinger, Cambridge University Press, 1992.

E-reference:

www.meteo.physik.uni-muenchen.de › lehre › roger › manuskripte

Mapping with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	H	H	S
CO2	H	M	S	H	S
CO3	H	L	H	S	H
CO4	H	L	H	S	H

S-Strong; **H**-High; **M**- Medium; **L**- Low

Programme Code:	M.Sc.	**Programme Title:**	Mathematics	
Course Code:	19P3MA14	**Course Title:**	**Batch:**	2019
Total Hours:	60	Python Programming	**Semester:**	III
			Credits:	2.0

Course Objective

The course aims

- To gain knowledge about the basics of Python programming to solve problems.
- To impart the fundamental concepts of Python Programming.
- To gain exposure about manipulation, lists and tables.
- To get knowledge about dictionaries, functions and modules.
- To learn about exception handling.

Course Outcomes (CO)

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

Knowledge Level	CO Number	Course Outcome
K2,K3	**CO1**	The students will be able to understand the working in Python programming.
K3	**CO2**	The students will be able to understand the basics of Python programming constructs.
K3,K4	**CO3**	The students will be able to realize the need of strings, lists and tables.
K4	**CO4**	The students will be able to design programs involving dictionaries and functions.
K4,K5	**CO5**	The students will be able to develop programs using file concepts and modules

K1 – Remember; **K2 –** Understanding; **K3 –** Apply; **K4 –** Analyze; **K5 –** Evaluate

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	PYTHON BASICS - Statements and Syntax - Variable Assignment - Identifiers- Basic style Guidelines - PYTHON OBJECTS - Python Objects - Other Built in Types- Internal Types - Standard Type Operators - Standard Type Built in functions.	**12**
II	SEQUENCES: STRINGS, LISTS AND TUPLES - Sequences - strings - strings and Operators - String only Operators - Lists - Operators - Built in Functions - List Type Built-in methods - Special Features of Lists - Tuples - Tuple Operators and Built in Functions - Special Features of Tuples.	**12**
III	CONDITIONS AND LOOPS - if Statement - else Statement – else if- Statement conditional expressions - while Statement - for Statement - break Statement - continue Statement- pass statement else statement- take two iterators- list comprehensions - generator expressions - related Modules.	**12**
IV	FILES AND INPUT/OUTPUT - File objects - File Built-in Functions - File Built-in Methods - File Built-in Attributes - Standard Files - Command-Line Arguments - File System - File Execution - Persistent Storage Modules – Related Modules - ERRORS AND EXCEPTIONS - Exceptions - Exceptions in Python - Detecting and Handling Exceptions.	**12**

V	FUNCTIONS AND FUNCTIONAL PROGRAMMING - Calling Functions - Creating Functions - Passing Functions - Formal Arguments - Variable Length Arguments - MODULES - Modules and Files - Namespaces - Importing Modules - Features of Module Import - Module Built-in Functions - Packages.	**12**

Text Book:

Wesley J. Chun, Core Python Programming, Publisher: Dorling Kindersley (India) Pvt. Ltd, Second Edition, 2007

Unit I (Chapter 3: Section 3.1 - 3.4 & Chapter 4: Section 4.1 - 4.5),
Unit II (Chapter 6: Section 6.1 - 6.4, 6.11 -6.18),
Unit III (Chapter 8),
Unit IV (Chapter 9 & Chapter 10: Section 10.1 - 10.3),
Unit V (Chapter 11: Section 11 .1 - 11.6 & Chapter 12: Section 12.1 - 12.7)

Reference Books:

1. Magnus Lie Hetland, Beginning python, Springer Publisher, Second edition, 2009.
2. Dr. K Negeswara Rao "Core Python Programming" Dreamtech Press 2017 Edition.

