Palamuru University, Mahabubnagar, Telangana State
M.Sc. Mathematics Course Structure
(Choice Based Credit System) (w.e.f. the academic year 2024-2025)

SEMESTER – III

Subjects	Code	Paper Title	THPW	CCE	Credits	IA	ESE	Total
Core	M 301	Functional Analysis	4	2	4	40	60	100
Core	M 302	General Measure & Integration	4	2	4	40	60	100
Core	M 303	Numerical Analysis	4	2	4	40	60	100
Elective	M 304(A)	Mathematical Statistics	4	2	4	40	60	100
	M 304(B)	Advanced Complex Analysis						
	M 304(C)	Mechanics						
Elective	M 305(A)	Operations Research	4	2	4	40	60	100
	M 305(B)	Graph Theory						
	M 305(C)	Finite Difference Methods						
			20	10	20			500

SEMESTER – IV

Subjects	Code	Paper Title	THPW	CCE	Credits	IA	ESE	Total
Core	M 401	Integral Equations & Calculus of Variations	4	2	4	40	60	100
Core	M 402	Elementary Operator Theory	4	2	4	40	60	100
Core	M 403	Partial Differential Equations	4	2	4	40	60	100
Elective	M 404(A)	Analytical Number Theory	4	2	4	40	60	100
	M 404(B)	Differential Geometry						
	M 404(C)	Fluid Mechanics						
Elective	M 405(A)	Integral Transforms	4	2	4	40	60	100
	M 405(B)	Cryptography						
	M 405(C)	Advanced Operations Research						
			20	10	20			500

THPW = Teaching Hours Per Week.
CCE – Continuous Comprehensive Evaluation.
IA = Internal Assessment (Conducted 4 Internals for 50 marks should be scaled down to 10 marks).
ESE = End-Semester Examination. (Duration - 3 Hrs.)

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M 301 **Semester-III**

Paper-I: Functional Analysis

Unit- I

Normed Spaces - Banach Spaces - Further properties of normed spaces - Finite dimensional normed spaces and sub spaces - compactness and finite dimension - linear operators - Bounded and continuous linear operators. [2.2, 2.3, 2.4, 2.5, 2.6 *and* 2.7].

Unit- II

Linear functional – normed spaces of operators – Dual space – Inner product space-Hilbert Space – Further Properties of Inner product Spaces – Orthogonal complements and direct sums – Orthogonal sets and sequences. [2.8, 2.10, 3.1, 3.2, 3.3 *and* 3.4]

Unit- III

Series related to Orthonormal Sequences and sets – Total Orthonormal sets and sequences – Representation of Functions on Hilbert spaces – Hilbert – Adjoint Operator-Self-Adjoint, unitary and normal operators. [3.5, 3.6, 3.8, 3.9 *and* 3.10]

Unit- IV

Hahn-Banach Theorem - Hahn-Banach Theorem for Complex Vector Spaces and Normed Spaces

–Adjoint Operator- Reflexive Spaces- Category Theorem - Uniform Boundedness Theorem - Open Mapping Theorem - Closed Linear Operators – Closed Graph Theorem. [4.2, 4.3, 4.5, 4.6, 4.7, 4.12 *and* 4.13]

Text Book:

Introductory Functional Analysis with Applications by Erwin Kreyszig, John Wiley and sons, New York.

References:

1. **Functional Analysis** by B.V.Limaye 2nd Edition..
2. **Introduction to Topology and Modern Analysis** by G.F.Sinmmons. Mc.Graw-Hill International Edition.

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M 302 **Semester-III**

Paper-II: General Measure & Integration

Unit I

Measure spaces - Measurable functions - Integration - General Convergence theorem.

Unit II

Signed measures - The Radon - Nikodym theorem.

Unit III

Outer measure and measurability - The Extension theorem - The Product measure.

Unit-IV

Inner measure - Extension by sets of measure zero - Caratheodory outer measure

Text Book:

Real Analysis (Chapters 11, 12) By H.L. Royden, Wiley.

