# HINDI MAHAVIDYALAYA

## (AUTONOMOUS & NAAC RE-ACCREDITED)

## (Affiliated to Osmania University)

## Nallakunta, Hyderabad-44

# M.Sc. I & II YEAR - I TO IV SEMESTER

# DEPARTMENT OF MATHEMATICS

**(With effect from batch of students admitted from the Academic Year 2023-24 under CBCS Semester system)**

# HINDI MAHAVIDYALAYA

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

# DEPARTMENT OF MATHEMATICS
## M.Sc. Mathematics

## (BOS – MEETING on 24-02-2024)

# SYLLABUS, MODEL PAPER
# PANEL OF EXAMINERS etc…

**For the Academic Year**
**2023 – 2024**

# HINDI MAHAVIDYALAYA, NALLAKUNTA, HYDERABAD

**(AUTONOMOUS)**

**COMPOSITION OF THE BOARD OF STUDIES OF DEPARTMENT OF MATHEMATICS**

**Meeting on 24-02-2024**

1. Head of the Department concerned (Chairman)

   Smt. G. Sreevani, Department of Mathematics

2. The entire faculty of department
   i. Mr. M. Sudhakar
   ii. Smt. T. Ramadevi
   iii. Miss Laxmi Prasanna

3. One expert to be nominated by the Vice Chancellor from a panel of six recommended by the College Principal

   i. Prof. N. Kishan , University Nominee. Department of Mathematics, Osmania University, Hyderabad.
   ii. Prof. V. Dhanalaxmi, 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.

   i. Dr. V. Srinivas, Associative Professor, Department of Mathematics, Osmania University, Hyderabad.
   ii. Dr. Loka Pavani , Associative Professor, Department of Mathematics , Telangana Mahila University, Hyderabad

5. One postgraduate meritorious alumnus to be nominated by the Principal. The Chairperson, Board of Studies, may with the approval of the Principal of the College.

6. Experts from outside the College whenever special courses of studies are to be formulated. -To be nominated.
7. Other members of staff of the same faculty.

**Chairperson** **University Nominee** **Chairperson**
**(BOS, Dept of Maths, OU)**

Chairperson
BoS in Mathematics
Department of Mathematics
Osmania University
Hyderabad-500 007

**Members** **Principal**

PRINCIPAL
HINDI MAHAVIDYALAYA
(AUTONOMOUS)
Arts, Commerce & Science
Nallakunta, Hyderabad-44.

1. Associate Professor
Dept of Maths O.U.

2. Dr LOKA PAVANI
ASSOCIATE PROFESSOR
Department of Mathematics and Statistics
Telangana Mahila Viswavidyalayam
(Women s University)
Koti, Hyderabad-500 095.

# HINDI MAHAVIDYALAYA, NALLAKUNTA, HYDERABAD
**(AUTONOMOUS)**
## DEPARTMENT OF MATHEMATICS
## AGENDA OF THE MEETING
**Meeting on 24-02-2024**

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 all the Semester

5 The Scheme of evaluation for M.Sc. Mathematics (I, II, III & IV Semesters) is as under.

6 Discussion on Pattern and model paper of Semester Exam and internal exam for all the Semester

7 Panel of Examiners

8 Any other matter

9 Vote of thanks

**Chairperson** **University Nominee** **Chairperson (BOS, Dept of Maths, OU)** **Members** **Principal**

PRINCIPAL
HINDI MAHAVIDYALAYA
(AUTONOMOUS)
Arts, Commerce & Science
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Chairperson
BOS in Mathematics
Department of Mathematics
Osmania University
Hyderabad-500 007.

1. Associate Professor
Dept of Maths O.U

2.

Dr. LOKA PAVANI
ASSOCIATE PROFESSOR
Department of Mathematics and Statistics
Telangana Mahila Viswavidyalayam
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Koti, Hyderabad-500 095.