E-references:

1. https://books.google.co.in
2. https://www.pdfdrive.com
3. https://www.python.org
4. https://en.m.wikipedia.org
5. https://www.houseofpots.com

Mapping with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	M	H	H
CO2	H	H	H	S	S
CO3	M	H	H	S	S
CO4	M	M	H	H	S
CO5	M	S	S	S	S

S-Strong; **H**-High, **M**- Medium, **L**- Low

Programme Code:	M.Sc.	**Programme Title:**	Mathematics	
Course Code:	19P3MAP2	**Course Title:**	**Batch:**	2019
Total Hours:	30	Programming Lab (Python Programming)	**Semester:**	III
			Credits:	1.0

SYLLABUS		
Unit	**Content**	**No. of Hours**
	1. Write a Python program to print Prime numbers. 2. Write a Python program to check given string is Palindrome or not. 3. Write a Python program to display the Largest Factors for between two numbers. 4. Write a Python program to print the Fibonacci series. 5. Write a Python program to find a Factorial for given number. 6. Write a Python program to determine the total number of Vowels, Consonants and Words in a text sentence. 7. Write a Python program to test Identifier Validity. 8. Write a Python program to use Lists as a Stack. 9. Write a Python program to use Lists as a Queue. 10. Write a Python program to Create a File. 11. Write a Python program to Read and Display File Content. 12. Write a Python program to Compare Two Text Files. 13. Write a Python program for Credit Card Transactions. 14. Write a Python program for Testing Functions. 15. Write a Python program for Arithmetic Game.	**30**

Programme Code:	M.Sc.	Programme Title:	Mathematics	
Course Code:	19P3MA15	Course Title:	Batch:	2019
Total Hours:	90	Control Theory	Semester:	IV
			Credits:	5.0

Course Objective

The course aims

- To learn Observability and Controllability of Linear and Nonlinear Dynamical Systems.
- To solve Stability problem of Abstract Differential Equations.
- To stabilize the Unstable by Control System.
- To solve Optimal Control Problems of Unit Cost Equations.

Course Outcomes (CO)

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

Knowledge Level	CO Number	Course Outcome
K1	CO1	Develop their knowledge in the basic Problem namely observability, controllability, stability, stabilizability and optimal control.
K2	CO2	Differentiate and solve the problem in Linear Systems and Nonlinear Systems.
K3	CO3	Find the rank of matrices by using the concepts of observability controllability.
K4	CO4	Easily understand the Linear Time Varying System and Linear Time Invariant System.

K1 – Remember; K2 – Understanding; K3 – Apply; K4 – Analyze; K5 – Evaluate

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	Motivation-Basic Results of Differential Equations-Fixed Point Methods-Observability of Linear Systems-Nonlinear systems.	18
II	Controllability of Linear Systems –Nonlinear Systems.	18
III	Stability of Linear Systems-Perturbed Linear Systems-Nonlinear Systems.	18
IV	Stabilizabilty –Stabilization via Linear Feedback Control –The Controllable Subspace-Stabilization with Restricted Feedback.	18
V	Optimal control –Linear Time Varying systems-Time Invariant Systems-Non linear Systems.	18

Text Book:

Elements of Control Theory-Second Edition by K .Balachandran and J.P,Daur, Narosa Publishing House.

Unit- I: Chapter –1 Sections 1.2, 1.3
Chapter – 2 Sections 2.1, 2.2
Unit- II: Chapter –3 Sections 3.1, 3.2
Unit- III: Chapter –4 Sections 4.1-4.3
Unit- IV: Chapter –5 Sections 5.1-5.3
Unit- V: Chapter –6 Sections 6.1-6.3

Reference Books:

1. Conti R, Linear Differential Equations and Control, Academic Press, London.1976.
2. Curtain R.F and Pictchard A.J Function Analysis and Modern Applied Mathematics, Academic Press New York, 1977.
3. Klamka Controllability of dynamical Systems,Klumer Academic Publisher, Dordrecht.

E-references:

1. https//www.youtube.com/watch?b=YMf-nZFzwM
2. https//ocw.mit.edu/forces.

Mapping with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S
CO2	H	S	M	S	H
CO3	M	M	S	S	S
CO4	M	H	M	S	H

S-Strong; **H**-High, **M**- Medium, **L**- Low

Programme Code:	M.Sc.	**Programme Title:**	Mathematics	
Course Code:	19P3MA16	**Course Title:**	**Batch:**	2019
Total Hours:	90	Mechanics	**Semester:**	IV
			Credits:	5.0

Course Objective

The course aims

- To study some basic concepts of Mechanics using Newton's law.
- To study Hamiltonian Theory of Mechanics.
- To study the concepts of Poisson & Lagrange brackets.

Course Outcomes (CO)

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

Knowledge Level	**CO Number**	**Course Outcome**
K2	**CO1**	Have a deep understanding of virtual work and energy.
K2, K3	**CO2**	Describe and understand the Lagrangian and Hamiltonian approach in classical mechanics.
K4	**CO3**	Understand the theory of Hamilton – Jacobi equation.
K3, K4	**CO4**	Familiarized with canonical transformations and Poisson brackets.

