HINDI MAHAVIDYALAYA

(AUTONOMOUS & NAAC RE-ACCREDITED)
(Affiliated to Osmania University)
Nallakunta, Hyderabad-44

BOARD OF STUDIES
DEPARTMENT OF MATHEMATICS
M.Sc. Mathematics
2nd YEAR
2020-2021

HINDI MAHAVIDYALAYA

(AUTONOMOUS & NAAC RE-ACCREDITED)
(Affiliated to Osmania University)
Nallakunta, Hyderabad-44

DEPARTMENT OF MATHEMATICS

M.Sc. Mathematics

2nd YEAR

2020-2021

HINDI MAHAVIDYALAYA

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Nallakunta, Hyderabad-44

DEPARTMENT OF MATHEMATICS
M.Sc. Mathematics

(BOS – MEETING on 04 – 01 - 2021)

SYLLABUS, MODEL PAPER
PANEL OF EXAMINERS etc…

For the Academic Year
2020-2021

HINDI MAHAVIDYALAYA
NALLAKUNTA, HYDERABAD
(AUTONOMOUS)

COMPOSITION OF THE BOARD OF STUDIES IN AN AUTONOMOUS COLLEGE

I. Composition: Department of Mathematics

1. Head of the Department concerned (Chairperson)
   Smt. G. Sreevani HOD, Department of Mathematics
2. The entire faculty of each specialization
   1. Smt. T.S. Rama devi
   2. Mr. M.Sudhakar
   3. Mr. T. Thirupathaiah
3. One expert to be nominated by the Vice Chancellor from a panel of six recommended by the College Principal
   1. Prof. B.Surender Reddy, Ex – Officio Member & Chairperson, BOS, Dept. of Mathematics, Osmania University, Hyderabad.
4. Two experts on the subject from outside the college to be nominated by the Academic Council.
   1. Dr. N.Kishan, Department of Mathematics, Osmania University, Hyderabad.
   2. Dr. M.A. Srinivas , Department of Mathematics , JNTU, Hyderabad.
5. One postgraduate meritorious alumnus to be nominated by the Principal. The Chairman, Board of Studies, may with the approval of the Principal of the College.

(a) Experts from outside the College whenever special courses of studies are to be formulated. -To be nominated.
(b) Other members of staff of the same faculty.

Chairperson	University Nominee	Members	Principal
	Chairperson Board of Studies in Mathematics Department of Mathematics Osmania University Hyderabad-500 007.	1. 2.	

Dr. Naikoti Kishan
Professor of Mathematics
Department of Mathematics
Osmania University
Hyderabad-500 007.

2) HOD, Mathematics
JNTU Hyderabad

HINDI MAHAVIDYALAYA , NALLAKUNTA, HYDERABAD
(AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
BOARD OF STUDIES
Academic Year – 2020-2021
Minutes of BOS Meeting

BOS meeting of the Department of Mathematics was held on 04 – 01 – 2021 .
The following members were present

Prof. B.Surender Reddy	-	Ex – Officio Member & University Nominee
Smt. G. Sreevani	-	Chair person
Prof.N.Kishan	-	Member of BOS
Dr. M.A. Srinivas	-	Member of BOS

1. Welcome address by the chair

The chair welcomed the University Nominee, Chairperson BOS, O.U. Department of Mathematics and Member of B.O.S.

2. Previous Meeting details

The CBCS system has been introduced by Osmania University from 2019 -20. The theory and Seminar syllabus of I & II years of M.Sc. Mathematics question paper pattern for theory, internal assessment pattern and panel of examiners were discussed and approved by all the BOS Members in previous BOS meeting.

3. Discussion and Distribution of Common Core Syllabus for semester III and IV.

i. Members were informed by the chair that Department of Mathematics, Hindi Mahavidyalaya is following common core syllabus prescribed by Osmania University M.Sc. II YEAR in III and IV semesters.
ii. The syllabus comprises of 4 units.
iii. Syllabus copy for both the semesters is enclosed.
iv. Syllabus was approved by the Members of BOS.

4. Marks allotted for Internal and end Semester exams.

1. Internal assessment are of 15 marks and these are either offline or online test, where in one Internal Assessment students have to answer 25 (10 MCQ, 10 FIB and 5 SAQ) in 45 minute and other Internal Assessment students have to answer Three Questions out of Five Questions each question carries 5 marks. In each Semester two internal assessments of 15 Marks will be conducted and an average of both the internal assessments and Assignment 5 Marks will be added in the marks of theory exam.
2. Theory Question paper is of 80 marks.
3. Total allotted marks are 100 for each theory paper

The distribution of marks was approved by the Members of BOS.

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Hyderabad-500 007.

Dr. Naikoti Kishan
Professor of Mathematics
Department of Mathematics
Osmania University
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5. Discussion on Pattern and Model Paper of Semester exam and Model Paper of Internal Assessment Exams

1. It was informed by the department that in each Semester Two Internal exams will be conducted for 15 marks. One internal assessment will have **THREE** sections.

Section – A 10 MCQs 10 x ½ = 5 M
Section – B 10 FIBs 10 x ½ = 5 M
Section – C 5 SAQs 5 x 1 = 5 M

And other Internal Assessment will have only one section, Section A contains **FIVE** Questions. The student has to answer **THREE** questions. Each Question carries 5 Marks (3 X 5 = 15 Marks)

Average of marks of these two internal exams will be taken.

2. Semester exam will be conducted as per the Almanac which will be provided by the exam branch. Internal exam duration will be 45 Min. and Semester exam duration will be of 3 hrs.