# HINDI MAHAVIDYALAYA, NALLAKUNTA, HYDERABAD
## (AUTONOMOUS)
## DEPARTMENT OF MATHEMATICS
## BOARD OF STUDIES
## Academic Year – 2023 – 2024
### Minutes of BOS Meeting

**BOS meeting of the Department of Mathematics held on 24-02-2024 .**

**The following members were present**

| | | |
|---|---|---|
| Prof. N. Kishan | - | University Nominee, Department of Mathematics, Osmania University, Hyderabad |
| Prof. V. Dhanalaxmi | - | Chair person, BOS, Department of Mathematics, Osmania University, Hyderabad |
| Dr. V. Srinivas | - | Member of BOS, Department of Mathematics, Osmania University, Hyderabad |
| Dr. Loka Pavani | - | Member of BOS, Department of Mathematics, Telangana Mahila University, Hyderabad. |
| Smt. G. Sreevani | - | Chair person, BOS, HMV, Hyderabad. |

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 syllabus of I & II years of M.Sc., 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. **Details of choice based credit system.**
   Members were informed that TSCHE has referred that from the academic year 2019-20 autonomous institutions have to follow NEW CBCS i.e. From the Academic Year 2019-20 Osmania University has instructed all the Degree colleges including Autonomous Degree colleges to follow NEW CBCS under which after passing the exam student will get the Grade in the Final Result

4. **Discussion and Distribution of Common Core Syllabus for I & II Year (Semesters I to IV).**
   i. Members were informed by the chair that Department of Mathematics, Hindi Mahavidyalaya is following syllabus prescribed by Osmania University M.Sc. I & II YEAR in I to IV semesters.
   ii. The syllabus comprises of 4 units.
   iii. Syllabus copy all semesters is enclosed.
   iv. Syllabus was approved by the Members of BOS.

5. **The Scheme of evaluation for M.Sc. Mathematics (I, II, III & IV Semesters) is as under**
   The Performance of the students will be evaluated for 100 marks which consist of 50 marks for Internal Assessment & 50 marks for semester – end examination.

   **Continuous Assessment:** Students engage in ongoing evaluation, where a total of 40 marks are distributed across four Internal Assessment tests. Each assessment carries a specific weightage of 10 marks, contributing to the overall assessment

   **Attendance:** A portion of the assessment, accounting for 10 marks, is dedicated to tracking student's attendance. This aspect serves as an incentive for active engagement in the learning and teaching process.

| 1st Internal Assessment (10 Marks) | 2nd Internal Assessment (10 Marks) | 3rd Internal Assessment (10 Marks) | 4th Internal Assessment (10 Marks) |
|---|---|---|---|
| a. 10 Multiple Choice Questions each one carrying ½ marks ( 10 X ½ = 5 Marks)<br>b. 10 Fill in Blank Questions each one carrying ½ marks ( 10 X ½ = 5 Marks) | 10 Short Questions each one carrying 1 marks ( 10 X 1 = 10 Marks) | Report Writing – 10 Marks **(OR)** Two Paraphrasing 5 Marks each | Student Seminar for 5 Marks **and** Student Assignment for 5 marks |

**Weightage for Attendance**

| Attendance Percentage | Marks |
|---|---|
| **95% - 100%** | **10 Marks** |
| **86% - 94%** | **8 Marks** |
| **81% - 85%** | **6 Marks** |
| **75% - 80%** | **5 Marks** |
| **65% - 75%** | **4 Marks *** |

*** Applicable only to those who provide a valid reason with condonation.**

ii. Semester – end examination theory question paper is of 50 marks.
iii. Total allotted marks are 100 for each Theory Paper (Semester – end Examination 50 Marks + Internal assessment 50 Marks)

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

**6. Discussion on Pattern and Model Paper of Semester – End examination and Model Paper of Internal Examination**

i. Model Question paper for Semester – End Examination I –IV Semesters was discussed.
Theory paper for each Semester will have TWO sections.
i) **Section A** contains 5 short Questions. The student has to answer ALL questions. Each Question carries 2 Marks (5 X 2 = 10 Marks)
ii) **Section B** contains 5 Essay type Questions with internal choice. Each Question Carries 8 Marks (5 X 8 = 40 Marks)

**ii. Internal Assessment Pattern**

| 1st Internal Assessment (10 Marks) | 2nd Internal Assessment (10 Marks) | 3rd Internal Assessment (10 Marks) | 4th Internal Assessment (10 Marks) |
|---|---|---|---|
| a. 10 Multiple Choice Questions each one carrying ½ marks ( 10 X ½ = 5 Marks)<br>b. 10 Fill in Blank Questions each one carrying ½ marks ( 10 X ½ = 5 Marks) | 10 Short Questions each one carrying 1 marks ( 10 X 1 = 10 Marks) | Report Writing – 10 Marks (OR) Two Paraphrasing 5 Marks each | Student Seminar for 5 Marks and Student Assignment for 5 marks |

iii. Semester – End examination and Internal Assessment test will be conducted as per the Almanac which will be provided by the Examination Branch. Internal Assessment Test duration will be 30 Min. and Semester – End examination duration will be of 2 hrs.