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M 303 **Semester-III**

Paper-III: Numerical Analysis

Unit- I

Transcendental and Polynomial Equations: Introduction, Bisection Method - Iteration Methods Based on First Degree Equation: Secant Method, RegulaFalsi Method, Newton-Raphson Method

- Iteration Methods Based on Second Degree Equation: Muller's Method, Chebyshev Method,Multipoint Iteration Methods, Rate of convergence - Iteration Methods.

Unit- II

System of Linear Algebraic Equations: Introduction - Direct Methods: Gauss Elimination Method, Gauss Jordan Elimination Method, Triangularization Method, Cholesky Method, Partition Method - Iteration Methods: Jacobi Iteration Method, Gauss Seidel Iteration Method, SOR Method, Convergence Analysis for iterative Methods.

Unit- III

Interpolation and Approximation: Interpolation: Introduction - Lagrange and Newton Interpolations, Finite Difference Operators - Interpolating Polynomials using Finite Differences - Hermite Interpolations, Piecewise and Spline Interpolations. Approximation: Least Squares Approximation.

Differentiation : Methods based on interpolation, Methods based on finite differences.

Unit- IV

Numerical Integration: Methods Based on Interpolation: Newton- Cotes Methods - Methods Based on Undetermined Coefficients: Guass- Legendre Integration Methods - Composite IntegrationMethods.

Numerical Solution of ODEs: Introduction - Numerical Methods: Euler Methods-Mid point Method Single Step Methods: Taylor series method, Runge-Kutta Method (2nd and 4th orders). Multistep Methods: Adams Bashforth Method - Adams Moulton Method, Milne-Simpson Method - Predictor Corrector Methods.

Text Book:

Numerical Methods for Scientific and Engineering computation by M.K. Jain, S.R.K. Iyengar, R.K. Jain, 7th Edition, *New Age International Publishers,2019.*

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M 304 (A) **Semester-III**

Paper-IV (A) : Mathematical Statistics

Unit- I

Probability: Sample space and events of an experiment, Properties of Probability experiments, Equally likely out comes, Conditional probability and independence, Bayes' Theorem. **Discrete Random Variables**: Random variables, Expected value, Properties of expected values, varianceof random variables, Properties of variances, Binomial random variables and its Expected value and variance, Hyper-geometric random variables, Poisson random variables.[ch4, 5]

Unit- II

Normal Random Variables: Continuous random variables, Normal random variables, Probabilitiesassociated with a standard Normal random variable, Finding Normal probabilities. Problems on related. **Distributions of Sampling Statistics**: Sample Mean, Central Limit Theorem, Distribution of the sample mean, Sample size needed, Sampling proportions from a finite population; Probabilities associated with sample proportions. **Estimation** : Point estimator of a population mean, population proportion, Estimating a population variance,.(Ch.6, 7, 8)

Unit- III

Testing Statistical Hypotheses: Hypothesis tests and Significance levels, Tests concerning the mean of a Normal population: Case of known variance, One-sided tests; the t-test for the meanof a Normal population: Case of unknown variance, Hypothesis Tests Concerning Population Proportions. Two-Sided Tests of p. **Hypothesis Tests Concerning Two Populations**:Testing equality of means of two Normal populations: Case of known and unknown variances and large Sample sizes, Testing equality of means: Small - sample tests when the unknown population variances are equal, Paired-sample t-test, Testing equality of population proportions. Problems on related.(Ch.9, 10)

Unit- IV

Chi-Squared Goodness of Fit Tests: Chi-Squared Goodness of fit Tests, Testing for independence in Populations classified according to two characteristics, Testing for independence in contingency tables with fixed marginal totals. Analysis of Variance: Introduction, One-factor and two factor Analysis of Variances, Parameter estimation, Degrees of freedom, Testing hypotheses. (ch11, 12)

Text Book: Introductory Statistics by Sheldon M. Ross (2010), Academic Press, Elsevier, 3rd Edition. (chapters4 to 12).

References:

1. **Introduction to Probability Models** by Sheldon M. Ross (2010), Academic Press, Elsevier,10th Edition. (chapters 4 to 13).