3. Model Question paper for Semester III and Semester IV was discussed. Theory paper for each Semester will have 2 sections.

i) Section A contains 8 short Questions. The student has to answer All questions. Each Question carries 4 Marks (8X4=32 Marks)

ii) Section B contains 4 Essay type Questions with internal choice. Each Question Carries 12 Marks (4X12=48 Marks)

6. Panel of Examiners

The panel of examiners was approved by the members.

- List is enclosed

7. Any other matter.

8. Vote of Thanks

Meeting concluded with the Vote of Thanks by Smt. G Sreevani.

Chairperson **University Nominee** **Members** **Principal**

1.

2.

Dr. Naikoti Kishan
Professor of Mathematics
Department of Mathematics
Osmania University
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HINDI MAHAVIDYALAYA

(AUTONOMOUS & NAAC RE-ACCREDITED)
BOARD OF STUDIES

DEPARTMENT OF MATHEMATICS

Chairperson
Smt. G. Sreevani
Head-Department of Mathematics
Hindi Mahavidyalaya
Nallakunta, Hyderabad

University Nominee
Prof. B.Surender Reddy
Ex – Officio Member and Chairman-BOS
Department of Mathematics
Osmania University, Hyderabad

Osmania University
Hyderabad-500 007.

Members of BOS

1. Prof. N Kishan
   Department of Mathematics
   Osmania University, Hyderabad

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Professor of Mathematics
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2. Prof. M.A. Srinivas
   Department of Mathematics
   JNTU, Hyderabad

Faculty of Mathematics Department

3. Sri. M.Sudhakar
   Lecturer, Department of Mathematics
   Hindi Mahavidyalaya
   Nallakunta, Hyderabad

4. Smt. T.Ramadevi
   Lecturer, Department of Mathematics
   Hindi Mahavidyalaya
   Nallakunta, Hyderabad

5. Sri. Thirupathaiah
   Lecturer, Department of Mathematics
   Hindi Mahavidyalaya
   Nallakunta, Hyderabad

HINDI MAHAVIDYALAYA
NALLAKUNTA, HYDERABAD
(AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
AGENDA OF THE MEETING

1. Welcome address by the chair.
2. Previous Meeting Details.
3. Details of choice based credit system.
4. Discussion and Distribution of Common Core Syllabus for the Semester (III and IV)
5. Marks allotted for internal and end semester exams.
6. Discussion on Pattern and model paper of Semester Exam and internal exam for all the Semester (III and IV)
7. Panel of Examiners
8. Any other matter
9. Vote of thanks

Chairperson **University Nominee** **Members** **Principal**

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DEPARTMENT OF MATHEMATICS

M.Sc. MATHEMATICS

SCHEME OF INSTRUCTION
AND
EXAMINATION
(THEORY AND SEMINARS)

HINDI MAHAVIDYALAYA

(AUTONOMOUS & NAAC RE-ACCREDITED)
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DEPARTMENT OF MATHEMATICS

M.Sc. MATHEMATICS

SECOND YEAR

With effect from batch of students admitted from the Academic Year

2019-2020

under CBCS semester system

HINDI MAHAVIDYALAYA

(AUTONOMOUS & NAAC RE-ACCREDITED)
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Nallakunta, Hyderabad-44
M.SC. MATHEMATICS
Choice Based Credit System(CBCS)

Semester - III

S.No.	Code No	Paper	Paper Title	Hrs/ Week	Theory	T*	Continuous Evaluation	Semester End Exam	Total Marks	Credits
	Theory						Internal Assessment			
1	MM 301	I	Functional Analysis	6	5	1	20	80	100	5
2	MM 302	II	General Measure & Integration	6	5	1	20	80	100	5
3	MM 303	III	Linear Algebra	6	5	1	20	80	100	5
4	MM 304A	IV	Operation Research	6	5	1	20	80	100	5
	MM 304B		Mathematical Statistics							
	MM 304C		Advanced Complex Analysis							
5	MM 305A	V	Mechanics	5	4	1	20	80	100	4
	MM 305B		Numerical Analysis							
	MM 305C		Differential Geometry							
6			Seminar	2	2		5	20	25	1
			Total	31					525	25

T*-Tutorial Class for problems solving session.

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M.SC. MATHEMATICS

Choice Based Credit System (CBCS)

Semester - IV

S.No.	Code No	Paper	Paper Title	Hrs/ Week	Theory	T*	Continuous Evaluation Internal Assessment	Semester End Exam	Total Marks	Credits
	Theory									
1	MM 401	I	Integral Equations & Calculus of Variation	6	5	1	20	80	100	5
2	MM 402	II	Elementary Operator Theory	6	5	1	20	80	100	5
3	MM 403	III	Analytic Number Theory	6	5	1	20	80	100	5
4	MM 404A	IV	Integral Transforms	6	5	1	20	80	100	5
	MM 404B		Graph Theory							
	MM 404C		Cryptography							
5	MM 405A	V	Fluid Mechanics	5	4	1	20	80	100	4
	MM 405B		Advanced Operation Research							
	MM 405C		Finite Difference Methods							
6			Seminar	2	2		5	20	25	1
			Total	31					525	25

T*-Tutorial Class for problems solving

Chairperson **University Nominee** **Members** **Principal**

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DEPARTMENT OF MATHEMATICS

M.Sc. Mathematics

Semester III

SYLLABUS

HINDI MAHAVIDYALAYA, NALLAKUNTA, HYDERABAD
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BOS-DEPARTMENT OF MATHEMATICS
M.SC. MATHEMATICS

M 301 **SEMESTER – III** **Credits: 5**

PAPER – I: FUNCTIONAL ANALYSIS

Objective:

1) This is the basic course for all Advance Analysis courses. Students are introduced to different function spaces like Banach Spaces, Hilbert Spaces etc.
2) Students will also be exposed to Bounded Linear Operators on Banach Spaces and its spectral Analysis and unbounded operators.