K1 – Remember; **K2 –** Understanding; **K3 –** Apply; **K4 –** Analyze; **K5 –** Evaluate

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	Introductory concepts – Mechanical Systems – Generalized Co-ordinates – Constraints – Virtual work – Energy and Momentum. **Chapter 1 1.1 – 1.5**	**18**
II	Lagrange's Equations: Derivation of Lagrange's Equations – Examples – Integrals of Motion. **Chapter 2 2.1 – 2.3**	**18**
III	Hamilton's Equations: Hamilton's principle – Hamilton's Equations. **Chapter 4 4.1 – 4.2**	**18**
IV	Hamilton – Jacobi Theory: Hamilton's principle function – Hamilton-Jacobi Equation – Separabillity. **Chapter 5 5.1 – 5.3**	**18**
V	Canonical Transformations: Differential forms and Generating functions – Lagrange and Poisson Brackets. **Chapter 6 6.1 – 6.3**	**18**

Text Book:

Classical Dynamics – by D .T. Greenwood: Prentice Hall of India PVT. LTD., New Delhi. (1979)

Reference Book:

JC.Upadhyaya, "Classical Mechanics", Himalaya publishing House.

E-references:

1. Classical Mechanics – Dr.J.B.Tatum – https//orca.phys.uvic.ca
2. https://www.khanacademy.org

Mapping with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	S	L	S
CO2	S	M	H	M	S
CO3	M	L	H	S	M
CO4	M	M	S	H	H

S-Strong; **H**-High; **M** – Medium; **L**- Low

Programme Code:	M.Sc.	**Programme Title:**	Mathematics	
Course Code:	19P3MA17	**Course Title:**	**Batch:**	2019
Total Hours:	90	Statistics	**Semester:**	IV
			Credits:	5.0

Course Objective

The course aims

- To develop the knowledge of probability, standard statistical distributions and the estimation theory.

Course Outcomes (CO)

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

Knowledge Level	**CO Number**	**Course Outcome**
K1	**CO1**	Illustrate the concepts of random events and the concepts of probability theory.
K2	**CO2**	Understand the concepts of single and multidimensional random variables.
K3	**CO3**	Understand and evaluate the characteristic function of basic functions.
K4	**CO4**	Apply concepts of some special distributions and limiting theorems.

K1 – Remember; **K2 –** Understanding; **K3 –** Apply; **K4 –** Analyze; **K5 –** Evaluate

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	Random Events and Operations Performed on them - The system of Axioms of Probability - Conditional Probability - Bayes Theorem - Independent Events. Random Variables: Definition - The Distribution Functions - Discrete and Continuous type - Functions of Random Variables.	**18**
II	Multidimensional Random Variables - Marginal Distributions - Conditional Distributions - Independent Random Variables - Functions of Multidimensional Random Variables. Expected Values - Moments - The Chebyshev inequality - Absolute Moments - Lapnov Inequality - Order Parameters - Moments of Random vectors.	**18**
III	Characteristic Functions - Definition - Properties - Moments - Semi Invariants - The characteristic Function of the sum of independent random variables - Inversion Theorem of Characteristic Funtion - Determination of the distribution function by the characteristic function - Probability Generating Functions. One Point and Tow Point Distributions - The Binomial Distribution - The Poisson Distribution.	**18**

IV	The Uniform distribution - The Normal Distribution - The Gamma Distribution - Beta Distribution - The Cauchy And Laplace Distribution - Compound Distributions. Limit Theorems: Stochastic Convergence – Bernoulli's law of large numbers - The Levy Cramer Theorem - The De-Moivre theorem - The Lendeberg-Levy Theorem.	**18**
V	Sample Moments And Their functions: The Notion of Sample And Statistic - The Distribution of Arithmetic Mean of independent normally distributed Random Variables - The Chi-Square distribution - The distribution of the Statistic $(\bar{X}, S)$ (without Proof) - Student's t-distributions - Fisher's Z – Distributions. Theory of Estimation: Definition - Consistent Estimates - Unbiased Estimates - The sufficiency of estimate - The efficiency of an estimate - The Rao-Cramer Inequality.	**18**

Text Book:

Marec Fisz, Probability Theory and Mathematical Statistics, Third Edition, John wiley & Sons, India.

