JAYA COLLEGE OF ARTS AND SCIENCE

THIRUNINRAVUR

DEPARTMENT OF MATHEMATICS

Year : 2020-2021

Programme Offered :

- **M.Sc (Mathematics)**

Programme Objective :

PO 1:	To provide student with a knowledge, abilities, and insight in mathematics and computational techniques so that they are able to work as mathematical professionals.
PO 2:	To increase students self-confident in conducting research independently or within a team.
PO 3:	To provide students with knowledge and capability in formulating and analysis of mathematical models of real life applications.
PO 4:	To train the students who can work on real life challenging problems.

Programme Outcome :

Programme Specific Outcomes	
PSO 1:	Demonstrate the ability to conduct research independently and pursue higher studies towards the Ph.D degree in Mathematics.
PSO 2:	Carry out development work as well as take up challenges in the emerging area of industry.
PSO 3:	Use Mathematical and computational skilla to Model, formulate and solve real life applications.
PSO 4:	Acquire deep knowledge of different mathematical and computational disciplines so that they can qualifySLET, NET or GATE Examinations.

SEMESTER	SUBJECT TITLE		CREDITS	MARKS		TOTAL
				CIA	UE	
	Core Paper-I	Algebra-I	4	25	75	100
	Core Paper-II	Real Analysis-I	4	25	75	100

I	Core Paper-III	Ordinary Differential Equations	4	25	75	100
	Core Paper-IV	Graph Theory	4	25	75	100
	Elective paper -I	Fuzzy sets and Applications	3	25	75	100
	Soft skill Paper-I	Essential of language and communication Skills	2	40	60	100
II	Core Paper-V	Algebra-II	4	25	75	100
	Core Paper-VI	Real Analysis-II	4	25	75	100
	Core Paper-VII	Partial Differential Equations	4	25	75	100
	Core Paper-VIII	Probability Theory	4	25	75	100
	Elective paper -II	Mathematical programming	3	25	75	100
	Extra Disciplinary-I	Programming in C++	3	25	75	100
	Soft Skill Paper-II	Computing Skills	2	40	60	100
		Summer Internship	2	-	-	-
III	Core Paper-IX	Complex Analysis -I	4	25	75	100
	Core Paper-X	Topology	4	25	75	100
	Core Paper-XI	Operation Research	4	25	75	100
	Core Paper-XII	Mechanics	4	25	75	100
	Elective paper -III	Number theory and Cryptography	3	25	75	100
	Extra Disciplinary-II	Data Structures and Algorithms	3	25	75	100
	Soft Skill Paper-III	Managerial Skills	2	40	60	100
IV	Core Paper-XIII	Complex Analysis-II	4	25	75	100
	Core Paper-XIV	Differential Geometry	4	25	75	100
	Core Paper-XV	Functional Analysis	4	25	75	100
	Elective paper -IV	Fluid Dynamics	3	25	75	100
	Elective paper -V	Tensor Analysis and Relativity	3	25	75	100
	Soft Skill paper-IV	Spoken and Presentation Skills	2	40	60	100

Semester: I

Course Name: Algebra-I **Course Code: MFF1A**

Course Objective

- The core of algebra comprises the theory equations in many variables the theory on group sets and linear maps. The objectives of this course is to introduce some advance material in linear .

Course OutCome

CO 1:	Recognise technical terms and appreciate some of the uses of algebra.
CO 2:	Collect like terms and simplify expressions term by term
CO 3:	Simplify some formulas using group and linear transformation problems.
CO 4:	Solve simple linear equations using linear transformations.

Syllabus:

UNIT I-Group actions on a set, Sylow theorems - Applications of Sylow theorems.
Chapter 3: Section 3.6
Chapter 4 – Sections 4.2 and 4.3 from J.B. Fraleigh (18 hrs)

UNIT II - Direct products - Finite abelian groups- Modules
Chapter 2: Sections 2.13 and 2.14
Chapter 4: Section 4.5
from I.N.Herstein(18 hrs)

UNIT III - Linear Transformations - Canonical forms -Triangular form – Nilpotent transformations.
Chapter 6: Sections 6.4 ,6.5 from I.N. Herstein (18 hrs)

UNIT IV - Jordan form - rational canonical form.
Chapter 6 : Sections 6.6 and 6.7 from I.N. Herstein (18 hrs)

UNIT V - Trace and transpose - Hermitian, unitary, normal transformations, real quadratic form.
Chapter 6 : Sections 6.8, 6.10 and 6.11 (Omit 6.9) from I.N. Herstein (18 hrs)

Recommended Text :

1. J.B. Fraleigh, A first course in Abstract Algebra, 5^{th} edition.
2. I.N. Herstein. Topics in Algebra (II Edition) Wiley, 2002.

Reference Books :

1. M.Artin, Algebra, Prentice Hall of India, 1991.
2. P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, Basic Abstract Algebra (II Edition) Cambridge University Press, 1997. (Indian Edition)
3. I.S.Luther and I.B.S.Passi, Algebra, Vol. I - Groups(1996); Vol. II Rings(1999), Narosa Publishing House , New Delhi
4. D.S.Dummit and R.M.Foote, Abstract Algebra, 2nd edition, Wiley, 2002.
5. N.Jacobson, Basic Algebra, Vol. I & II W.H.Freeman (1980); also published by Hindustan Publishing Company, New Delhi.

Course Name: Real Analysis-I Course Code: MFF1B

Course Objective

- The course will develop a deep and rigorous understanding of real line and defining terms to prove the results about convergence and divergence of sequences and series of real numbers. These concepts has vidu range of applications in real life scenario.

Course OutCome

CO 1:	Describe the fundamental properties of the real numbers that underpin the formal development of real analysis.
CO 2:	Demonstrate an understanding of the theory of sequences and series, continuity, differentiation and integration.
CO 3:	Demonstrate an understanding of the theory of Riemann Stieltjes integral.
CO 4:	Apply the theory in the course to solve a variety of problems at an appropriate level of difficulty.

Syllabus:

UNIT-I : Functions of bounded variation - Introduction - Properties of monotonic functions - Functions of bounded variation - Total variation - Additive property of total variation - Total variation on [a, x] as a function of x - Functions of bounded variation expressed as the difference of two increasing functions - Continuous functions of bounded variation.
Chapter – 6 : Sections 6.1 to 6.8

Infinite Series : Absolute and conditional convergence - Dirichlet's test and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series.
Chapter 8 : Sections 8.8, 8.15, 8.17, 8.1 **(18 hrs)**

UNIT-II : The Riemann - Stieltjes Integral - Introduction - Notation - The definition of the Riemann - Stieltjes integral - Linear Properties - Integration by parts- Change of variable in a Riemann - Stieltjes integral - Reduction to a Riemann Integral – Euler's summation formula - Monotonically increasing integrators, Upper and lower integrals - Additive and linearity properties of upper and lower integrals - Riemann's condition - Comparison theorems.
Chapter - 7 : Sections 7.1 to 7.14 (18 hrs)

UNIT-III : The Riemann-Stieltjes Integral - Integrators of bounded variation-Sufficient conditions for the existence of Riemann-Stieltjes integrals-Necessary conditions for the existence of Riemann-Stieltjes integrals- Mean value theorems for Riemann - Stieltjes integrals - The integrals as a function of the interval - Second fundamental theorem of integral calculus-Change of variable in a Riemann integral-Second Mean Value Theorem for Riemann integral-Riemann-Stieltjes integrals depending on a parameter-Differentiation under the integral sign-Lebesguecriteriaon for the existence of Riemann integrals.