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, 2.7].

Unit II

Linear Functionals - normed spaces of operators - Dual space - Inner productspace - 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- Category Theorem - Uniform Boundedness Theorem - Open Mapping Theorem - Closed Linear Operators - Closed Graph Theorem. [4.2,4.3,4.5,4.7,4.12 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 Editi0n.

Expected Outcome: On successful completion of the course, students can opt for courses like Operator Theory, Spectral Theory, and Representation Theory etc.

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BOS-DEPARTMENT OF MATHEMATICS
M.SC. MATHEMATICS

M 302 **SEMESTER – III** **Credits: 5**

PAPER – II: GENERAL MEASURE & INTEGRATION

Objectives:

1) Measure Theory formalizes and generalizes the notion of integration.

2) It is fundamental to many areas of mathematics and probability and has applications in other fields such as physics and economics. Students will be introduced to Lebesgue measure and integration, signed measures, the Hahn-Jordan decomposition, the Radon-Nikodym derivative, conditional expectation, Borel sets and standard Borel spaces, product measures, and the Riesz representation theorem.

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

Unit II
Signed measures - The Radon - Nikodyn 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.

Outcomes:

1) After completing this subject, students will understand the fundamentals of measure theory and be acquainted with the proofs of the fundamentaltheorems underlying the theory of integration.
2) They will also have an understanding of how these underpin the use of mathematical concepts such as volume, area, and integration and they will develop a perspective on the broader impact of measure theory in Ergodic theory and have the ability to pursue further studies in this and related areas.

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M.SC. MATHEMATICS

M 303 **SEMESTER – III** **Credits: 5**

PAPER – III: LINEAR ALGEBRA

Objectives:

1) How to analyze and solve a linear system of equations.
2) Important characteristics of matrices, such as its four fundamental subspaces, rank, determinant, eigen values and eigenvectors, different factorizations, etc.
3) How to use characteristics of a matrix to solve a linear system of equations or study properties of a linear transformation; • important concepts of vector spaces such as independence, basis, dimensions, orthogonality.

Unit I

Elementary Canonical forms Introduction, Characteristic Values, Annihilating Polynomials, Invariant Subspaces, Simultaneous Triangulation and Simultaneous Diagonalization (Ch6, Sec 6.1 - 6.5).

Unit II

Direct sum Decomposition, Invariant Direct sums, The Primary Decomposition Theorem (Ch6, Sec6.6 - 6.8). The Rational and Jordan Forms: Cyclic Subspaces and Annihilators(Ch7, Sec 7.1)

Unit III

Cyclic Decompositions and the Rational Form, The Jordan Form, Computation of Invariant Factors, Semi Simple Operators (Ch7, Sec 7.2 - 7.5)

Unit-IV

Bilinear Forms: Bilinear Forms, Symmetric Bilinear Forms, Skew - Symmetric Bilinear Forms, Groups Preserving Bilinear Forms (Ch10, Sec 10.1 - 10.4)

Text Book: Linear Algebra by Kenneth Hoffman and Ray Kunze (2e) PHI

References: [1] Advanced Linear Algebra by Steven Roman (3e)
[2] Linear Algebra by David C Lay
[3] Linear Algebra by Kuldeep Singh

Outcomes:

1) Determine the existence and uniqueness of the solution of a linear system, A~x =~b and find all solutions by choosing an effective method such as Gaussian elimination, inverting A, a suitable factorization or diagonalization of A, et.;
2) Find the dimension and basis of a a given vector space.
3) Write down the matrix representing a linear transformation (such as projection, rotation, dilation, etc.) under a given basis, and determine how the matrix changes if the basis is changed.
4) Find the Gram-Schmidt orthogonalization of a matrix.
5) Determine the rank, determinant, eigenvalues and eigenvectors, diagonalization, and different factorizations of a matrix.

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M 304A **SEMESTER – III** **Credits: 5**

PAPER – IV : OPERATIONS RESEARCH

Objective:

1) The objective of this course is to familiarize the industrial problems to students with various methods of solving Linear Programming Problems, Transportation Problems, Assignment Problems and their applications.
2) To impart knowledge in concepts and tools of Operations Research
3) To understand mathematical models used in Operations Research.
4) To apply these techniques constructively to make effective business decisions

Unit I

Formulation of Linear Programming problems, Graphical solution of Linear Programming problem, 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. Solution of simultaneous equations by simplex Method, Inverse of a Matrix by simplex Method, Concept of Duality in Linear Programming, Comparison of solutions of the Dual and its primal.

Unit II

Mathematical formulation of Assignment problem, Reduction theorem, Hungarian Assignment Method, Travelling salesman problem, Formulation of Travelling Salesman problem as an Assignment problem, Solution procedure.

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 methods, Optimality test, Method of finding optimal solution, Degeneracy in transportation problem, Method to resolve degeneracy, Unbalanced transportation problem.

Unit III

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.

Unit-IV

Probability Theory Introduction concept of Uncertainty, Concept of Probability, Sample Space, Elementary Events, Acceptable , Assignment of Probabilities to elementary events , Nature Assignment of probabilities to Elementary events, Probability of an Event , Frequency interpretation, Classical Definition, The Playing card Addition Law of Probability, the conditional Probability, Discrete and Continuous Variable , Random Variable, Probability Distribution of Random Variable, Discrete, Continuous Probability Distribution , Mean , Variance and Standard Deviation

Text **Books: [1]** S. D. Sharma, Operations Research.
[2] Kanti Swarup, P. K. Gupta and Manmohan, Operations Research.
[3] H. A. Taha, Operations Research – An Introduction. G. I. Gauss, Linear Programming.