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M 304 (B) **Semester-III**

Paper-IV (B) : Advanced Complex Analysis

Unit- I

Convergence of Sequences - Convergence of Series - Taylor Series - Laurent Series - Absolute and Uniform Convergence of Power Series – Continuity of sums of power series- Uniqueness of series representation.

Unit – II

Residues - Cauchy's Residue Theorem – Using a single residues - The Three Types of Isolated Singular Points - Residues at Poles- Examples - Zeros of Analytic Functions - Zeros and Poles - Behavior of Functions Near IsolatedSingular Points.

Unit- III

Evaluation of Improper Integrals - Improper Integrals from Fourier Analysis - Jordan's Lemma – Indented paths - Definite Integrals Involving Sines and Cosines - Argument Principle - Rouche's Theorem.

Unit- IV

Linear Transformations - The Transformation $w = 1/z$ - Mappings by $w = 1/z$ - Linear Fractional Transformations - An Implicit Form – Mapping of the upper half plane – The transformation w=sin z, Mapping by z^2.

Text Book:

[1] Complex Variable and Application (8^{th} Edition) by James ward Brown, Ruel V. Churchill Mc Graw Hall Int. Edition.

References:

1. **Complex Analysis** by Dennis G. Gill.
2. **Complex Analysis** by Steven G. Krantz.
3. **Complex Variables with Applications** by S. Ponnusamy, Herb Silverman.
4. **Complex Analysis** by Joseph Bak, Donald J. Newman.

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M 304 (C) **Semester-III**

Paper-IV (C) : Mechanics

Unit- I

Dynamics of systems of Particles: Introduction - Centre of Mass and Linear Momentum of a system

- Angular momentum and Kinetic Energy of a system, Centre of mass of Rigid body, symmetry considerations(Solid hemisphere,Hemispherical shell,Semicircle, Semicircular lamina), Rotation ofa Rigid body about a fixed axis, Moment of Inertia, calculation of moment of Inertia, Perpendicular axis theorem for plane lamina,Parallel axis theorem for any rigid body, Radius of Gyration. (7.1, 7.2, 8.1, 8.2, 8.3 of [1])

Unit- II

Physical pendulum - Angular momentum Laminar Motion of a Rigid body in Laminar motion.Body rolling down an inclined plane. Motion of Rigid bodies in three dimension – Rotation of rigid body about an arbitrary axis,moments and products of inertia. (8.4, 8.5, 8.6, 9.1 of [1])

Unit- III

Angular momentum vector, Rotational kinetic energy of a rigid body, principles axes of a rigid body, Determination of the other two principal axes when one is known, Determining principal axes by diagonalizing the moment of inertia matrix, Dynamics of a particle in a rotating coordinate system. Euler's equation of motion of a Rigid body , Free rotation of a rigid body, Free rotationof a rigid body. (9.2, 5.2, 9.3, 9.4 of [1])

Unit- IV

Hamilton's variational principle-An example,Generalized Coordinates, Lagrange's Equations of motion for conservative systems, applications of Lagrange's equations, Generalized momenta,Ignorable coordinates, D'Alembert Principle-Generalised forces, Hamilton function - Hamilton's Equations. (10.1, 10.2, 10.4, 10.5, 10.6, 10.8, 10.9 of [1])

Text Book:

Analytical Mechanics by G.R.Fowles G.L Cassiday, Cengage Learning , 7th edition.

References:

Classical Mechanics by Herbert Goldstein, Charles P.Poole and JhonSafko, Pearson pub.

Principles Of Mechanics by Synge J. L. and B.A. Griffith, McGraw Hill, 3rd edition.

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M 305 (A) **Semester-III**

Paper-V(A): Operations Research

Unit- I

Formulation of Linear Programming problems, Graphical solution of Linear Programming problem,Convex set,General formulation of Linear Programming problems, Standard and Matrix forms of Linear Programming problems,Simplex Method, Two-phase method, Big-M method, Method to resolve degeneracy in Linear Programming problem, Alternative optimal solutions.