Chapter - 7 : 7.15 to 7.26 (18 hrs)

UNIT-IV :Infinite Series and infinite Products - Double sequences - Double series - Rearrangement theorem for double series - A sufficient condition for equality of iterated series - Multiplication of series - Cesarosummability - Infinite products.

Chapter - 8 Sec, 8.20, 8.21 to 8.26

Power series - Multiplication of power series - The Taylor's series generated by a function - Bernstein's theorem - Abel's limit theorem - Tauber's theorem.

Chapter 9 : Sections 9.14 9.15, 9.19, 9.20, 9.22, 9.23 (18 hrs)

UNIT-V: Sequences of Functions - Pointwise convergence of sequences of functions - Examples of sequences of real - valued functions - Definition of uniform convergence - Uniform convergence and continuity - The Cauchy condition for uniform convergence - Uniform convergence of infinite series of functions - Uniform convergence and Riemann - Stieltjes integration – Non-uniform Convergence and Term-by-term Integration - Uniform convergence and differentiation - Sufficient condition for uniform convergence of a series - Mean convergence.

Chapter -9 Sec 9.1 to 9.6, 9.8,9.9, 9.10,9.11, 9.13 (18 hrs)

Recommended Text:

Tom M.Apostol :Mathematical Analysis, 2nd Edition, Narosa,1989.

Reference Books:

1. Bartle, R.G. Real Analysis, John Wiley and Sons Inc., 1976.

2. Rudin,W. Principles of Mathematical Analysis, 3rd Edition. McGraw Hill Company, New York, 1976.

3. Malik,S.C. and SavitaArora. Mathematical Anslysis, Wiley Eastern Limited.New Delhi, 1991.

4. Sanjay Arora and BansiLal, Introduction to Real Analysis, SatyaPrakashan, New Delhi, 1991.

5. Gelbaum, B.R. and J. Olmsted, Counter Examples in Analysis, Holden day, San Francisco, 1964.

6. A.L.Gupta and N.R.Gupta, Principles of Real Analysis, Pearson Education, (Indian print) 2003.

Course Name: Ordinary Differential Equations Course Code: MFF1C

Course Objective

- The aim of course is to cover the basic of first and higher order differential equations. The objective of the course is to develop in student, an intuitive understanding of differential equation emphasizing on its application science and engineering fields.

Course OutCome

CO 1:	Understand the genesis of ordinary differential equations.

CO 2:	Learn various techniques of getting exact solution of solvable first order differential equations and linear differential equation of higher order.
CO 3:	Grasp the concept of a general solution of a linear equation of an arbitrary order and also learn a few methods to obtain the general solution of such equations.
CO 4:	To understand the concept of linear equation with regular singular point.
CO 5:	To understand the equation with variable separated method, Lipschitz condition – Convergence of the successive approximations and the existence theorem.

Syllabus:

UNIT-I : **Linear equations with constant coefficients**

Second order homogeneous equations-Initial value problems-Linear dependence and independence-Wronskian and a formula for Wronskian-Non-homogeneous equation of order two.

Chapter 2: Sections 1 to 6 **(18 hrs)**

UNIT-II :**Linear equations with constant coefficients**

Homogeneous and non-homogeneous equation of order n –Initial value problems-Annihilator method to solve non-homogeneous equation.

Chapter 2 : Sections 7 to 11. **(18 hrs)**

UNIT-III :**Linear equation with variable coefficients**

Initial value problems -Existence and uniqueness theorems – Solutions to solve a non-homogeneous equation – Wronskian and linear dependence – Reduction of the order of a homogeneous equation – Homogeneous equation with analytic coefficients-The Legendre equation.

Chapter : 3 Sections 1 to 8 (omit section 9) **(18 hrs)**

UNIT-IV :**Linear equation with regular singular points**

Second order equations with regular singular points –Exceptional cases – Bessel equation .

Chapter 4 : Sections 3, 4 and 6 to 8 (omit sections 5 and 9) **(18 hrs)**

UNIT-V :**Existence and uniqueness of solutions to first order equations:**

Equation with variable separated – Exact equation – Method of successive approximations – the Lipschitz condition – Convergence of the successive approximations and the existence theorem.

Chapter 5 : Sections 1 to 6 (omit Sections 7 to 9) **(18 hrs)**

Recommended Text:

1. E.A.Coddington, An introduction to ordinary differential equations (3^{rd} Printing) Prentice-Hall of India Ltd.,New Delhi, 1987.

Reference Books:

1. Williams E. Boyce and Richard C. Di Prima, Elementary differential equations

andboundary value problems,John Wiley and sons, New York, 1967.
2. George F Simmons, Differential equations with applications and historical notes, Tata McGraw Hill, New Delhi, 1974.
3. N.N. Lebedev, Special functions and their applications, Prentice Hall of India, New Delhi, 1965.
4. W.T.Reid. Ordinary Differential Equations, John Wiley and Sons, New York, 1971
5. M.D.Raisinghania,Advanced Differential Equations, S.Chand& Company Ltd. New Delhi 2001
6. B.Rai, D.P.Choudhury and H.I. Freedman, A Course in Ordinary DifferentialEquations, Narosa Publishing House, New Delhi, 2002.

Course Name: Graph Theory Course Code: MFF1D

Course Objective

- To understand how graph theory have been.
- To understand the concept of vertex connectivity and edge connectivity in graphs.
- To develop the understand of connectivity and euler tour.
- To have an idea of matching in graphs and study some applications of matching in day to day life problems.
- To introduce the idea of coloring in graphs.

Course OutCome

CO 1:	Able to define the basic concept of graphs, subgraph and tree.
CO 2:	To understand the concept of connectivity, block, euler tour and Hamilton cycle.
CO 3:	To understand the concept of matching, covering in bipartile graph and vizing's theorem.
CO 4:	To have an ideal of plane graph, planar graph, Euler graph and five color theorem.

Syllabus:

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 ana Bonds – Cut Vertices.
Chapter 1 (Section 1.1 – 1.7)
Chapter 2 (Section 2.1 – 2.3) **(18 hrs)**

UNIT-II :Connectivity, Euler tours and Hamilton Cycles : Connectivity – Blocks – Euler tours – Hamilton Cycles.
Chapter 3 (Section 3.1 – 3.2)
Chapter 4 (Section 4.1 – 4.2) **(18 hrs)**

UNIT-III :Matchings, Edge Colourings : Matchings – Matchings and Coverings in Bipartite Graphs – Edge Chromatic Number – Vizing's Theorem.
Chapter 5 (Section 5.1 – 5.2)
Chapter 6 (Section 6.1 – 6.2) **(18 hrs)**

UNIT-IV: Independent sets and Cliques, Vertex Colourings : Independent sets – Ramsey's Theorem – Chromatic Number – Brooks' Theorem – Chromatic Polynomials.
Chapter 7 (Section 7.1 – 7.2)
Chapter 8 (Section 8.1 – 8.2, 8.4) (18 hrs)

UNIT-V: Planar graphs : Plane and planar Graphs – Dual graphs – Euler's Formula – The Five-Colour Theorem and the Four-Colour Conjecture.
Chapter 9 (Section 9.1 – 9.3, 9.6) (18 hrs)

Recommended Text:

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

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, New York, 1989.
5. R.J. Wilson, Introduction to Graph Theory, Pearson Education, 4th Edition, 2004, Indian Print.
6. S.A.Choudum, A First Course in Graph Theory, MacMillan India Ltd. 1987.