Outcomes:

1) To solve problems as networks and graphs, develop linear programming (LP) models for shortest path, maximum flow, minimal spanning tree, critical path, minimum cost flow, and transshipment problems.
2) To solve the problems using special solution algorithms use CPM and PERT techniques, to plan, schedule, and control project activities.
3) To construct linear integer programming models and discuss the solution techniques.

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BOS-DEPARTMENT OF MATHEMATICS
M.SC. MATHEMATICS

M 304B **SEMESTER – III** **Credits: 5**

Paper-IV: Mathematical Statistics

Objectives:

1) Demonstrate knowledge of probability and the standard statistical distributions.
2) Demonstrate knowledge of fixed-sample and large-sample statistical properties of point and interval estimators.
3) Demonstrate knowledge of the properties of parametric, semi-parametric and nonparametric testing procedures.

Unit I

Probability: Sample space and events of an experiment, Properties of Probability experiments Equally likely outcomes, Conditional probability and independence, Bayes' Theorem.

Discrete Random Variables: Random variables, Expected value, Properties of expected values, variance of random variables, Properties of variances, Binomial random variables and its Expected value and variance, Hyper-geometric random variables, Poisson random variables.[ch 4, 5]

Unit II

Normal Random Variables: Continuous random variables, Normal random variables, Probabilities associated 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 mean of 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: Sheldon M. Ross (2010): Introductory Statistics, Academic Press, Elsevier, 3rd Edition. (chapters 4 to 12).

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

Outcomes:

1) Students should be able to critically evaluate the strengths and weaknesses of study designs and can select a study design that is appropriate for addressing a specific research question.
2) Students should be able to use statistical reasoning, formulate a problem in statistical terms, perform exploratory analysis of data by graphical and other means, and carry out a variety of formal inference procedures.
3) Students should be able to describe important theoretical results and understand how they can be applied to answer statistical questions.

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BOS-DEPARTMENT OF MATHEMATICS
M.SC. MATHEMATICS

M 304C **SEMESTER – III** **Credits: 5**

Paper-IV: Advanced Complex Analysis

Objective:

1) This course is aimed to provide some selected topics in complex analysis for functions of a complex variable.
2) This course is designed for students who have completed a basic course in complex analysis in their under graduate or post graduate level.
3) As a pre-requisite to this course students are required to have a reasonable mastery of analytic properties of complex functions.
4) The content of the course mainly covered the notion of harmonic and sub harmonic functions; entire functions; meromorphic functions and elliptic functions.

Unit I

Entire Functions: Jensen's formula - Functions of finite order - Infinite products Generalities - Example: the product formula for the sine function - Weierstrass infinite products - Hadamard's factorization theorem

Unit II

The Gamma and Zeta Functions: The gamma function - Analytic continuation-Further properties of Γ - The zeta function - Functional equation and analytic continuation.

Unit III

The Zeta Function and Prime Number Theorem: Zeros of the zeta function - Estimates for $1/\zeta(s)$ Reduction to the functions ψ and ψ_1 - Proof of the asymptotics for ψ_1 - Note on interchanging double sums.

Unit-IV

Conformal Mappings: Conformal equivalence and examples - The disc and upper half-plane - Further examples - The Dirichlet problem in a strip - The Schwarz lemma; automorphisms of the disc and upper half-plane - Automorphisms of the disc - Automorphisms of the upper half plane

Text Book:

Elias M Stein, Rami Shakarchi, Complex Analysis

References:

[1] Lars V Ahlfors, Complex Analysis.

[2] R P Boas, Entire Functions.

[3] Lars V Ahlfors, Conformal Invariants.

Outcomes: After completing this course, students are expected to be able to

1) Know the harmonic analogue of analytic functions. Able to explain the concept, state and prove theorems and properties involving harmonic and sub harmonic functions. For example, able to recognize and apply Poisson Integral, Mean Value theorem, Maximum and minimum modulus theorem for harmonic and sub harmonic functions. This may help a student to continue higher study on potential theory.
2) Construct entire functions as well as meromorphic functions when information about the zeros and poles respectively, are given. It provide a platform to continue more study on the growth and order of entire and meromorphic functions. Able to continue higher study on Nevannlina theory.
3) Know the properties of double periodic functions mainly elliptic functions. Can able to know the behavior of Weirstrass P-function, Riemamm zeta function, gamma functions, Psi functions, etc. This will motivates the student to work on other directions of complex analysis, analytic number theory and modular functions.
4) Completions of this course ultimately open up higher studies in many directions related to complex analysis in general.

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BOS-DEPARTMENT OF MATHEMATICS
M.SC. MATHEMATICS

M 305A **SEMESTER – III** **Credits: 4**

Paper-V: Mechanics

Objective: This course is aim to be a second course to the existing undergraduate courses. They will introduce Lagrangian and Hamiltonian mechanics with all necessary Geometric pre requisites like differential Geometry and Symplectic Geometry.

Unit I

Newton's Law of Motion: Historical Introduction, Rectilinear Motion: Uniform Acceleration Under a Constant Force, Forces that Depend on Position: The Concepts of Kinetic and Potential Energy, Dynamics of systems of Particles:- Introduction - Centre of Mass and Linear Momentum of a system - Angular momentum and Kinetic Energy of a system, Mechanics of Rigid bodies - Planar motion:- Centre of mass of Rigid body.