Unit- II

Solution of simultaneous equations by Simplex Method, Inverse of a Matrix by Simplex Method,Revised Simplex Method,Concept of Duality in Linear Programming, Comparison of solutions of the Dualand its primal

Unit- III

Mathematical formulation of Transportation problem, Tabular representation, Methods to find initial basic feasible solution, North West corner rule, Lowest cost entry method, Vogel's approximation method, Optimality test, Method of finding optimal solution, Degeneracy in transportation problem,

Method to resolve degeneracy, Unbalanced transportation problem. Mathematical formulation of Assignment problem, Reduction theorem, Hungarian Assignment Method, Travelling salesman problem, Formulation of Travelling Salesman problem as an Assignment problem, Solution procedure

Unit- IV

Concept of Dynamic programming, Bellman's principle of optimality, characteristics of Dynamic programming problem,Backward and Forward recursive approach,Minimum path problem,Single Additive constraint and Multiplicatively separable return, Single Additive constraint and Additively separable return, Single Multiplicatively constraint and Additively separable return.

Text Book:

Operations Research by S.D.Sharma, 18th Revised Edition 2017, KedarNath Ram NathPublications.

References:

1. **Operations Research – An Introduction** by Hamdy A. Taha, 10th Edition.
2. **Linear Programming** by G.Hadley.

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M 305 (B) **Semester-III**

Paper-V(B): Graph Theory

Unit- I

Basics of Graph Theory: Graphs, isomorphism, subgraphs, matrix representations, degree,operations on graphs, degree sequences.

Connected graphs and shortest paths: Walks, trails, paths, connected graphs, distance, cut-vertices, cut edges, blocks,connectivity, weighted graphs, shortest path algorithms.

Unit- II

Trees: Characterizations, number of trees, minimums panning trees.

Special classes of graphs: Bipartite graphs, line graphs, chordal graphs.

Eulerian graphs: Characterization, Fleury's algorithm, chinese - postman - problem.

Hamilton graphs: Necessary conditions and sufficient conditions

Unit- III

Independent sets, coverings, matchings: Basic equations, matchings in bipartite graphs,perfect matchings, greedy and approximation algorithms.

Vertex colorings: Chromatic number and cliques, greedy coloring algorithm, coloring of chordalgraphs, Brook's theorem.

Edge colorings: Gupta - Vizing theorem, Class-1 graphs and class-2 graphs, equitable edge -coloring.

Unit- IV

Planar graphs: Basic concepts, Eulers formula, polyhedrons and planar graphs, characterizations,planarity testing, 5-color-theorem.

Directed graphs: Out-degree, in- degree, connectivity, orientation, Euleri and irected graphs,Hamiltondi - rected graphs, tournaments.

Text Book:

Graph Theory with Applications by J.A.Bondy and U.S.R.Murty. (Freely downloadablefrom Bondy's web site; Google - Bondy).

Introduction to Graph Theory by D.B. West, Prentice-Hall of India/Pearson, 2009 (latestimpression).

References:

1. **Graph Theory** by J.A.Bondy and U.S.R.Murty, Springer, 2008.
2. **Graph Theory** by R.Diestel, Springer(low price edition), 2000.

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M 305 (C) **Semester-III**

Paper-V(C): Finite Difference Methods

Unit- I

Partial Differential Equations: Introduction - Classification of Second order Partial Differential Equations PDE's - Difference Methods - Routh Hurwitz criterion - Domain of Dependence of Hyperbolic Equations. (1.1 to 1.4)

Unit- II

Difference Methods for Parabolic Partial Differential Equations : Introduction – One Space Dimension - Two Space Dimensions - Spherical and Cylindrical Coordinate System. (2.1 to2.3, 2.5, 2.6).

Unit- III

Difference Methods for Hyperbolic Partial Differential Equations: Introduction - One Space Dimensions - Two Space Dimensions - System of First order equations.(3.1 to 3.5).

Unit- IV

Numerical Methods for Elliptic Partial Differential Equations: Introduction - Difference Methods for linear boundary value problems - General second order linear equation - Equation in polar coordinates.(4.1 to 4.5).