Course Name: Fuzzy Sets and their Applications **Course Code: MFFAC**

Course Objective

- Fuzzy set theory has been shown to be a useful tool to describe situations in which the data are imprecise or vague. Fuzzy sets handle such situation by attributing a degree to which a certain object belongs to a set. In other words, there may be a hesitation or uncertainty about the membership degree of x in A.

Course OutCome

CO 1:	Learn crips and fuzzy set theory .make calculation on fuzzy set theory.
CO 2:	Recognize fuzzy logic membership function.
CO 3:	Make applications on fuzzy logic membership function and fuzzy inference systems.

CO 4:	Analysis statistical data by using fuzzy logic methods.

Syllabus:

UNIT-I : Fundamental Notions: Chapter I: Sec. 1 to 8 (18 hrs)

UNIT-II : Fuzzy Graphs: Chapter II: Sec. 10 to 18 (18 hrs)

UNIT-III : Fuzzy Relations: Chapter II: Sec. 19 to 29 (18 hrs)

UNIT-IV : Fuzzy Logic: Chapter III: Sec.31 to 40 (omit Sec. 37, 38, 41) (18 hrs)

UNIT-V : The Laws of Fuzzy Composition: Chapter IV: Sec.4```3 to 49 (18 hrs)

Recommended Text:

A.Kaufman, Introduction to the theory of Fuzzy subsets,Vol.**I,** Academic Press, New York, 1975.

Reference Books:

1. H.J.Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers, Chennai, 1996

2. George J.Klir and Bo Yuan, Fuzzy sets and Fuzzy Logic-Theory and Applications, Prentice Hall India, New Delhi, 2001.

Semester: II

Course Name: Algebra-II **Course Code: MFF2A**

Course Objective

- This course aims to provide a first approach to the subjects of algebra, which is one of the basic pillars of modern mathematics.
- In particular to study in details the sylow theorems and polynomials.
- This course helps to gain skill in problem solving and critical thinking.
- Abstract algebra is a classical field that is associated with the study of polynomials in several variables.

Course OutCome

CO 1:	Classify a extension fields and transcendence.

CO 2:	Evaluate and simply problems based on the theory on galois and roots of polynomial.
CO 3:	Perform calculations using order of operations based on roots of polynomials.
CO 4:	Evaluate and simply algebraic problem on radical-Galois groups over the rationals.

Syllabus:

UNIT I - Extension fields - Transcendence of e.
Chapter 5: Section 5.1 and 5.2 **(18 hrs)**

UNIT II - Roots or Polynomials.- More about roots
Chapter 5: Sections 5.3 and 5.5 **(18 hrs)**

UNIT III - Elements of Galois theory.
Chapter 5 : Section 5.6 **(18 hrs)**

UNIT IV - Finite fields - Wedderburn's theorem on finite division rings
Chapter 7: Sections 7.1 and 7.2 (Theorem 7.2.1 only) **(18 hrs)**

UNIT V - Solvability by radicals–Galois groups over the rationals -–A theorem ofFrobenius.

Chapter 5: Sections 5.7 and 5.8
Chapter 7: Sections 7.3 **(18 hrs)**

Recommended Text :

1.I.N. Herstein. Topics in Algebra (II Edition) Wiley 2002

Reference Books :

1. M.Artin, Algebra, Prentice Hall of India, 1991.
2. P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, Basic Abstract Algebra (II Edition) Cambridge University Press, 1997. (Indian Edition)
3. I.S.Luther and I.B.S.Passi, Algebra, Vol. I - Groups(1996); Vol. II Rings, (1999) Narosa Publishing House , New Delhi.
4. D.S.Dummit and R.M.Foote, Abstract Algebra, 2nd edition, Wiley, 2002.
5. N.Jacobson, Basic Algebra, Vol. I & II Hindustan Publishing Company, New Delhi.

Course Name: Real Analysis-II **Course Code: MFF2B**

Course Objective

- The develop the concept of measure on the real line in lebesgue measurability, integration of functions of a real variable, fourier series and fourier integrals, solve the problem based on the theory multivariable differential calculus, implicit functions and extremum problems.

Course OutCome

CO 1:	Understand the theory and applications of the measure on the real line.
CO 2:	Have a good knowledge of the theory and practice of integratin of functions of real variable.
CO 3:	Understand the role of fourier series and fourier integrals.
CO 4:	Solve the problem based on multivariable and differential calculus.

Syllabus:

UNIT-I : Measure on the Real line - Lebesgue Outer Measure - Measurable sets - Regularity - Measurable Functions - Borel and Lebesgue Measurability
Chapter - 2 Sec 2.1 to 2.5 of de Barra(18 hrs)

UNIT-II : Integration of Functions of a Real variable - Integration of Non- negative functions - The General Integral - Riemann and Lebesgue Integrals
Chapter - 3 Sec 3.1,3.2 and 3.4 of de Barra (18 hrs)

UNIT-III : Fourier Series and Fourier Integrals - Introduction - Orthogonal system of functions - The theorem on best approximation - The Fourier series of a function relative to an orthonormal system - Properties of Fourier Coefficients - The Riesz-Fischer Thorem - The convergence and representation problems in for trigonometric series - The Riemann - Lebesgue Lemma - The Dirichlet Integrals - An integral representation for the partial sums of Fourier series - Riemann's localization theorem - Sufficient conditions for convergence of a Fourier series at a particular point - Cesarosummability of Fourier series- Consequences of Fejes's theorem - The Weierstrass approximation theorem
Chapter 11 : Sections 11.1 to 11.15 of Apostol (18 hrs)

UNIT-IV : Multivariable Differential Calculus - Introduction - The Directional derivative - Directional derivative and continuity - The total derivative - The total derivative expressed in terms of partial derivatives - The matrix of linear function - The Jacobian matrix - The chain rule - Matrix form of chain rule - The mean - value theorem for differentiable functions - A sufficient condition for differentiability - A sufficient condition for equality of mixed partial derivatives - Taylor's theorem for functions of R^n to R^1
Chapter 12 : Section 12.1 to 12.14 of Apostol (18 hrs)

UNIT-V : Implicit Functions and Extremum Problems : Functions with non-zero Jacobian determinants – The inverse function theorem-The Implicit function theorem-Extrema of real valued functions of severable variables-Extremum problems with side conditions.
Chapter 13 : Sections 13.1 to 13.7 of Apostol (18 hrs)

Recommended Text:

1. G. de Barra, Measure Theory and Integration, New Age International, 2003 (for Units I and II)
2. Tom M.Apostol : Mathematical Analysis, 2nd Edition, Narosa 1989 (for Units III, IV and V) .