Reference Books:

1. S.C. Gupta & V.K. Kapoor, Fundamentals of Mathematical Statistics, 11th Revised edition, Sultan Chand & Sons, New Delhi.
2. Robert V. Hogg Allen craig & Joseph W. Mckean , Introduction to Mathematical Statistics, Sixth Edition, Pearson

E-references:

1. https://nptel.ac.in/courses/111105041/1
2. https://nptel.ac.in/courses/105105138/M7L35.pdf

Mapping with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S
CO2	M	S	M	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S

S-Strong; **H**-High; **M** – Medium; **L**- Low

Programme Code:	M.Sc.	**Programme Title:**	Mathematics	
Course Code:	19P3MA18	**Course Title:**	**Batch:**	2019
Total Hours:	90	Mathematical Methods	**Semester:**	IV
			Credits:	4.0

Course Objective

The course aims

- To provide the use of Integral Transforms.
- To understand the terminology, scope, main results and solution procedure of Integral Equations.
- To make the students to be expert in Calculus of Variations using various functional.

Course Outcomes (CO)

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

Knowledge Level	CO Number	Course Outcome
K2, K3	**CO1**	Understand the general description and properties of Fourier and Hankel Transforms and apply these transforms to solve Initial and Boundary Value Problems.
K2	**CO2**	Know the concepts of Eigen Values, Eigen Functions and various metods of solving Fredholm and Volterra Integral Equations with separable Kernels.
K3	**CO3**	Apply Integral Equations to solve Ordinary Differential Equations.
K4	**CO4**	Realize the significance of Calculus of Variations using various funtionals.

K1 – Remember; **K2 –** Understanding; **K3 –** Apply; **K4 –** Analyze; **K5 –** Evaluate

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	Fourier Transforms, Finite Fourier Transforms, Applications of Fourier Transforms in Initial and Boundary value problems.	**18**
II	Hankel Transforms and Finite Hankel Transforms, Applications of Hankel Transforms in Initial and Boundary value problems.	**18**
III	Introduction: Definition - Regularity conditions - Special kinds of Kernels -Eigen values and Eigen Functions - Convolution Integral - The inner or scalar product of two functions. Integral Equations with Separable Kernels: Reduction to a system of Algebraic equation - Examples - Fredholm Alternatives Examples - An Approximate method. Method of Successive Approximations: Iterative Scheme - Examples - Volterra Integral Equation - Examples.	**18**
IV	Application of Integral Equation to Ordinary Differential Equation: Initial value problems, Boundary value problems - Examples. Singular Integral Equation: Abel integral equation - Examples.	**18**

V	Calculus of Variations: Variation and it's properties - Euler's equation - Functionals of theform: Functional dependent on higher order derivatives, Functionals dependent on the functions of several independent variables - Variational problem in parametric form.	**18**

Text Books:

1. Integral Transforms by Vasistha and Gupta, Krishna Prakasam Mandir Meerut, 1993 - 94. (For Units I & II)
   Unit - I
   Chapter 6: Sections 6.1, 6.4 - 6.12, Examples 1-10.
   Chapter 7: Sections 7.1-7.4, Examples 1-9.
   Chapter 8: Sections 8.1, 8.2, Examples 1-5, Sections 8.3-8.5, Examples 13-17.
   Unit-II
   Chapters: 9, 10, 11.
2. Linear Integral Equations by Ram P.Kanwal, Academic Press, New York, 1971.
   (For Units III & IV)
   Unit-III
   Chapter 1: Sections 1.1-1.6.
   Chapter 2: Sections 2.1-2.5.
   Chapter 3: Sections 3.1-3.4.
   Unit-IV
   Chapter 5: Sections 5.1-5.3.
   Chapter 8: Sections 8.1-8.2.
3. Differential Equations and Calculus of Variations by L.Elsgolts, Mir Publishers, 1970.
   (For Unit-V)
   Unit-V
   Chapter 6: Sections 6.1-6.6.