Text Book:

Computational Methods for Partial Differential Equations by M.K.Jain, S.R.K.Iyengar, R.K.Jain, Wiley Eastern Limited, New Age International(P) Limited, New Delhi.

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M 401 **Semester-IV**

Paper-I: Integral Equations and Calculus of Variations

Unit- I

Volterra Integral Equations: Basic concepts - Relationship between Linear differential equations and Volterra Integral equations - Resolvent Kernel of Volterra Integral equation. Differentiation of some resolvent kernels - Solution of Integral equation by Resolvent Kernel - The method of successive approximations - Convolution type equations - Solution of Integro-differential equations with the aid of the Laplace Transformation – Volterra integral equation of the first kind-Euler integrals-Abel's problem-Abel's integral equation and its generalizations.

Unit- II

Fredholm Integral Equations : Fredholm integral equations of the second kind – Fundamentals

The Method of Fredholm Determinants - Iterated Kernels constructing the Resolvent Kernel with the aid of Iterated Kernels - Integral equations with Degenerated Kernels. Hammerstein type equation – Characteristic numbers and Eigen function and its properties.

Green's function :Construction of Green's function for ordinary differential equations-Special case of Green's function –Using Green's function in the solution of boundary value problem.

CALCULS OF VARIATIONS:

Unit- III

Introduction – The Method of Variations in Problems with fixed Boundaries: Definitions of Functionals –Variation and Its properties - Euler's'equation- Fundamental Lemma of Calculus of Variation – The problem of minimum surface of revolution - Minimum Energy Problem Brachistochrone Problem - Variational problems involving Several functions - Functional dependent on higher order derivatives - Euler Poisson equation.

Unit- IV

Functional dependent on the functions of several independent variables - Euler's equations in two dependent variables – Variational problems in parametric form-Applications of Calculus of Variation-Hamilton's principle - Lagrange's Equation,Hamilton's equations.

Text Book:

1. Problems and Exercises in Integral Equations by M.KRASNOV, A.KISELEV, G.MAKARENKO,(1971).
2. Integral Equations by S.Swarup, (2008).
3. Differential Equations and The Calculus of Variations by L.ELSGOLTS, MIR Publishers,MOSCOW.
4. Analytical Mechanics by Grant R. Fowles and George L. Cassiday, 7Th Edition.

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M 402 **Semester-IV**

Paper-II: Elementary Operator Theory

Unit- I

Spectral theory in finite dimensional normed spaces - Basic concepts of spectrum - Spectral properties of bounded linear operators –Further properties of resolvent and spectrum. (Sections7.1,7.2, 7.3 and 7.4 of [1]).

Unit- II

Compact linear operators on normed spaces - Further properties of compact linear operators - Spectral properties of compact linear operators on normed spaces-Operator equations involving compact linear operators. (Sections 8.1, 8.2, 8.3 and 8.5 of [1]).

Unit- III

Spectral properties of bounded self adjoint linear operators - Further spectral properties of bounded linear operators – Positive operators –Square root of a positive operator. (Sections 9.1, 9.2, 9.3 and 9.4 of [1])

Unit- IV

Projection operators - Properties of projection operators - Spectral family - Spectral family of a bounded self adjoint linear operator. (Sections 9.5, 9.6, 9.7 and 9.8 of [1])

Text Book:

Introductory Functional Analysis by E.Kreyszig, John Wiley and Sons, New York, 1978.

References:

Elements of Functional Analysis by Brown and Page, D.V.N. Comp.

Functional Analysis by B.V. Limaye, Wiley Eastern Limited,(2nd Edition).

A Hilbert Space Problem Book by P.R.Halmos, D.VanNostrand Company,Inc.1967.

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M 403 Semester-IV

Paper-III: Partial Differential Equations

Unit- I

First order Nonlinear Equations, Cauchy's method of Characteristics, compatible systems of first order equations, Charpit's method, Special types of first order equations.