Reference Books:

1. Burkill,J.C. The Lebesgue Integral, Cambridge University Press, 1951.
2. Munroe,M.E. Measure and Integration. Addison-Wesley, Mass.1971.
3. Royden,H.L.Real Analysis, Macmillan Pub. Company, New York, 1988.
4. Rudin, W. Principles of Mathematical Analysis, McGraw Hill Company, New York,1979.
5. Malik,S.C. and SavitaArora. Mathematical Analysis, Wiley Eastern Limited. New Delhi, 1991.

Course Name: Partial Differential Equations **Course Code:MFF2C**

Course Objective

- In this course we have studied the Partial Differential techniques which consist of applying your mathematical skills to obtain useful answer to real problem. Equations are used in a very wide range of applications, some of which do not appear initially to be mathematical in nature. Learning to apply mathematical skills is very different from learning mathematics itself.

Course OutCome

CO 1:	Introduce and derive of partial differential equation, linear partial differential equation of second order.
CO 2:	Discuss Canonical form for hyperbolic equation, canonical form for parabolic equation and elliptic equation.
CO 3:	Understand the laplace and poisson equation, Dirichlet problem and solution of laplace equation in cylindrical coordinates.
CO 4:	Solve using separation of variable method.
CO 5:	Apply in finding the solution for Derivation of One-dimensional Wave Equation , Solution of One-dimensional Wave Equation by Canonical Reduction ,The Initial Value Problem,and D'Alembert's Solution.
CO 6:	Solve the concept of Green's function for Laplace equation,Green's function for the wave equation,Helmholtz theorem and Green's function for the Diffusion equation.

Syllabus:

UNIT – I
Fundamental Concepts :

Introduction – Classification of Second Order PDE – Canonical Forms : Canonical Form for Hyperbolic Equation , Canonical Form for Parabolic Equation , Canonical Form for Elliptic Equation.

Section 1.1 to 1.3 **(18 hrs)**

UNIT – II

Elliptic Differential Equations :

Occurrence of the Laplace and Poisson Equations: Derivation of Laplace Equation, Derivation of Poisson Equation. Boundary Value Problem (BVPs) – Some important Mathematical tools - Separation of Variables – Dirichlet Problem for a Rectangle - The Neumann Problem for a rectangle - Interior Dirichlet Problem for a Circle – Exterior Dirichlet Problem for a Circle – Interior Neumann Problem for a Circle- Solution of Laplace equation in cylindrical coordinates.

Section 2.1 to 2.3, 2.5 to 2.11 **(18 hrs)**

UNIT – III

Parabolic Differential Equations:

Occurrence of The Diffusion Equation –Boundary Conditions – Elementary Solutions of the Diffusion Equation – Dirac Delta Function – Separation of Variables Method – Solution of diffusion equation in cylindrical coordinates.

Section 3.1 to 3.6 **(18 hrs)**

UNIT –IV

Hyperbolic Differential Equations :

Occurrence of the Wave Equation – Derivation of One-dimensional Wave Equation – Solution of One-dimensional Wave Equation by Canonical Reduction – The Initial Value Problem ; D'Alembert's Solution – Vibrating String : Variables Separable Solution - Forced Vibrations: Solution of Non-homogeneous Equation – Boundary and Initial Value Problem for Two-dimensional Wave Equations: Method of Eigenfunction.

Section 4.1 to 4.7 **(18 hrs)**

UNIT –V

Green's Function:

Introduction – Green's function for Laplace equation – the methods of Images – the eigenfunction method – Green's function for the wave equation: Helmholtz theorem – Green's function for the Diffusion equation.

Section 5.1.to 5.6. **(18 hrs)**

Recommended Text :

"Introduction to Partial Differential Equation" by k.SankaraRao , Third Edition, PHI Learning Private Limited.

Reference Books:

1. R.C Mc.Owen, Partial Differential Equations, 2nd edition Pearson Education. New Delhi,2005.

2. I.N.Sneddon, Elements of Partial Differential Equations, McGraw Hil, News Delhi, 1983.

3. R. Dennemeyer, Introduction to Partial Differential Equations and Boundry Value Problems, McGraw Hill, New York, 1968.

4.T.Amarnath, Partial Differential Equations, Narosa publishing House.

Course Name: Probability Theory **Course Code: MFF2D**

Course Objective

- Objective probability refers to the chances or the odds that an event will occur based o the analysis of concrete measures rather than hunches or guesswork. Each measure is a recorded observation, a hard fact or part of a long history of collected data.

Course OutCome

CO 1:	Calculate probabilities by applying probability laws and theoretical results.
CO 2:	Identify an appropriate probability distribution for a given continuous random variable and use its properties to calculate probabilities.
CO 3:	Understanding the concept of parameters of the distribution and probability characteristic functions.
CO 4:	Solve the problems about Bayes theorem and cauchy and laplace distributions.

Syllabus:

UNIT-I : **Random Events and Random Variables:** Random events – Probability axioms – Combinatorial formulae – conditional probability – Bayes Theorem – Independent events – Random Variables – Distribution Function – Joint Distribution – Marginal Distribution – Conditional Distribution – Independent random variables – Functions of random variables.

Chapter 1: Sections 1.1 to 1.7 Chapter 2 : Sections 2.1 to 2.9 (18 hrs)

UNIT-II : Parameters of the Distribution : Expectation- Moments – The Chebyshev Inequality – Absolute moments – Order parameters – Moments of random vectors – Regression of the first and second types.

Chapter 3 : Sections 3.1 to 3.8 (18 hrs)

UNIT-III:Characteristic functions : Properties of characteristic functions – Characteristic functions and moments – semi0invariants – characteristic function of the sum of the independent random variables – Determination of distribution function by the Characteristic function – Characteristic function of multidimensional random vectors – Probability generating functions.

Chapter 4 : Sections 4.1 to 4.7 (18 hrs)

UNIT-IV :Some Probability distributions: One point , two point , Binomial – Polya – Hypergeometric – Poisson (discrete) distributions – Uniform – normal gamma – Beta – Cauchy and Laplace (continuous)

distributions.

Chapter 5 : Section 5.1 to 5.10 (Omit Section 5.11) (18 hrs)

UNIT-V:Limit Theorems : Stochastic convergence – Bernaulli law of large numbers – Convergence of sequence of distribution functions – Levy-Cramer Theorems – de Moivre-Laplace Theorem – Poisson, Chebyshev, Khintchine Weak law of large numbers – Lindberg Theorem – LapunovTheroem – Borel-Cantelli Lemma - Kolmogorov Inequality and Kolmogorov Strong Law of large numbers.

Chapter 6 : Sections 6.1 to 6.4, 6.6 to 6.9 , 6.11 and 6.12. (Omit Sections 6.5, 6.10,6.13 to 6.15)

Recommended Text:

1.M. Fisz, Probability Theory and Mathematical Statistics, John Wiley and Sons, New York, 1963.