Unit II

Rotation of a Rigid body about a fixed axis, Moment of Inertia: calculation of moment of Inertia Perpendicular and Parallel axis theorem- Physical pendulum-A general thecrem concerning Angular momentum-Laminar Motion of a Rigid body-Body rolling down an inclined plane (with and without slipping).

Unit III

Motion of Rigid bodies in three dimension: Angular momentum of Rigid body products of Inertia, Principles axes-Determination of principles axes - Rotational Kinetic Energy of Rigid body - Momentum of Inertia of a Rigid body about an arbitrary axis - The momental ellipsoid - Euler's equation of motion of a Rigid body.

Unit-IV

Lagrange Mechanics: Generalized Coordinates-Generalized forces - Lagrange's Equations and their applications - Generalized momentum - Ignorable coordinates - Hamilton's variational principle - Hamilton function-Hamilton's Equations - Problems - Theorems.

Text Book: G.R.Fowles, Analytical Mechanics, CBS Publishing, 1986.

Expected Outcome: This course can be followed by courses in Integrable models, foundation of Mechanics, Celestial Mechanics etc. This prepares an adequate mathematical background for understanding any research papers in Mechanics.

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M.SC. MATHEMATICS

M 305B | SEMESTER – III | Credits:4

Paper-V: Numerical Analysis

Objective:

1) Calculation of error and approximation is a necessity in all real life, industrial and scientific computing.
2) The objective of this course is to acquaint students with various methods of finding solution of different type of problems such as locating roots of equations, finding solution of nonlinear equations, systems of linear equations, differential equations, Interpolation and approximation, differentiation, evaluating integration so as to minimize the error and time required to solve.

Unit I

Transcendental and Polynomial Equations: Introduction, Bisection Method - Iteration Methods Based on First Degree Equation: Secant Method, Regula Falsi 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.

Unit III

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

Unit-IV

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

Numerical Solution of ODE's: Introduction - Numerical Methods: Euler Methods-Mid point Method Single Step Methods: Taylor series method, Runge-Kutta Method (2^{nd} and 4^{th} order). Multistep Methods: Adam Bashforth Method - Adams Moulton Method, Milne-Simpson Method - Predictor Corrector Methods.

Text Books: [1] Numerical Methods for Scientific and Engineering Computation by M.K. Jain, S.R.K. Iyengar, R.K. Jain, New Age Int. Ltd., New Delhi.

Outcome: After getting trained a student can opt for the courses like advanced Numerical analysis and numerical functional analysis. Use of good mathematical software will help in getting the accuracy one need from the computer and can assess the reliability of the numerical results, and determine the effect of round off error or loss of significance.

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SEMESTER – III

M 305C

Credits: 4

Paper-V: Differential Geometry

Objective: After a course in Analytic Geometry and Differential geometry of curves at undergraduate level, Differential Geometry is a core component of a post graduate syllabus which introduces the methods of differential manifolds, tensor analysis, vector fields, Lie Group, Lie Algebra etc. The objective is to prepare the students for further coursework and research in geometry in future.

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. Bansi Lal, Three dimensional differential geometry, Atma Ram Publisher.

Outcome: After completing this course, a student can opt for a course on Lie Group, Lie Algebra, Symplectic Geometry, Poisson Geometry, Global Analysis, Several Complex Variable, Hyperbolic Geometry, Projective and Algebraic Geometry and all these courses are main component for Mathematical Physics, Relativity, Cosmology and Standard Models.

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DEPARTMENT OF MATHEMATICS

M.Sc. Mathematics

Semester IV

SYLLABUS

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M 401 **Semester IV** **Credits – 5**

Paper-I: Integral Equations & Calculus of Variations

Objectives:

1) The objective of the course module is to study Integral Equations and to know that what is the relationship between the integral equations and ordinary differential equations.
2) The calculus of variations is a field of mathematical analysis that uses variations, which are small changes in functions and functionals, to find maxima and minima of functionals: mappings from a set of functions to the real numbers

INTEGRAL EQUATIONS:

Unit I

Volterra Integral Equations: Basic concepts - Relationship between Linear differential equations and Volterra Integral equations - Resolvent Kernel of Volterra Integral equation. Di erentiation of some resolvent kernels - Solution of Integral equation by Resolvent Kernel - The method of successive approxima-tions - Convolution type equations - Solution of Integro-di erential equations with the aid of the Laplace Transformation { Volterra integral equation of the rst kind - Euler integrals - Abel's problem - Abel's inte-gral 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 It-erated Kernels - Integral equations with Degenerated Kernels. Hammerstein type equation - Characteristic numbers and Eigen functions and its properties. Green's function: Construction of Green's function for ordinary di erential 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 Books:

[1] M. KRASNOV, A. KISELEV, G. MAKARENKO, Problems and Exercises in Integral Equations (1971).

[2[S. Swarup, Integral Equations, (2008).

[3] L.ELSGOLTS, Differential Equations and The Calculus of Variations, MIR Publishers, MOSCOW.

Outcomes: After studying this course, you should be able to: understand what functionals are, and have some appreciation of their applications. apply the formula that determines stationary paths of a functional to deduce the differential equations for stationary paths in simple cases.

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M 402 **Semester IV** **Credits - 5**

Paper-II: Elementary Operator Theory

Objective: The dominance of operator methods in foundation of quantum mechanics and the success of spectral analysis and scattering methods and the evolution of operator algebras has found operator theory as an essential course at post graduate level. The objective of the course is to introduce basic operator theoretic methods as a second course to functional analysis.