Unit- II

Higher order Linear Partial Differential Equations with constant coefficients, Homogeneous Partial Differential Equations with constant coefficients, Classification of second order Partial Differential Equations, Canonical forms, Canonical form for hyperbolic, parabolic and elliptic equations.

Unit- III

Fourier Transforms : Fourier Integral Representations, Fourier Transforms Pairs, Fourier Transform

of Elementary Functions, Properties of Fourier Transform, Convolution theorem, Parseval's Relation,Transformof Dirac Delta Function, Finite Fourier Transforms.

Unit- IV

Solution of diffusion, wave and Laplace equations by using Fourier transforms and Separation of Variables Methods, D'Alembert's solution of wave equation, Dirichlet problem and Neumann problem.

Text Book:

Introdction to Partial Differential Equations by K. Shankar Rao, PHI, Third Edition.

References:

1. **Elements of Partial Differential Equations** by Ian Sneddon, Mc.Graw-Hill InternationalEdition.
2. **Partial Differential Equations** by Lawrence C. Evans, American Mathematical Society.

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M 404 (A) **Semester-IV**

Paper-IV(A): Analytical Number Theory

Unit- I

Averages of arithmetical function : The big oh notation- Asymptotic equality of functions- Euler summation formula- Some asymptotic formulas- The average order of $d(n)$- The average order of the divisor functions $\sigma(n)$ – The average order of $\phi(n)$ - An application to the distribution of lattice points visibletr on a the origin-The average order of $\mu(n)$ and $\Lambda(n)$ - The partial sumsof dirichlet product- Applications to $\mu(n)$ and $\Lambda(n)$ - Another identity for the partial sums of a dirichlet product.(Sections 3.1 to 3.12).

Unit- II

Some elementary theorems on the distribution of prime numbers- Introduction chebyshev's functions

- $\chi(x)$ and $\theta(x)$ - Relation connecting $\theta(n)$ and $\pi(n)$ - Some equivalent forms of the prime number theorem - Inequalities for $\pi(n)$ and p_n. (Sections 4.1 to 4.5)

Unit- III

Shapiro's Tauberian theorem – Applications of shapiro's theorem Anasymptotic formula for the partial sums $1/p$ - The partial sums of the mobins function - Selberg Asymptotic formula.(Sections

4.6 to 4.11 except 4.10)

Unit- IV

Finite Abelian groups and their character: Construction of sub groups - Characters of finite abelian group-The character group- The orthogonality relations for characters Dirichlet characters- Sums involving dirichelt characters the non vanishing of $L(1, \chi)$ for real non principal χ. (Sections 6.4to 6.10)

Text Book:

An Introduction to Analytic Number Theory by Tom M.Apostol - Springer.

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M 404 (B) **Semester-IV**

Paper-IV (B) : Differential Geometry

Unit I

Space Curves, Tangent Line, Contact of order of a curve and a surface, Osculating Plane, Principal normal, Binormal, Torsion - Curvature - Serret - Frenet formulae - Examples thereon, The Osculating Circle - Osculating Sphere - Helices Involutes and Evolutes - Examples thereon.

Unit II

Curves on Surfaces tangent plane - Normal, Parametric curves, First order magnitudes - Second order magnitudes - Direction coefficients - Double family of curves, Curvature of normal section - Meunier's theorem - Examples thereon.

Unit III

Principal directions and curvatures - First curvatures Gaussian curvatures, Euler's theorem. The surface $z = f(x, y)$, Surface of revolution - Examples thereon, Geodesics, Normal property of Geodesics - Geodesics curvature, Torsion - Joachimsthal Theorem.

Unit-IV

Envelops characteristics - Edge of regression - Developable surfaces - Osculating developable - Polar developable - Rectifying developable, Envelopes - Characteristic points - Examples thereon.

Text Book:

C.E. Wedderburn, Differential Geometry of three dimensions, (E.L.B.S.Edition,1964).

References:

[1] T.J. Willmore, An Introduction to differential geometry (Oxford University press), 11th Edition, New Delhi,1993.