Reference Books:

1. R.B. Ash, Real Analysis and Probability, Academic Press, New York, 1972

2. K.L.Chung, A course in Probability, Academic Press, New York, 1974.

4. R.Durrett, Probability : Theory and Examples, (2^{nd} Edition) Duxbury Press, New York, 1996.

5. V.K.RohatgiAn Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern Ltd., New Delhi, 1988(3^{rd} Print).

6. S.I.Resnick, A Probability Path, Birhauser, Berlin,1999.

7. B.R.Bhat , Modern Probability Theory (3^{rd} Edition), New Age International (P)Ltd, New Delhi, 1999.

Course Name: Mathematical programming **Course Code: MFFAD**

Course Objective

- Mathematical programming methods are based on the solution of a CAMD problem as an optimization problem where the objective function is defined in terms of the performance criteria and target properties that must be satisfied are introduced as constraints.

Course OutCome

CO 1:	Formulate a given simplified description of a suitable real-world problem as a linear programming model in general, standard and canonical forms.
CO 2:	Classify a two-dimensional linear programming model by the type of its solution.
CO 3:	Solve a two-dimensional linear programming problem graphically.
CO 4:	Use the simples method to solve small linear programming models by hand,given a basic feasible point.

Syllabus:

UNIT-I: Integer Linear Programming: Types of integer linear programming problems- Concept of cutting plane- Gomory's all integer cutting plane method –Branch and Bound method.

Chapter 7

UNIT-II: Dynamic Programming: Characteristic of Dynamic Programming Problem- Developing optimal Decision policy – Dynamic Programming under Certainty – DP approach to solve LPP.

Chapter22

UNIT-III:Classical optimization Method: Unconstrained Optimization- Constrained Multi-variable Optimization with Equality Constraints – Constrained Multi-variable Optimization with inequality constraints

Non-Linear Programming Methods: Examples of NLPP – General NLPP- Graphical solution – Quadratic programming – Wolfe's modified simplex method.

Chapter 23 and chapter 24: Section 24.1 to 24.4

UNIT-IV: Linear programming problem- Simple problems.

Parametric Linear Programming: Variation in the coefficients c_j, variation in the Right hand side b_j

Chapter 4: Section 4.1 to 4.3 and Chapter 29

UNIT-V: Goal Programming: Difference between LP and GP approach- Concept of Goal Programming – Goal programming model formulation – Graphical solution method of Goal Programming.

Chapter8: section 8.1 to 8.5

Recommended Text:

J.K. Sharma, Operations Research, (fourth edition) Macmilan, New Delhi, 2009.

Reference Books:

1.Hamdy A. Taha, Operation Research, (Seventh edition) Prentice- Hall of india Private Limited, New Delhi, 1997.

2.F.S. Hiller , J.Liberman introduction to Operation Research (7^{th} edition) Tata –McGraw Hill Company, New Delhi, 2001.

3.Beightler.C , D.philips, B.Wilde Foundations of Optomization (2^{nd} edition) Prentice Hall Pvt Ltd., New York 1979.

4.S.S. Rao –Optimization Theory and Applications, Wiley Eastern, New Delhi 1990.

Semester: III

Course Name: Complex Analysis-I Course Code: MFF3A

Course Objective

- This course is aimed to provide an introduction to the theories for functions of a complex variable. Students will be equipped with the understanding of the fundamental concepts of complex variable of first level.

Course OutCome

CO 1:	Students will be equipped with the understanding of the fundamental concept of complex variable theory and skill using of contour integration to evaluate complicated real integral via residue calculus.
CO 2:	Apply problem-solving using cauchy integral formula and analytic function.
CO 3:	To understanding the concepts of Schwarz theorem, weierstraws theorem and series.
CO 4:	Apply problem-solving using harmonic, partial and entire function.

Syllabus:

UNIT I - Cauchy's Integral Formula: The Index of a point with respectto a closed curve - The Integral formula - Higher derivatives.
Local Properties of Analytical Functions : Removable Singularities-Taylors's Theorem-Zeros and poles-The local Mapping - The Maximum Principle .
Chapter 4 : Section 2 : 2.1 to 2.3, Section 3 : 3.1 to 3.4 **(18 hrs)**

UNIT II - The general form of Cauchy's Theorem : Chains and cycles- SimpleConnnectivity - Homology - The General statement of Cauchy's Theorem - Proof of Cauchy's theorem – Locally exact differentials-Multilply connected regions – Residue theorem - The argument principle.
Chapter 4 : Section 4 : 4.1 to 4.7, Section 5: 5.1 and 5.2 **(18 hrs)**

UNIT III - Evaluation of Definite Integrals and Harmonic Functions:
Evaluation of definite integrals - Definition of Harmonic functions and basic

properties - Mean value property - Poisson formula.
Chapter 4 : Section 5 : 5.3, Section 6 : 6.1 to 6.3 **(18 hrs)**

UNIT IV - **Harmonic Functions and Power Series Expansions:**

Schwarz theorem - The reflection principle - Weierstrass theorem - Taylor Series - Laurent series .
Chapter 4 : Sections 6.4 and 6.5
Chapter 5 : Sections 1.1 to 1.3 **(18 hrs)**

UNIT V - **Partial Fractions and Entire Functions:** Partial fractions– Infinite products - Canonical products - Gamma Function - Jensen's formula
Chapter 5 : Sections 2.1 to 2.4, Section 3.1 **(18 hrs)**

Recommended Text :

1.Lars V. Ahlfors, Complex Analysis, (3rd edition) McGraw Hill Co., New York, 1979.

Reference Books :

1. H.A. Priestly, Introduction to Complex Analysis, Clarendon Press,Oxford, 2003.
2. J.B.Conway, Functions of one complex variable, Springer International Edition, 2003
3. T.W Gamelin, Complex Analysis, Springer International Edition, 2004.
4. D.Sarason, Notes on complex function Theory, Hindustan Book Agency, 1998.

Course Name: Topology **Course Code: MFF3B**

Course Objective

- The objective of the course on Topology is to provide the knowledge of topological spaces and their importance. To acquaint students with the concept of homeomorphism and the topological properties and important mathematical concepts which can generalized in topological spaces, so that students may learn and appreciate the nature of abstract mathematics.

Course OutCome

CO 1:	Understand the concept of topological spaces and the basic definitions of open sets, neighbourhood, interior, exterior, closure and their axiom for defining topological spaces.
CO 2:	Understanding the concept of Bases and subspaces, create new topological spaces by using subspaces.
CO 3:	Understand continuity, compactness, connectedness, local connectedness and compact subspaces of the real life.
CO 4:	Understand normal spaces , urysohn lemma and extension theorem.

CO 4:	Understand the concept od product topology, Homotopy of paths and fundamental group.

Syllabus:

Unit I - Topological spaces, Basis for a topology, Product topology on X x Y,Subspace topology, Closed sets and Limit points, Continuous functions.
Chapter 2 - Sections 12, 13, 15, 16, 17, 18. **(18 hrs)**

Unit II - Connected spaces, Connected subspaces of the real line, Components and Local connectedness, Compact spaces, Compact subspaces of the real line.
Chapter 3 - Sections 23, 24, 25, 26, 27. **(18 hrs)**

Unit III - Countability axioms, Separation axioms, Normal spaces, Urysohn Lemma, Urysohnmetrization theorem, Tietze extension theorem.
Chapter 4 - Sections 30, 31, 32, 33, 34, 35. **(18 hrs)**

Unit IV - Product topology, Tychonoff theorem.
Chapter 2 - Sections 19.
Chapter 5 - Section 37. **(18 hrs)**

Unit V - Homotopy of paths, Fundamental group.
Chapter 9 - Sections 51, 52. **(18 hrs)**

Recommended Text :

James R. Munkres"Topology" (Second edition) PHI, 2015.