E-references:

1. https://mathworld.wolfram.com/VolterraIntegralEquationoftheSecondKind.html
2. https://www.britannica.com/Science/Calculus-of-variations-mathematics

Mapping with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	H	M	H	M
CO2	S	S	H	H	H
CO3	H	M	S	S	S
CO4	H	L	L	H	S

S-Strong; **H**-High; **M**- Medium; **L**- Low

Programme Code:	M.Sc.	**Programme Title:**	Mathematics	
Course Code:	19P3MA19	**Course Title:**	**Batch:**	2019
Total Hours:	90	Graph Theory	**Semester:**	IV
			Credits:	4.0

Course Objective

The course aims

- To acquire basic knowledge in the field of Graph Theory and to expose the concept of graphs and subgraphs.
- To equip adequate understanding the properties of Trees and connectivity of graphs.
- To construct simple mathematical proofs in graph colouring and possess the ability to verify them by graphically.
- To apply abstract ideas and rigorous methods of graph theory to solve practical problems in various fields.

Course Outcomes (CO)

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

Knowledge Level	**CO Number**	**Course Outcome**
K2,K3	**CO1**	Describe fundamental properties of graphs and familiar with basic proof techniques.
K2	**CO2**	Understanding connectivity of a graph and their uses in Reliable Communication Networks.
K3	**CO3**	Apply the Euler's theorem and Hamilton' theorem to assignment problems in the context of graph theory and interconnected to various fields in sciences.
K4	**CO4**	Evaluate chromatic number and prove theorems related to graph colourings.

K1 – Remember; **K2 –** Understanding; **K3 –** Apply; **K4 –** Analyze; **K5 –** Evaluate

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**Graphs and Subgraphs:** Graphs and simple graphs – Graph isomorphism – Incidence and Adjacency Matrices– Subgraphs – Vertex degrees – Paths and connection – Cycles – Application – The shortest path problem. (Chapter 1 : Sections 1.1 to 1.8)	**18**
II	**Trees and Connectivity:** Trees – Cut edges and bonds – Cut vertices – Cayley's formula - Application –Connector problem – Connectivity – Blocks – Application – Reliable Communication Networks. (Chapter 2: Sections 2.1 to 2.5 and Chapter 3: Sections 3.1 to 3.3)	**18**
III	**Euler Tours and Matchings:** Euler Tours – Hamilton cycles – Application – Chinese Postman Problem –	**18**

	Traveling salesman problem - Matchings – Matching and coverings in Bipartite Graphs – Perfect Matchings – Applications – Personal Assignment Problem – Optimal Assignment Problem. (Chapter 4: Sections 4.1 to 4.4 and Chapter 5: Sections 5.1 to 5.5)	
IV	**Edge Colouring and Independent sets:** Edge Colouring – Edge Chromatic Number – Vizings Theorem – Application –Timetabling Problem – Independents sets – Ramsey's Theorem – Turan's Theorem. (Chapter 6: Sections 6.1 to 6.3 and Chapter 7: Sections 7.1 to 7.3)	**18**
V	**Vertex Colourings:** Vertex Colourings – Chromatic Number – Brook Theorem – Hajos conjecture –Chromatic Polynomials – Girth and Chromatic Number – A storage problem. (Chapter 8 : Sections 8.1 to 8.6)	**18**

Text Book:

J.A.Bondy and U.S.R. Murty, Graph Theory with Applications, North Holland, NewYork, 1982.

Reference Books:

1. Narasing Deo, Graph Theory with Application to Engineering and Computer Science, Prentice Hall of India, New Delhi. 2003.
2. F. Harary, Graph Theory, Addison – Wesely Pub. Co. The Mass. 1969.
3. L. R. Foulds, Graph Theory Application, Narosa Publ. House, Chennai, 1933.

Mapping with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	H	M	M	L
CO2	H	S	M	M	S
CO3	M	M	S	L	L
CO4	L	M	M	M	S

S-Strong; **H**-High; **M**- Medium; **L**- Low

Question Paper Pattern - P.G. Courses

(Common for Major and Supportive Papers)

For EOS Examinations: 60 Marks

The Question Paper is to be divided into THREE Sections.

Section-A Carries 10 Marks, Section-B Carries 20 Marks and Section-C Carries 30 Marks.

Section-A Contains 10 Multiple Choice Questions. (10 x 1 = 10)

Two Questions from each unit. (Q. No: 1 to 10)

Section-B Contains 5 Either or Choice Questions. (5 x 4 = 20)

Each Question carries 4 Marks. Both (a) and (b) from the same unit.