[2] Mittal and Agarwal, Differential Geometry (Krishna Prakashan Media (P) Ltd.) 12th Edition.

[3] Bansi Lal, Three dimensional differential geometry, Atma Ram Publisher.

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M 404 (C) **Semester-IV**

Paper-IV (C) : Fluid Mechanics

Unit I

General Orthogonal Curvilinear Coordinates: Definition - Kinematics of fluids in motion: Real fluids and ideal fluids - velocity of a fluid at a point - Lagrangian and Eulerian Methods - Stream lines, Path lines and Streak lines - Steady and Unsteady flows - The velocity potential - the vorticity vector - Local and particle rates of change - Acceleration of fluid - The Equation of Continuity (Vector and Cartesian form) - Conditions at a Rigid Boundary.

Unit II

Equations of Motion of Fluid: Euler's equations of motion (Vector and Cartesian form) - Lagrange's equations of Motion - Equation in one dimensional flow problems: Bernoulli's Theorem - Applications of the Bernoulli Theorem - Kelvins circulation theorem.

Unit III

Some Two Dimensional Flows: The complex potential - Irrotational motion - Velocity potential - Stream function - physical meaning of Stream function - Source, Sinks and Doublets and their Images - Milne Thomson Circle Theorem - The Theorem of Blasius.

Unit-IV

Irrotational Motion in Two Dimensions: Two-dimensional Irrotational motion produced by motion of circular cylinder, two coaxial cylinders. Equations of motion of a circular cylinder.

Text Books:

[1] FRANK CHORLTON, **Textbook of Fluid Dynamics**, CBS-Publishers, New Delhi, India.

[2] W.H.BESANT and A.S.RAMSEY, **A Treatise on Hydro-Mechanics (Part-II)**, CBS-Publishers, New Delhi, India.

[3] M.D.RAISINGHANIA, **Fluid Dynamics** S.Chand & Company, New Delhi.

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M 405 (A) **Semester-IV**

Paper V (A) : INTEGRAL TRANSFORMS

Unit-I

Fourier Transforms: Introduction - Classes of functions - Fourier Series and Fourier Integral Formula - Fourier Transforms - Fourier sine and cosine Transforms - Linearity property - Change of Scale property - Shifting property - The Modulation theorem - Evaluation of integrals by means of inversion theorems - Fourier Transform of some particular functions - Convolution or Faltung of two integrable functions - Convolution or Falting or Faltung Theorem for FT – Parseval's relations - Fourier Transform of the derivative of a function - Fourier Transform of some more useful functions - Fourier Transforms of Rational Functions - Other important examples concerning derivative of FT - The solution of Integral Equations of Convolution Type - Fourier Transform of Functions of several variables - Application of Fourier Transform to Boundary Value Problems.

Unit II

Laplace Transforms: Introduction - Definitions - Sufficient conditions for existence of Laplace Transform - Linearity property of Laplace Transform - Laplace transforms of some elementary functions - First shift theorem - Second shift theorem - The change of scale property - Examples - Laplace Transform of derivatives of a function - Laplace Transform of Integral of a function - Laplace Transform of tnf(t)- Laplace Transform
of f(t)/t - Laplace Transform of a periodic function - The Initial-Value Theorem and the Final-Value Theorem of Laplace Transform - Examples - Laplace Transform of some special functions - The Convolution of two functions - Applications.

Unit III

Inverse Laplace Transforms & Applications: Introduction - Calculation of Laplace inversion of some elementary functions - Method of expansion into partial fractions of the ratio of two - The general evaluation technique of inverse Laplace transform - Application of Laplace Transforms.
Finite Laplace Transforms: Introduction - Definition of Finite Laplace Transform - Finite Laplace Transform of elementary functions - Operational Properties - The Initial Value and the Final Value Theorem - Applications.