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. (Sections 7.1, 7.2, 7.3 & 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:

[1] Elements of Functional Analysis by Brown and Page, D.V.N. Comp.
[2] Functional Analysis by B.V. Limaye, Wiley Eastern Limited, (2nd Edition).
[3] A Hilbert Space Problem Book by P.R.Halmos, D.Van Nostrand Company, Inc. 1967.

Outcomes: This course prepare a student to take a second course in operator algebra, Differential operators, Spectral theory, scattering theory, Fundamental solutions quantum probability etc. This is highly applicational. This course open ways to different research areas in this branch particularly and also in the area of functional analysis broadly, like representation theory , operators on different function spaces etc..

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M 403 **Semester IV** **Credits - 5**

Paper-III: Analytic Number Theory

Objectives: A course in Number theory is a must solicited course every mathematics students for its beauty and clarity. The objective of the present course is to expose students to basics of Analytic Number Theory, Arithmetic Function, Distribution of Prime Number, Riemann Zeta function and work of Ramanujam.

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 (n)- The average order of (n)- An application to the distribution of lattice points visible trona the origin-The average order of (n) and (n)- The partial sums of dirichlet product- Applications to (n) and (n)-Another identity for the partial sums of a dirichlet product. (Sections3.1 to 3.12).

Unit II

Some elementary theorems on the distribution of prime numbers- Introduction chebyshev's functions- (x) and (x)- Relation connecting (n) and (n)- Some equivalent forms of the prime number theorem- Inequal-ities for (n) and p_n. (Sections4.1 to 4.5)

Unit III

Shapiro's Tauberian theorem- Applications of shapiro's theorem An asymptotic formula for the partial sums 1=p - The partial sums of the mobins function- Selberg Asymptotic formula. (Sections4.6 to 4.11 except p 4.10)

Unit-IV

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

Text Book: Tom M. Apostol- An Introduction to Analytic Number Theory, Springer.

Outcomes: At the end of the course students are expected to get interested to solve challanging problems in Number Theory. They will be able to collect and utilize Numerical Information to shape conjuctures in Number Theory. This also prepares to opt for courses in Cryptography, Algebraic Number Theory and Ramanujams Works.

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M 404A **Semester IV** **Credits – 5**

Paper-IV: Integral Transforms

Objectives: The course is aimed at exposing the students to learn the Laplace transforms and Fourier transforms.

1) To equip with the methods of finding Laplace transform and Fourier Transforms of different functions.
2) To make them familiar with the methods of solving differential equations, partial differential equations, IVP and BVP using Laplace transforms and Fourier transforms..

Unit I

FOURIER TRANSFORM: Introduction - Classes of functions - Fourier Series and Fourier Integral For-mula - 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 theo-rems - 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

THE LAPLACE TRANSFORM: Introduction - De nitions - Sucient 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 $t_n f(t)$-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

THE INVERSE LAPLACE TRANSFORM AND APPLICATION: 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 - De nition 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 - De nition of Mellin Transform - Mellin Transform of derivative of a 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 generalized Mellin Transform - Finite Mellin Transform. The Z-Transform: Introduction - Transform: De nition - 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.

Outcomes : On successful completion of the course students will be able to recognize the different methods of finding Laplace transforms and Fourier transforms of different functions. They apply the knowledge of L.T, F.T, and Finite Fourier transforms in finding the solutions of differential equations, initial value problems and boundary value problems

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SEMESTER – IV

M 404B **Credits:5**

Paper-IV: Graph Theory

Objectives: Graphs are used to model networking problems in physical and biological sciences etc. As an essential tools in computer and information sciences, the concepts in Graph Theory address problems of social media, linguistics, chemical bonds, computational neuro science, market and financial analysis, communication system, data organisation, flows and links. The objective of this course is to introduce the basic of Graph Theory to students.

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, minimum spanning 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 chordal graphs, 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, aracterizations, planarity testing, 5-color-theorem.Directed graphs: Out-degree, in-degree, connectivity, orientation, Eulerian directed graphs, Hamilton directed graphs, tournaments

Text Books:

[1] J.A. Bondy and U.S.R. Murty: Graph Theory with Applications (Freely downloadable from Bondy's website; Google-Bondy).

[2] D.B. West: Introduction to Graph Theory, Prentice-Hall of India/Pearson, 2009 (latest impression).

References:

J.A. Bondy and U.S.R. Murty: Graph Theory, Springer, 2008.

R.Diestel: Graph Theory, Springer(low price edition) 2000.

Outcomes: A course in Graph Theory is prerequisite to almost all courses and research in computer science. Besides it has applications to other branches in mathematical sciences. A student can opt for Matroid theory, Network Analysis, Algorithm and Data Analysis courses after completing this course

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M 404C **SEMESTER – IV** **Credits: 5**

Paper-IV: Cryptography

Objectives:

1) Enable the students to learn fundamental concepts of cryptography and utilize these techniques in computing systems.
2) To acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.
3) To understand the various key distribution and management schemes.
4) To understand how to deploy encryption techniques to secure data.

Unit-I

Some Simple Cryptosystems: The Shift Cipher Simple substitution ciphers; Divisibility and greatest common divisors Modular arithmetic; Prime numbers, unique factorization, and finite fields; Powers and primitive roots in finite fields; Cryptography before the computer age; Symmetric and asymmetric ciphers.

Unit II

The birth of public key cryptography, The discrete logarithm problem Di e{Hellman key exchange, The El-Gamal public key cryptosystem, An overview of the theory of groups, How hard 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

Pollard's (p 1) factorization algorithm, Factorization via difference of squares, Smooth numbers and sieves, Elliptic curves, Elliptic curves over finite elds, The elliptic curve discrete logarithm problem, Elliptic curve cryptography.