Q. No.: 11 (a) or (b) to 15(a) or (b)

Section-C Contains 5 Questions, out of which 3 Questions are to be answered. (3 x 10 = 30)

Each Question carries 10 Marks. One Question from each unit. Q. No.: 16 to 20

For CIA Examinations: 40 Marks

CIA Test I and II Question Paper Pattern: (30 Marks)

Section-A: 10 Multiple Choice Questions. (10 x 1 = 10)

Section-B: Two Questions out of Three. (2 x 5 = 10)

Section-C: One Question out of Two. (1 x 10 = 10)

Components of Continuous Internal Assessment (CIA)

<table>
<tr><th colspan="2">Components</th><th>Calculation</th><th>CIA Total</th></tr>
<tr><td>Test 1 & Test 2</td><td>30</td><td rowspan="3">$30 + 40 + 30 = \frac{100 \times 40}{100} = 40$</td><td rowspan="3">40</td></tr>
<tr><td>Test 3 (Model Exam)</td><td>40</td></tr>
<tr><td>Assignment + Seminar + Quiz / GD / Poster Presentation / Book Review / Field Visit Report</td><td>10+10+10 = 30</td></tr>
</table>

Programme Code:	ALL P.G.	Programme Title:	Supportive Paper	
Course Code:	19P4MA01	Course Title:	Batch:	2019
Total Hours:	90	Quantitative Techniques	Semester:	III
			Credits:	4.0

Course Objective

The course aims

- To know the basic concepts of probability theory and Binomial, Normal Distributions.
- To understand the problems in Graphical and Simplex methods.
- To study the Transportation and Assignment problems.

Course Outcomes (CO)

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

Knowledge Level	CO Number	Course Outcome
K2	CO1	Understand the concept of probability distribution and its features.
K3	CO2	Understand the difference between how probabilities are computed for discrete and continuous random variables.
K3	CO3	Eradicate the issues in decision making problems and improve the analytical and problem solving skills.
K4	CO4	Recognize and formulate transportation and assignment problems.

K1 – Remember; **K2 –** Understanding; **K3 –** Apply; **K4 –** Analyze; **K5 –** Evaluate

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**Theory of Probability** Introduction – Classical Definition – Addition Theorem – Multiplication Theorem – axiomatic Approach - Axioms of Probability - Conditional Probability – Multiplicative Law of Probability – Probability of an event in terms of Conditional Probability - Examples 1-40. (Theorems statement only). **Excluded Baye's theorem and its problems.** Part I – Chapter 1.	**18**
II	**Binomial Distribution** Binomial Frequency distribution – examples – Mean and Standard Deviation of Binomial Distribution – Mode of the binomial Distribution (Simple Problems only). **Normal Distribution** Characteristics of Normal Distribution – Standard Normal Probability Distribution – Examples (Simple Problems only). Part I – Chapter 2, 4.	**18**
III	**Linear Programming** Graphical Method – solution to Graphical Method – steps – Alternative Method – Examples – Infeasible solution – Unbounded solution – Multiple solution – Simplex method – Procedure for Solving by Simplex method – Table 1 – Table 2 – Examples (Simple Problems only). Part II – Chapter 3, 4.	**18**

IV	**Transportation Problem** Mathematical Formulation – feasible solution – Basic feasible solution – Non-degenerate basic Feasible solution – Methods I and IV – Steps – Test of Optimality – theorem (statement only) – Degeneracy in Transportation Problem – Unbalanced transportation problem – Maximization Problem in Transportation - Method of solving Maximization Problem in Transportation - Examples (Simple Problems only). Part II – Chapter 7.	**18**
V	**Assignment Problem** Mathematical formulation of an Assignment Problem – Property I, II (statement only) – Steps – Unbalanced Assignment Problem – Restricted Assignment Problem – Maximization Problem in Assignment – Examples (Simple Problems only). Part II – Chapter 8.	**18**

Text Book:

Quantitative Techniques by P.R.Vittal, Margham Publications, Reprint 2016.

Reference Books:

1. Statistical Methods, S.P.Gupta, Sultan Chand & Sons.
2. Operations Research, Kanti Swarup, P.K.Gupta and Man Mohan, Sultan Chand & Sons.

E-reference:

Shodhganga.inflibnet.ac.in

Mapping with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	H	H	H	S
CO2	H	H	S	H	S
CO3	H	M	H	S	H
CO4	H	S	H	S	H

S-Strong; **H**-High; **M** – Medium; **L**- Low