Unit-IV

The Mellin Transform: Introduction - Definition of Mellin Transform - Mellin Transform of derivative ofa function - Mellin Transform of Integral of a function - Mellin Inversion theorem - Convolution theorem of Mellin Transform - Illustrative solved Examples - Solution of Integral equations - Application to Summation of Series - The Generalised Mellin Transform - Convolution of generalised Mellin Transform - Finite Mellin Transform. The Z-Transform: Introduction - Transform: Definition - Some Operational Properties of Z-Transform - Application of Z-Transforms.

Text Book:

[1] An Introduction to Integral Transforms by Baidyanath Patra, CRC Press, Taylor Francis Group.

References:

[1] Integral Transforms by A.R.Vasishta and R.K.Guptha

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M 405 (B) **Semester-IV**

Paper-V(B): Cryptography

Unit- I

Simple substitution ciphers; Divisibility and greatest common divisors Modular arithmetic; Prime numbers, unique factorisation, and finite fields; Powers and primitive roots in finite fields; Cryptographybefore the computer age; Symmetric and asymmetric ciphers.

Unit- II

The birth of public key cryptography, The discrete logarithm problem Diffie – Hell mankey exchange, The ElGamal public key crypto system, An overview of the theory of groups, Howhard is the discrete logarithm problem?, A collision algorithm for the DLP.

Unit- III

The Chinese remainder theorem, The Pohlig-Hellman algorithm, Rings, quotients, polynomials, and finite fields, Euler's formula and roots modulo *pq*, Primality testing.

Unit- IV

Elliptic curves, Elliptic curves over finite fields, The elliptic curve discrete logarithm problem, Elliptic curve cryptography.

Text Book:

Mathematical Cryptography by Jeffrey Hoffstein, JillPipher, JosephH.Silverman.

References:

1. **Fundamental Principles and Applications** by Everyday Cryptography, Keith Martin.
2. **Cryptography: An Introduction** by N.P.Smart.

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M 405 (C) **Semester-IV**

Paper-V(C): Advanced Operations Research

Unit I

Characteristics of Game theory – Minimax (Maxmin) criterion and optimal strategy- Saddle points - Solution of Games with saddle points- Rectangular Games without saddle points - Minimax(Maxmin) principle for Mixed strategy Games - Equivalence of Rectangular Game and Linear programming problem - Solution of (m×n) Games by Simplex method-Arithmetic method for (2×2) Games - concept of Dominance - Graphical method for (3 × 3)Games without saddle point.

Unit II

Inventory Problems: Analytical structure of inventory Problem, ABC analysis, EOQ Problems with and without shortage, with (a) Production is instantaneous (b) finite constant rate (c) shortage permitted random models where the demand follows uniform distribution.

Unit III

Non - Linear programming-unconstrained problems of Maxima and Minima - constrained problems of Maxima and Minima - Constraints in the form of Equations – Lagrangian Method-Sufficient conditions for Max(Min) of Objective function with single equality constraint – With more than one equality constraints - Constraints in the form of Inequalities - Formulation of Non - Linear programming problems - General Nonlinear programming problem - Canonical form - Graphical Solution

Unit-IV

Quadratic programming - Kuhn-Tucker Conditions - Non-negative constraints, General quadratic programming problem - Wolfe's modified simplex method-Beales's Method - Simplex method for quadratic Programming.

Text Books:

[1] S.D. Sharma, Operations Research.

[2] Kanti Swarup, P. K. Gupta and Manmohan, Operations Research.

[3] O.L. Mangasarian, Non-Linear Programming, McGraw Hill, New Delhi.

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FACULTY OF SCIENCE

M.SC. (CBCS) I/II SEMESTER EXAMINATIONS, 2023 - 2024

MATHEMATICS

PAPER

TITLE OF THE PAPER

Time: 3 Hrs **Max Marks: 60**

Section – A (Short Answer Questions)

Marks: 5×4=20

Note: Answer the following Questions shortly. Each question carries equal marks.

1)

2)

3)

4)

5)

Sections – B (Essay answer Questions)

Marks: 5×8=40

Note: Answer the following Questions. Each question carries equal marks.

6)a)

(OR)

b)

7)a)

(OR)

b)

8)a)

(OR)

b)

9)a)

(OR)

b)

10)a)

(OR)

b)

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