Text Book: Mathematical Cryptography by Jefrey Ho stein, Jill Pipher, Joseph H. Silverman.

References: [1] Everyday Cryptography: Fundamental Principles and Applications by Keith Martin. [2] Cryptography: An Introduction by N. P. Smart.

Outcomes: Upon successful completion of this course students will be able to

1) Have a strong background of cryptography which has diverse practical applications.
2) Encrypt and decrypt messages using block ciphers, sign and verify messages using well known signature generation and verification algorithms.
3) Analyse existing authentication and key agreements.
4) Develop their skills in the programming of symmetric and/or asymmetric ciphers and their use in the networks.

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M.SC. MATHEMATICS

M 405A | **Semester IV** | **Credits – 4**

Paper-V: Fluid Mechanics

Objectives:

1) The course on fluid mechanics is devised to introduce fundamental aspects of fluid flow behaviour.
2) Students will learn to develop steady state mechanical energy balance equation for fluid flow systems, estimate pressure drop in fluid flow systems and determine performance characteristics of fluid machinery.

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 ow problems: Bernoulli's Theorem - Applications of the Bernoulli Theorem - Kelvins circulation theorem.

Unit II!

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 Thom-son 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.

Outcomes:

1) The student will understand stress-strain relationship in fluids, classify their behavior and also establish force balance in static systems. Further they would develop dimensionless groups that help in scale-up and scale-down of fluid flow systems.
2) Students will compute power requirement in fixed bed system and determine minimum fluidization velocity in fluidized bed.
3) Students will be able to determine and analyze the performance aspects of fluid machinery specifically for centrifugal pump and reciprocating pump

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M 405B **SEMESTER – IV** **Credits: 4**

Paper-V: Advanced Operations Research

Objectives:

1) Game theory is a theoretical framework to conceive social situations among competing players and produce optimal decision-making of independent and competing actors in a strategic setting.
2) Markov analysis can be used to also examine whether certain sequences occur less frequently than would be expected due to random chance.

Unit I

Characteristics of Game theory Minimax (Maximin) criterion and optimal strategy- Saddle points - Solution of Games with saddle points- Rectangular Games without saddle points - Minimax(Maximin) 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

Non - Linear programming-unconstrained problems of Maxima and Minima - constrained problems of Maxima and Minima - Constraints in the form of Equations {Lagrangian Method-Suffcient 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- III

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.

Unit – IV

Markov Analysis: Stochastic (Random) process – Markov Process – characteristics of Markov process- Transition probability – Transition probability matrix – construction of Transition Matrix – First and higher order Markov process – n- step Transition probabilities Markov chain – Markov Analysis.

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.

Outcomes:

1) An outcome is a situation which results from a combination of player's strategies. Formally, a path through the game tree, or equivalently a terminal node of the game tree. A primary purpose of game theory is to determine the outcomes of games according to a solution concept.
2) Markov analysis is a method used to forecast the value of a variable whose predicted value is influenced only by its current state, and not by any prior activity. In essence, it predicts a random variable based solely upon the current circumstances surrounding the variable

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M 405C **SEMESTER – IV** **Credits: 4**

Paper-V: Finite Difference Methods

Objectives: In numerical analysis, finite-difference methods (FDM) are a class of numerical techniques for solving differential equations by approximating derivatives with finite differences. Both the spatial domain and time interval (if applicable) are discretized, or broken into a finite number of steps, and the value of the solution at these discrete points is approximated by solving algebraic equations containing finite differences and values from nearby points.

Unit I

Partial differential Equations { Introduction - Difference Method - 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.(2.1, 2.2 2.3 & 2.5).

Unit III

Difference Methods for Hyperbolic Partial Differential Equations Introduction - One space dimensions - Two space dimensions - First order equations.(3.1 to 3.4).

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 4.4).

Text Book:

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

Outcomes: Finite difference methods convert ordinary differential equations (ODE) or partial differential equations (PDE), which may be nonlinear, into a system of linear equations that can be solved by matrix algebra techniques. Modern computers can perform these linear algebra computations efficiently which, along with their relative ease of implementation, has led to the widespread use of FDM in modern numerical analysis.

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M.Sc. Mathematics
Semester III & Semester IV

PATTERN OF
INTERNAL ASSESSMENT QUESTION PAPER
AND
THEORY QUESTION PAPER

HINDI MAHAVIDYALAYA, NALLAKUNTA, HYDERABAD
(AUTONOMOUS)
BOS-DEPARTMENT OF MATHEMATICS
M.SC. MATHEMATICS

The pattern of internal assessment test from the academic year 2019-2020 with the following specifications:

Two internal Assessment Tests of 15 Marks each (Average to taken)
One Assignment : 05 Marks
Total : 20 Marks

Internal Tests
I test to be conducted at the end of the 9th week of instruction (Covering 2/3 units of the syllabus).
II test to be conducted at the end of the 14th week of instruction (Covering the rest of the units).

Assignment
One Assignment (Topic to be assigned in the 6th week of instruction).
The assignment will consist of hand written (students own handwriting).

Definition /Explication of 20key concepts worth ¼ mark each. To be submitted for assignment in the 13th week of instruction.

Total marks for assignment 20 x ¼ =05 Marks

Chairperson **University Nominee** **Members** **Principal**

1.

2.

Dr. Naikoti Kishan
Professor of Mathematics
Department of Mathematics
Osmania University
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M.SC. MATHEMATICS
INTERNAL ASSESSMENT MODEL (III-IV SEMESTER)

Max. Marks :15

Model Paper of Internal assessment Examination

In Two Internal Assessment , One is descriptive and other one is Objective

Objective Type Model Paper

Note answer all the questions

Multiple choice questions Q1. – Q10.	**10 x ½ =05 Marks**
Fill in the Blanks Q1. – Q10.	**10 x ½ =05 Marks**
Short Answers type Questions Q1. – Q5.	**5 x 1 = 05 Marks**

Descriptive Type Model Paper

Write any three questions out of five questions. Each question carrying 5 Marks.