- Pattern of Model Theory Question Papers for Semester - End examination Paper is enclosed
- Evaluation of Mathematics Project Work Scheme is enclosed
- Pattern of Model Internal Assessment Question Paper is enclosed.

**iv.** Pattern of Model Theory Question Papers for Semester – End examination was approved by Member of BOS.

**v.** Evaluation Scheme of Mathematics Project Work was approved by Member of BOS.

**vi.** Pattern of Model Internal Assessment Question Paper was approved by Member of BOS.

**7. Panel of Examiners:** List is enclosed

The panel of examiners was approved by the members.

**8. Any other matter.**

- M.Sc. Mathematics I Year ( I & II Semesters) Syllabus is effected from the academic year 2023 - 24 **(With effect from batch of students admitted from the Academic Year 2023-24 under CBCS Semester system)**
- M.Sc. Mathematics II Year (III & IV Semesters) Syllabus is effected from the academic year 2024 – 25 **(With effect from batch of students admitted from the Academic Year 2023-24 under CBCS Semester system).**
- Introduce Certificate Courses i) Logical Reasoning & Arithmetic Ability ii) Vedic Mathematics Made Easy for all students in the college.

**9. Vote of Thanks**

Meeting concluded with the Vote of Thanks by

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

**(BOS, Dept of Maths, OU)**

PROFESSOR
Department of Mathematics
OSMANIA UNIVERSITY
HYDERABAD-500 007

Chairperson
Board of Mathematics
Department of Mathematics
Osmania University
Hyderabad-500 007.

PRINCIPAL
HINDI MAHAVIDYALAYA
(AUTONOMOUS)
Arts, Commerce & Science
Nallakunta, Hyderabad-44.

Associate Professor
Dept of Maths O.U

**2.**

Dr LOKA PAVANI
ASSOCIATE PROFESSOR
Department of Mathematics and Statistics
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Koti, Hyderabad-500 095.

# HINDI MAHAVIDYALAYA

**(AUTONOMOUS & NAAC RE-ACCREDITED)**

**BOARD OF STUDIES**

**DEPARTMENT OF MATHEMATICS**

**Meeting on 24-02-2024**

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

**Prof. N. Kishan**
**University Nominee**
Department of Mathematics
Osmania University, Hyderabad

**Prof. V. Dhanalaxmi**
**Chairperson – BOS**
Department of Mathematics
Osmania University, Hyderabad

**Members of BOS**

1. Dr. V. Srinivas, Associative Professor, Department of Mathematics, Osmania University, Hyderabad.
2. Dr. Loka Pavani , Associative Professor, Department of Mathematics, Telangana Mahila University, Hyderabad

**Faculty of Mathematics Department**

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

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

3. Miss Prasanna Laxmi
   Lecturer, Department of Mathematics
   Hindi Mahavidyalaya
   Nallakunta, Hyderabad

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**Nallakunta, Hyderabad-44**

## DEPARTMENT OF MATHEMATICS

***M.SC. MATHEMATICS I & II YEAR***

***I – IV SEMESTERS***

**(With effect from batch of students admitted from the Academic Year 2023-24 under CBCS semester system)**

# HINDI MAHAVIDYALAYA

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**(Affiliated to Osmania University)**

**Nallakunta, Hyderabad-44**

## M.Sc. I & II YEAR - I TO IV SEMESTER

## DEPARTMENT OF MATHEMATICS

# SCHEME OF INSTRUCTION

# AND

# EXAMINATION

# HINDI MAHAVIDYALAYA

**(Autonomous & Naac Re-Accredited) (Affiliated to Osmania University)**
**Nallakunta, Hyderabad-500044**

## M.Sc. Mathematics

## Choice Based Credit System (CBCS) Semester - I

| S.No. | Subject | Paper Code | Paper | Paper Title | THPW | Theory | T | Continuous Evaluation | | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Internal Assessment | End Semester Exams | | |
| 1 | Core | HMVPG23M101 | I | Abstract Algebra | 5 | 4 | 1 | 50 | 50 | 100 | 5 |
| 2 | Core | HMVPG23M102 | II | Mathematical Analysis | 5 | 4 | 1 | 50 | 50 | 100 | 5 |
| 3 | Core | HMVPG23M103 | III | Ordinary Differential Equations | 5 | 4 | 1 | 50 | 50 | 100 | 5 |
| 4 | Core | HMVPG23M104 | IV | Linear Algebra | 5 | 4 | 1 | 50 | 50 | 100 | 5 |
| | | | | Total | 20 | | | | | 400 | 20 |

**(With effect from batch of students admitted from the Academic Year 2023-24 under CBCS semester system)**

- T – Tutorial class: Each batch consists of 20 students and will be allotted to a teacher (Demonstrating the theory through a numerical example and practicing through mathematical software)
- THPW = Teaching Hours per Week.