Reference Books :

1. T.W. Gamelin and R.E. Greene, Introduction to Topology, The Saunders Series, 1983.
2. G.F. Simmons, Introduction to Topology and Modern Analysis,Mcgraw-Hill
3. J. Dugundji, Topology, Prentice Hall of India.
4. J.L. Kelly, General Topology, Springer.
5. S. Willard, General Topology, Addison-Wesley.

Course Name: Operation Research **Course Code: MFF3C**

Course Objective

- The objective of this course is to understand the theory of operation research developed for solving various types of optimization problem.

Course OutCome

CO 1:	To understand the concept of decision theory.
CO 2:	Understand network application, shortest route problem, linear programming formulation and network simplex algorithm.
CO 3:	Solve the problems Inventory Control Models and Probabilistic Inventory Control Models.
CO 4:	Learn about the application of Queueing Theory and Characteristic.

Syllabus:

UNIT-I : Decision Theory : Steps in Decision theory Approach – Types of Decision-Making Environments – Decision Making Under Uncertainty – Decision Making under Risk – Posterior Probabilities and Bayesian Analysis – Decision Tree Analysis – Decision Making with Utilities.

Chapter 10 : Sec. 10.1 to 10.8 (18 hrs)

UNIT-II : Network Models : Scope of Network Applications – Network Definition – Minimal spanning true Algorithm – Shortest Route problem – Maximum flow model – Minimum cost capacitated flow problem - Network representation – Linear Programming formulation – Capacitated Network simplex Algorithm.

Chapter 6 : Sections 6.1 to 6.6
H.A.Taha : Operations Research (18 hrs)

UNIT-III : Deterministic Inventory Control Models: Meaning of Inventory Control – Functional Classification – Advantage of Carrying Inventory – Features of Inventory System – Inventory Model building - Deterministic Inventory Models with no shortage – Deterministic Inventory with Shortages

Probabilistic Inventory Control Models:
Single Period Probabilistic Models without Setup cost – Single Period Probabilities Model with Setup cost.
Chapter 13: Sec. 13.1 to 13.8
Chapter 14: Sec. 14.1 to 14.3 (18 hrs)

UNIT-IV :Queueing Theory : Essential Features of Queueing System – Operating Characteristic of Queueing System – Probabilistic Distribution in Queueing Systems – Classification of Queueing Models – Solution of Queueing Models – Probability Distribution of Arrivals and Departures – Erlangian Service times Distribution with k-Phases.

Chapter 15 : Sec. 15.1 to 15.8 (18 hrs)

UNIT-V : Replacement and Maintenance Models: Failure Mechanism of items – Replacement of Items that deteriorate with Time – Replacement of items that fail completely – other Replacement Problems.

Chapter 16: Sec. 16.1 to 16.5 (18 hrs)

Recommended Texts:

1. For Unit 2 : H.A. Taha, Operations Research, 6th edition, Prentice Hall of India

2. For all other Units: J.K.Sharma, Operations Research ,MacMillan India, New Delhi, 2001.

Reference Books:

1. F.S. Hiller and J.Lieberman -,Introduction to Operations Research (7th Edition), Tata McGraw Hill Publishing Company, New Delhui, 2001.

2. Beightler. C, D.Phillips, B. Wilde ,Foundations of Optimization (2nd Edition) Prentice Hall Pvt Ltd., New York, 1979

3. Bazaraa, M.S; J.J.Jarvis, H.D.Sharall ,Linear Programming and Network flow, John Wiley and sons, New York 1990.

4. Gross, D and C.M.Harris, Fundamentals of Queueing Theory, (3rd Edition), Wiley and Sons, New York, 1998.

Course Name: Mechanics **Course Code: MFF3D**

Course Objective

- The course aims at understanding the various concepts of physical quantities and related effect on different bodies using mathematical techniques. It emphasizes knowledge building for applying mathematics in physical world.

Course OutCome

CO 1:	Know the significance of mathematics involved in physical quantities and their uses.
CO 2:	Understand the concept of generalized coordinates, constraints , virtual work , energy and momentum.
CO 3:	Learn the concept the legrange equation and integrals of motion.
CO 4:	Study about the Hamilton's principle function, Hamilton Jacobi equation and separability.
CO 5:	To understand the uses of transformation, lagrange and poisson brackets.

Syllabus:

UNIT-I :**Mechanical Systems** : The Mechanical system- Generalised coordinates – Constraints - Virtual work - Energy and Momentum
Chapter 1 : Sections 1.1 to 1.5 (18 hrs)

UNIT-II :**Lagrange's Equations**: Derivation of Lagrange's equations- Examples- Integrals of motion.
Chapter 2 : Sections 2.1 to 2.3 (Omit Section 2.4) (18 hrs)

UNIT-III : **Hamilton's Equations** : Hamilton's Principle - Hamilton's Equation - Other variational principles.
Chapter 4 : Sections 4.1 to 4.3 (Omit section 4.4) (18 hrs)

UNIT – IV :**Hamilton-Jacobi Theory** : Hamilton Principle function – Hamilton-Jacobi Equation - Separability
Chapter 5 : Sections 5.1 to 5.3 (18 hrs)

UNIT-V :**Canonical Transformation** : Differential forms and generating functions – Special Transformations– Lagrange and Poisson brackets.
Chapter 6 : Sections 6.1, 6.2 and 6.3 (omit sections 6.4, 6.5 and 6.6) (18 hrs)

Recommended Text:

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

Reference Books:

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

2. N.C.Rane and P.S.C.Joag, Classical Mechanics, Tata McGraw Hill, 1991.

3. J.L.Synge and B.A.Griffth, Principles of Mechanics (3rd Edition) McGraw Hill Book Co., New York, 1970.

Course Name: Number Theory and Cryptography **Course Code: MFFAH**

Course Objective

- Covers fundamental algorithms for integer arithmetic, greatest coomon divisor calculation, modular arithmetic, and other number-theoretic computations. Algorithms are derived, implemented and analyzed for primality testing and integer factorization. Application to cryptography are explored including symmetric and public-key cryptosystem. A cryptosystem will be implemented and methods of attack investigated. To be able to implement and analyze algorithms for integer factorization and Primality testing. To be able to use a system like Maple to explore concepts and theorems from numbertheory. To understand fundamental algorithms from symmetric-key and public-key cryptography.

Course OutCome

CO 1:	To understand fundamental number-theoretic algorithms such as the Euclidean algorithms.
CO 2:	To understand fundamental algorithms for crypto system and Enciphering matrices DES.
CO 3:	To understand the concept of finite fields , quadratic and Reciprocity.

CO 4:	To understand fundamental algorithms for symmetric key and public-key cryptography.