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MODEL PAPERS FOR SEMESTER EXAMINATION
(III - IV SEMESTER)

Time: 3 Hours **Max. Marks :80**

SECTION-A

Marks : = 8 x 4 =32

Unit-I

1.
2.

Unit-II

3.
4.

Unit-III

5.
6.

Unit-IV

7.
8.

SECTION-B

Marks : = 4 x 12 =48

Unit-I

9. a) (OR) b)

Unit-II

10. a) (OR) b)

Unit-III

11. a) (OR) b)

Unit-IV

12. a) (OR) b)

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HINDI MAHAVIDYALAYA

(AUTONOMOUS & NAAC RE-ACCREDITED)
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DEPARTMENT OF MATHEMATICS

M.Sc. Mathematics
PANEL OF EXAMINERS

HINDI MAHAVIDYALAYA

(AUTONOMOUS & NAAC RE-ACCREDITED)

DEPARTMENT OF MATHEMATICS

M.Sc. Mathematics

PANEL OF EXAMINERS

SEMESTER III			
Subject With Code	Name of the Examiner	Institution Name	Contact No
FUNCTIONAL ANALYSIS M301	DR. V. NAGARAJU	Department of Mathematics Osmania University, Hyd	9440496134
	DR. V.SRINIVAS	Department of Mathematics University College of Science , Saifabad, Hyd	9440378294
	V.VENKATESHWARULU	Department of Mathematics University College of Science, Saifabad, Hyd	9130450583
	DR. ARUN JYOTHI	Department of Mathematics AMS College, OU Road, Hyd	
GENERAL MEASURE & INTEGRATIO N M302	DR. V. KIRAN	Department of Mathematics Osmania University, Hyd	9912959615
	DR. K. PRUDVI	Department of Mathematics University College of Science, Saifabad, Hyd	9947063988
	JAYASHREE	Department of Mathematics GDC for Women Begumpet, Hyd.	8686883627
LINEAR ALGEBRA M303	DR. K SRIRAM REDDY	Department of Mathematics Osmania University, Hyd	9440581034
	DR. V. NAGARAJU	Department of Mathematics Osmania University, Hyd	9440496134
	V.VENKATESHWARULU	Department of Mathematics University College of Science, Saifabad, Hyd	9130450583
	DR. K. PRUDVI	Department of Mathematics University College of Science, Saifabad, Hyd	9947063988
	PHANEENDRA	Department of Mathematics University College of Science, Saifabad, Hyd	9849712466
OPERATION REASEARCH M304A	DR. G. KAMALA	Department of Mathematics Osmania University, Hyd	9848020397
	DR. V. KIRAN	Department of Mathematics Osmania University, Hyd	9912959615
	DR. ARUN JYOTHI	Department of Mathematics AMS College, OU Road, Hyd	
	DR. K. PRUDVI	Department of Mathematics University College of Science, Saifabad, Hyd	9947063988
	JAYASHREE	Department of Mathematics GDC for Women Begumpet, Hyd.	8686883627
NUMERICAL ANALYSIS M305B	V.VENKATESHWARULU	Department of Mathematics University College of Science, Saifabad, Hyd	9130450583
	DR. P.SARADA	Department of Mathematics AMS College, OU Road, Hyd	9491129549

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DEPARTMENT OF MATHEMATICS

M.Sc. Mathematics

PANEL OF EXAMINERS

SEMESTER IV			
Subject With Code	**Name of the Examiner**	**Institution Name**	**Contact No**
INTERGAL EQUATIONS & CALCULUS OF VARIATIONS M401	DR. G. KAMALA	Department of Mathematics Osmania University, Hyd	9848020397
	DR. V.SRINIVAS	Department of Mathematics University College of Science, Saifabad, Hyd	9440378294
	V.VENKATESHWARULU	Department of Mathematics University College of Science, Saifabad, Hyd	9130450583
ELEMENTARY OPERATOR THEORY M402	DR. B. KRISHNA REDDY	Department of Mathematics Osmania University, Hyd	9603620002
	DR. V.SRINIVAS	Department of Mathematics University College of Science, Saifabad, Hyd	9440378294
	DR. K. PRUDVI	Department of Mathematics University College of Science, Saifabad, Hyd	9947063988
ANALYTIC NUMBER THEORY M403	DR. B. SURENDER REDDY	Department of Mathematics Osmania University, Hyd	9000070756
	DR. E RAMA	Department of Mathematics University College of Science, Saifabad, Hyd	9989545301
	DR. K. PRUDVI	Department of Mathematics University College of Science, Saifabad, Hyd	9947063988
	PHANEENDRA	Department of Mathematics University College of Science, Saifabad, Hyd	9849712466
Integral Transforms M404A	DR. G. KAMALA	Department of Mathematics Osmania University, Hyd	9848020397
	V.VENKATESHWARULU	Department of Mathematics University College of Science, Saifabad, Hyd	9130450583
ADVANCED OPERATIONS RESEARCH M405	DR. B. SURENDER REDDY	Department of Mathematics Osmania University, Hyd	9000070756
	DR. E RAMA	Department of Mathematics University College of Science, Saifabad, Hyd	9989545301
	V.VENKATESHWARULU	Department of Mathematics University College of Science, Saifabad, Hyd	9130450583

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1. Dr. Naikoti Kishan

2.