**Chairperson**

**University Nominee**

28/2/2024
OSMANIA UNIVERSITY,
HYDERABAD-500 007.

**Chairperson**
**(BOS, Dept of Maths, OU)**

Chairperson
BOS, Dept of Mathematics
Department of Mathematics
Osmania University
Hyderabad-500 007.

**Members**

**Principal**

PRINCIPAL
HINDI MAHAVIDYALAYA
(AUTONOMOUS)
Arts, Commerce & Science
Nallakunta, Hyderabad-44.

1. Associate Professor
2. Dept of Maths O.U

Dr LOKA PAVANI
ASSOCIATE PROFESSOR
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**Nallakunta, Hyderabad-500044**

## M.Sc. Mathematics

## Choice Based Credit System (CBCS) Semester - II

| S.No. | Subject | Paper Code | Paper | Paper Title | THPW | Theory | T | Continuous Evaluation | | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Internal Assessment | End Semester Exams | | |
| 1 | Core | HMVPG23M201 | I | Galois Theory | 5 | 4 | 1 | 50 | 50 | 100 | 5 |
| 2 | Core | HMVPG23M202 | II | Lebesgue measure and Integration | 5 | 4 | 1 | 50 | 50 | 100 | 5 |
| 3 | Core | HMVPG23M203 | III | Complex Analysis | 5 | 4 | 1 | 50 | 50 | 100 | 5 |
| 4 | Core | HMVPG23M204 | IV | Topology | 5 | 4 | 1 | 50 | 50 | 100 | 5 |
| | | | | Total | 20 | | | | | 400 | 20 |

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**Chairperson**

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Chairperson
BOS in Dept of Mathematics
Osmania University
Hyderabad-500 007

**Members**

**Principal**
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Nallakunta, Hyderabad-500044

## M.Sc. Mathematics

## Choice Based Credit System (CBCS) Semester - III

| S.No. | Subject | Paper Code | Paper | Paper Title | THPW | Theory | T | Continuous Evaluation | | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Internal Assessment | End Semester Exams | | |
| 1 | Core | HMVPG24M301 | I | Functional Analysis | 5 | 4 | 1 | 50 | 50 | 100 | 5 |
| 2 | Core | HMVPG24M302 | II | Elementary Number Theory | 5 | 4 | 1 | 50 | 50 | 100 | 5 |
| 3 | Elective | HMVPG24M303(A) | III | Mathematical Statistics | 5 | 4 | 1 | 50 | 50 | 100 | 5 |
| | | HMVPG24M303(B) | | Discrete Mathematics | | | | | | | |
| | | HMVPG24M303(C) | | Mechanics | | | | | | | |
| 4 | Elective | HMVPG24M304(A) | IV | Operations Research | 5 | 4 | 1 | 50 | 50 | 100 | 5 |
| | | HMVPG24M304(B) | | Graph Theory | | | | | | | |
| | | HMVPG24M304(C) | | Finite Difference Methods | | | | | | | |
| | | | | Total | 20 | | | | | 400 | 20 |

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**Chairperson**

**University Nominee**

PROFESSOR
Department of Mathematics
OSMANIA UNIVERSITY
HYDERABAD-500 007

28/2/2024

**Chairperson**
**(BOS, Dept of Maths, OU)**

Chairperson
BOS in Mathematics
Department of Mathematics
Osmania University
Hyderabad-500 007

**Members**

1.
2.

Associate Professor
Dept of Maths O.U.