Syllabus:

UNIT-I :Elementary Number Theory: Time Estimates for doing arithmetic – divisibility and Euclidean algorithm – Congruences – Application to factoring. (Chapter 1)(18 hrs)

UNIT-II : Introduction to Classical Crypto systems – Some simple crypto systems – Enciphering matrices DES (Chapter 3)(18 hrs)

UNIT-III : Finite Fields, Quadratic Residues and Reciprocity (Chapter 2)

(18 hrs)

UNIT-IV : Public Key Cryptography (Chapter 4) (18 hrs)

UNIT-V: Primality , Factoring, Elliptic curves and Elliptic curve crypto systems (Chapter 5, sections 1,2,3 &5 (omit section 4), Chapter 6, sections 1& 2 only)
(18 hrs)

Recommended Text:

1.Neal Koblitz, A Course in Number Theory and Cryptography, Springer-Verlag, New York,1987.

Reference Books:

1. I. Niven and H.S.Zuckermann, An Introduction to Theory of Numbers (Edn. 3), Wiley Eastern Ltd., New Delhi,1976

2. David M.Burton, Elementary Number Theory, Brown Publishers, Iowa,1989

3. K.Ireland and M.Rosen, A Classical Introduction to Modern Number Theory, Springer Verlag, 1972

4. N.Koblitz, Algebraic Aspects of Cryptography, Springer 1998.

Semester: IV

Course Name: Complex Analysis-I I **Course Code: MFF4A**

Course Objective

- The course presents an introduction to some topics of contemporary complexanalysis.The purpose is to prepare the student to independent work in these topics and especially to use the methods of complex of complex analysis in other areas of mathematics.

Course OutCome

CO 1:	Represent complex numbers algebraically and geometrically.
CO 2:	Apply the concepts and consequences of Riemann zeta functions, Riemann mapping theorem, doubly periodic functions.
CO 3:	Apply the weierstrass theorem and functions, modular equation and conformal mapping.
CO 4:	Analysis solving problem based on elliptic functions simply periodic functions

Syllabus:

UNIT-I : Riemann Zeta Function and Normal Famalies :
Product development – Extension of □(s) to the whole plane – The zeros of zeta function – Equicontinuity – Normality and compactness – Arzela's theorem – Families of analytic functions – The Classcial Definition
Chapter 5 : Sections 4.1 to 4.4, Sections 5.1 to 5.5 (18 hrs)

UNIT-II :Riemann mapping Theorem : Statement and Proof – Boundary Behaviour – Use of the Reflection Principle.
Conformal mappings of polygons : Behaviour at an angle Schwarz-Christoffel formula – Mapping of a rectangle.Harmonic Functions : Functions with mean value property – Harnack's principle.
Chapter 6 : Sections 1.1 to 1.3 (Omit Section 1.4)
Sections 2.1 to 2.3 (Omit section 2.4), Section 3.1 and 3.2 (18 hrs)

UNIT-III : Elliptic functions : Simply periodic functions – Doubly periodic functions
Chapter 7 : Sections 1.1 to 1.3, Sections 2.1 to 2.4 (18 hrs)

UNIT-IV :Weierstrass Theory : The Weierstrass□-function – The functions □(s) and □(s) – The differential equation – The modular equation □(□) – The Conformal mapping by □(□).
Chapter 7 : Sections 3.1 to 3.5 (18 hrs)

UNIT-V: Analytic Continuation :The Weiesrtrass Theory – Germs and Sheaves – Sections and Riemann surfaces – Analytic continuation along Arcs – Homotopic curves – The Monodromy Theorem – Branch points.
Chapter 8 : Sections 1.1 to 1.7 (18 hrs)

Recommended Text:

Lars V. Ahlfors, Complex Analysis, (3rd Edition) McGraw Hill Book Company, New York, 1979.

Reference Books:

1.H.A. Priestly, Introduction to Complex Analysis, Clarendon Press,Oxford, 2003.

2.J.B.Conway, Functions of one complex variable, Springer International Edition, 2003

3.T.WGamelin, Complex Analysis, Springer International Edition, 2004.

4.D.Sarason, Notes on Complex function Theory, Hindustan Book Agency, 1998 .

Course Name: Differential Geometry Course Code: MFF4B

Course Objective

- The aim of the course is to provide knowledge of the geometry of curves and surfaces. The course integrates concept from different parts of mathematics, such as linear algebra, calculus and differential equations. It also provides intuitive examples for many conceptsin linear algebra, calculus and differential equations.

Course OutCome

CO 1:	Functionally use connections, curvature and geodesics.
CO 2:	Perform geometric calculations in local coordinates.
CO 3:	Demonstrate knowledge of important examples of gaussian and mean curavature.
CO 4:	Explain and apply major foundational results in TheoremaEgregium of Gauss.

Syllabus:

Unit I - Curves in the plane and in space :

Curves, parametrisation, arc length, level curves, curvature, plane and space curves.
Chapters 1 and 2. **(18 hrs)**

Unit II - Surfaces in space :

Surface patches, smooth surfaces, tangents, normals, orientability, examples of surfaces, lengths of curves on surfaces, the first fundamental form, isometries, surface area.
Chapter 4 - 4.1, 4.2, 4.3, 4.4, 4.7 and Chapter 5 - 5.1, 5.2, 5.4 **(18 hrs)**

Unit III - Curvature of surfaces:

The second fundamental form, Curvature of curves on a surface, normal, principal, Gaussian and mean curvatures, Gauss map.
Chapter 6 - 6.1, 6.2, 6.3 and Chapter 7 - 7.1, 7.5,7.6 **(18 hrs)**

Unit IV - Geodesics :

Geodesics, geodesic equations, geodesics as shortest paths, geodesic coordinates. **(18 hrs)**
Chapter 8 - 8.1, 8.2, 8.4, 8.5

Unit V - TheoremaEgregium of Gauss :

TheoremaEgregium, isometries of surfaces, Codazzi-Mainardi equations, compact surfaces of constant Gaussian curvature.
Chapter 10

(18 hrs)

Recommended Text :

A. Pressley, Elementary Differential Geometry, Springer-Indian Edition, 2004.

Reference Books :

1. J.A. Thorpe, Elementary Topics in Differential Geometry, Springer-Indian edition.
2. E.D. Bloch, A First Course in Geometric Topology and Differential Geometry, Birkhauser, 1997.
3. M.P. doCarmo, Differential Geometry of Curves and Surfaces, Prentice-Hall, 1976.

Course Name: Functional Analysis Course Code: MFF4C

Course Objective

- This course will develop a deeper and rigorous understanding of fundamental concepts of functional analysis, their properties and related theorems.

Course OutCome

CO 1:	Explain the fundamental concepts of functional analysis and their role in modern mathematics.
CO 2:	Explain the concept of Hahn-banach theorems and Banach spaces.
CO 3:	Utilize the concepts of functional analysis, for example continuous and bounded ,normed spaces and to study the behavior of different mathematical expressions arising in science and engineering.
CO 4:	Understand and apply fundamental theorem from the theory of normed and Banach spaces including the open mapping theorem, closed graph theorem and uniform boundness theorem.
CO 5:	Explain the concept of dual spaces , inner product space and operators.

Syllabus:

Unit I - Normed spaces, Continuity of linear maps, Hahn-Banach Theorems, Banach Spaces.
Chapters II (omit sections 6.8, 7.11, 7.12, 8.4) (18 hrs)

Unit II - Uniform boundedness principle, Closed Graph and Open Mapping theorems, Bounded Inverse Theorem, Spectrum of a bounded operator.
Chapter III (omit sections 9.4 to 9.7, 11.2, 11.4, 11.5, 12.6, 12.7)(18 hrs)

Unit III - Duals and Transposes, Weak and weak *convergence, Reflexivity
Chapter IV (omit sections 13.7, 13.8, 14, 15.5 to 15.7, 16.5 to 16.9)(18 hrs)

Unit IV - Inner Product Spaces, Orthonormal sets, Best approximation,Projection and RieszRepresentaion theorems.
. Chapter VI (omit sections 23.2, 23.4, 23.6, 24.7, 24.8) (18 hrs)

Unit V - Bounded operators and adjoints, Normal, unitary and self adjoint Operators, Spectrum and Numerical range, Compact selfadjoint operators
Chapter VII (omit sections 26.4, 26.5 26.6, 27.4 to 27.7, 28.7, 28.8)(18 hrs)

Recommended Text :

B.V. Limaye, Functional Analysis, New Age International, 1996.

Reference Books :

1. W.Rudin Functional Analysis, Tata McGraw-Hill Publishing Company, New Delhi , 1973

2. G.Bachman&L.Narici, Functional Analysis Academic Press, New York , 1966.

3. C. Goffman and G.Pedrick, First course in Functional Analysis, Prentice Hall of India, New Delhi, 1987

4. E. Kreyszig, Introductory Functional Analysis with Applications, John wiley& Sons, New York.,1978.

5. M.Thamban Nair, Functional Analysis. A First Course, Prentice Hall of India, New Delhi, 2002

Course Name: Fluid Dynamics Course Code: MFFAJ

Course Objective

- To introduce and explain fundamentals of fluid mechanics, which used in the applications of aerodynamics,gas dynamics etc.
- To develop understand about three dimensional and two dimensional problems in fluid flow.
- To determine the viscous of flows on a system and relation between stress and rate of strain
- To inculcate the importance of fluid flow measurement and its applications of in industries.

Course OutCome

CO 1:	Determine the fluid pressure and use if kinematics of fluid in motion and its problems.
CO 2:	Calculate equation of motion of a fluid on eulers equation of motion.
CO 3:	Apply the problem on solving some three dimensional flows,stokes stream function and axix symmetric flows.
CO 4:	Use of different fluid viscous flows on the problems.

Syllabus:

UNIT-I : Kinematics of Fluids in motion: Real fluids and ideals fluids-velocity of a fluid at a point ,stream lines, path lines, steady and unsteady flows- velocity potential- The voracity vector- Local and particle rates of changes-Equation of continuity- Worked examples-Acceleration of a fluid-Conditions at a rigid boundary.

Chapter2. Sec 2.1 to 2.10

UNIT-II : Equation of motion of a fluid: Pressure at a point in a fluid at rest-Pressure at a point in a moving fluid- Conditions at a boundary of two inviseid immiscible fluids- Euler's equation of motion – Disscussion of the case of steady motion under conservative body forces.

Chapter3. Sec3.1 to 3.7

UNIT-III : Some three dimensional flows. Introduction- Sources, sinks and doublets- images in a rigid infinite plane- Axis symmetric flows – Stokes stream function.

Chapter 4. Sec4.1, 4.2, 4.3, 4.5.

UNIT-IV : Some two dimensional flows: Meaning of two dimensional flow – Use of Cylindrical polar coordinates- The stream function- The complex potential for two dimensional, irrotational incompressible flow- Complex velocity potentials for standard two dimensional flows- Some worked examples- Two dimensional image system- The Milne Thompson circle Theorem.

Chapter5. Sec 5.1 to 5.8

UNIT-V : Viscous flows: Stress components in a real fluid- Relation between Cartesian components of stress- Translational motion of fluid elements –The rate of strain quadric and principle stresses- Some further properties of the rate of strain quadric- Stress analysis in fluid motion – Relation between stress and rate of strain – The coefficients of viscosity and Laminar flow – The Navier- Stokes equations of motion of a Viscous fluid.

Chapter8. Sec 8.1 to 8.9

Recommended Text:

F. Chorlton. Text Book of Fluid Dynamics, CBS Publicatins, Delhi, 1985.

Reference Books:

1.R.W. Fox and A.T.McDonald. Introduction to Fluid Mechanics, Wiley, 1985.

2. Krause, Fluid Mechanics with Problems and Solutions, Springer, 2005.

3. B.S.Massey , J.W.Smith and A.J.W.Smith, Mechanics of Fluids, Taylor and Francis, New York, 2005.

4.P.Orlandi, Fluid Flow Phenomena, Kluwer, New York, 2002.

5.T.Petrila, Basies of Fluid Mechanics and Introduction to Computational Fluid Dynamics, Springer, berlin, 2004.

Course Name: Tensor Analysis and Relativity Course Code: MFFAM

Course Objective

- The aim of the course is to introduce and develop the methods of Tensor analysis and relativity. These methods provide a natural aid to the understanding of geometry and some physical concepts. They are also fundamental tool in many theories of Applied Mathematics.

Course OutCome

CO 1:	Understand the basic concept of tensor variable and different form of tensor methods.
CO 2:	Realize importance of Riemannian space and christoffel symbol and their properities.
CO 3:	Evaluate the concept of curvature tensor and intrinsic differentiation.
CO 4:	Know the fundamental concept in special theory of relativity and principle of relativity.
CO 5:	To understand the concept of Accelerated Systems, Relativistic Dynamics and Relativistic Kinematics **.**

Syllabus:

UNIT-I : Tensor Algebra : Systems of Different orders – Summation Convention – Kronecker Symbols - Transformation of coordinates in S_n - Invariants – Covariant and Contravariant vectors - Tensors of Second Order – Mixed Tensors – ZeroTensor – Tensor Field – Algebra of Tensors – Equality of Tensors – Symmetric and Skew-symmetric tensors - Outer multiplication, Contraction and Inner Multiplication – Quotient Law of Tensors – Reciprocal Tensor – Relative Tensor – Cross Product of Vectors.
Chapter I : I.1 – I.3,I.7 and I.8 and Chapter II : II.1 – II.19 (18 hrs)

UNIT-II : Tensor Calculus : Riemannian Space – Christoffel Symbols and their properties.
Chapter III: III.1 and III.2

UNIT-III : Tensor Calculus(contd) : Covariant Differentiation of Tensors – Riemann–Christoffel Curvature Tensor – Intrinsic Differentiation
Chapter III: III.3 – III.5 (18 hrs)

UNIT-IV : Special Theory of Relativity : Galilean Transformations – Maxwell's equations – The ether Theory – The Principle of Relativity.
Relativistic Kinematics : 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.
Chapter 7 : Sections 7.1 and 7.2 (18 hrs)

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.

Chapter 7 : Sections 7.3 and 7.4 (18 hrs)

Recommended Text:

1.U.C. De, Absos Ali Shaikh and JoydeepSengupta, Tensor Calculus, Narosa Publishing House, New Delhi, 2004.

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

Reference Books:

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