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**Principal**

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**Nallakunta, Hyderabad-500044**

## M.Sc. Mathematics

## Choice Based Credit System (CBCS) Semester - IV

| S.No. | Subject | Paper Code | Paper | Paper Title | THPW | Theory | T | Continuous Evaluation | | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Internal Assessment | End Semester Exams | | |
| 1 | Core | HMVPG24M401 | I | Integral Equations and Calculus of Variations | 5 | 4 | 1 | 50 | 50 | 100 | 5 |
| 2 | Core | HMVPG24M402 | II | Partial Differential Equations | 5 | 4 | 1 | 50 | 50 | 100 | 5 |
| 3 | Elective | HMVPG24M 403(A) | III | Elementary Operator Theory | 5 | 4 | 1 | 50 | 50 | 100 | 5 |
| | | HMVPG24M 403(B) | | Analytical Number Theory | | | | | | | |
| | | HMVPG24M 403(C) | | Numerical Analysis | | | | | | | |
| | | HMVPG24M 403(D) | | Cryptography | | | | | | | |
| 4 | Project | HMVPG24M 404 | IV | Mathematics Project | 5 | | | 60 | 40 | 100 | 5 |
| | | | | Total | 20 | | | | | 400 | 20 |

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

PROFESSOR, Department of Mathematics, OSMANIA UNIVERSITY, HYDERABAD-500 007.

Chairperson, BOS in Mathematics, Department of Mathematics, Osmania University, Hyderabad-500 007

PRINCIPAL, HINDI MAHAVIDYALAYA (AUTONOMOUS), Arts, Commerce & Science, Nallakunta, Hyderabad-44.

1.

2. Associate Professor, Dept of Maths O.U.

Dr LOKANADAVANI, ASSOCIATE PROFESSOR, Department of Mathematics and Statistics, Telangana Mahila Viswavidyalayam (Women's University), Koti, Hyderabad-500 095.

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**Nallakunta, Hyderabad-44**

## DEPARTMENT OF MATHEMATICS

***M.SC. MATHEMATICS FIRST YEAR***

**(With effect from batch of students admitted from the Academic Year 2023-24 under CBCS semester system)**

# Semester I

# SYLLABUS

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

**HMVPG23M101** **SEMESTER – I** **Credits: 5**

# PAPER – I : ABSTRACT ALGEBRA

**Unit-I**

Automorphisms - Conjugacy and G - sets - Normal series Solvable groups - Nilpotent groups. (Pages 104 to 128 )

**Unit-II**

Structure theorems of groups: Direct product - Finitely generated abelian groups - Invariants of a finite abelian group - Sylow's theorems - Groups of orders p2 , pq . (Pages 138 to 155)

**Unit-III**

Ideals and homomorphisms - Sum and direct sum of ideals, Maximal and prime ideals - Nilpotent and nil ideals - Zorn's lemma (Pages 179 to 211).

**Unit-IV**

Unique factorization domains - Principal ideal domains - Euclidean domains - Polynomial rings over UFD (Pages 212 to 228)

**Text Book:**

- Basic Abstract Algebra by P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul.

**Reference:**

- Topics in Algebra by I.N. Herstein.
- Elements of Modern Algebra by Gibert& Gilbert.
- Abstract Algebra by Jeffrey Bergen. [4] Basic Abstract Algebra by Robert B Ash.

**Chairperson** **University Nominee** **Chairperson** **Members** **Principal**
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**M.SC. MATHEMATICS**

**HMVPG23M102** **SEMESTER – I** **Credits: 5**

# PAPER – II : MATHEMATICAL ANALYSIS

## Unit- I

**Metric spaces** - Compact sets - Perfect sets - Connected sets.(Page No. 30-46).

## Unit- II

**Limits of functions** - Continuous functions - Continuity and compactness, Continuity and connectedness Discontinuities - Monotonic functions, Differentiation.(Page No. 83-102)

## Unit- III

**Riemann - Steiltjes integral** - Definition and Existence of the Integral - Properties of the integral – Integration and differentiation, Integration of vector valued functions - Rectifiable curves.(Page No. 120-133 & 135-142)

## Unit- IV

**Sequences and Series of Functions**: Uniform convergence - Uniform convergence and continuity Uniform convergence and integration - Uniform convergence and differentiation – The Stone-Weierstrass theorem. (Page No. 143-154, 159-161, 165-171 & 220-222)

***Text Book:***

- **Principles of Mathematical Analysis** (3rd Edition) By Walter Rudin, *McGraw-Hill International Edition*.

***References:***

- **The Real Numbers** by John Stillwel.
- **Real Analysis** by Barry Simon.
- **Mathematical Analysis** Vol - I by D J H Garling.
- **Measure and Integral** by Richard L.Wheeden and Antoni Zygmund.

**Chairperson** **University Nominee** **Chairperson** **Members** **Principal**
(BOS, Dept of Maths, OU)

Department of Mathematics
OSMANIA UNIVERSITY
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Chairperson
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**HINDI MAHAVIDYALAYA, NALAAKUNTA, HYDERABAD**
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**BOS-DEPARTMENT OF MATHEMATICS**
**M.SC. MATHEMATICS**

**HMVPG23M103** **SEMESTER – I** **Credits: 5**

## Paper - III: Ordinary Differential Equations

### Unit- I

**Existence and Uniqueness of Solutions**: Preliminaries – Successive approximations – Picard's theorem – Some examples – Continuation and dependence on initial conditions – Existence of solutions in the large – Existence and uniqueness of solutions of systems.

### Unit- II

**Linear Differential Equations of Higher Order**: Introduction – Higher order linear differential equations – A Mathematical model – Linear dependence and Wronskian – Homogeneous linear equations with constant coefficients – Equations with variable coefficients – Method of variation of parameters – Some standard methods –Laplace transforms.

### Unit- III

**Solutions in Power Series** : Introduction – Second order linear equations with ordinary points. Legendre equation and Legendre Polynomials – Second order equations with regular singular points – Bessel functions.

### Unit- IV

**Oscillations of Second Order Equations**: Introduction – Sturm's comparision theorem – Sturm's separation theorem-Elementary linear oscillations – Comparision theorem of Hille – Wintner. Oscillations of $x'' + a(t)x = 0$, Boundary value problems: Sturm – Liouville problem.

**Text Book:**

- **Ordinary Differential Equations** by S.G. Deo, V. Raghavendra , Rasmita Kar and V. Lakshmikantham , Third Edition, McGraw-Hill Education(India)Private Limited, New Delhi.

## References:

- **Differential Equations with Applications with Historical Notes** by George F.Simmons, *Second Edition*.
- **Ordinary Differential Equations** by Earl A Coddington.

| Chairperson | University Nominee | Chairperson (BOS, Dept of Maths, OU) | Members | Principal |
|---|---|---|---|---|

PROFESSOR
Department of Mathematics
OSMANIA UNIVERSITY
HYDERABAD-500 007

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**M.SC. MATHEMATICS**

**HMVPG23M104** **SEMESTER – I** **Credits: 5**

**Paper-IV: Linear Algebra**

**Unit- I**

Elementary Canonical forms - Introduction, Characteristic Values, Annihilating Polynomials, Invariant Sub-spaces, Simultaneous Triangulation and Simultaneous Diagonalization (Ch6, Sec6.1 - 6.5).

**Unit- II**

Direct sum Decomposition, Invariant Direct sums, The Primary Decomposition Theorem (Ch6, Sec 6.6 - 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, GroupsPreserving Bilinear Forms (Ch10, Sec 10.1 - 10.4)

**Text Book:**

**Linear Algebra** by Kenneth Hoffman and Ray Kunze, (2e), PHI.

**References:**

**Advanced Linear Algebra** by Steven Roman(3e).

**Linear Algebra** by David C Lay.

**Linear Algebra** by Kuldeep Singh.

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## DEPARTMENT OF MATHEMATICS

***M.SC. MATHEMATICS FIRST YEAR***

**(With effect from batch of students admitted from the Academic Year 2023-24 under CBCS semester system)**

# Semester II

# SYLLABUS

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**HMVPG23M201** **SEMESTERS – II** **Credits: 5**

## Paper - I: Galois Theory

### Unit- I

**Algebraic extensions of fields**: Irreducible polynomials and Eisenstein criterion - Adjunction of roots - Algebraic extensions - Algebraically closed fields. (Page No. 281-299).

### Unit- II

**Normal and separable extensions**: Splitting fields - Normal extensions - Multiple roots - Finitefields - Separable extensions. (Page No. 300 - 321).

### Unit- III

**Galois Theory**: Automorphism groups and fixed fields - Fundamental theorem of Galois Theory -Fundamental theorem of Algebra. (Page No. 322 - 339).

### Unit- IV

**Applications of Galois Theory to classical problems**: Roots of unity and cyclotomic polynomials -Cyclic extensions - Polynomials solvable by radicals (Page No. 340 - 364).

**Text Book:**

- **Basic Abstract Algebra** by P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul. *SecondEdition*

**References:**

- **Topics in Algebra** by I.N. Herstein.
- **Elements of Modern Algebra** by Gibert and Gilbert.
- **Abstract Algebra** by Jeffrey Bergen.
- **Basic Abstract Algebra** by Robert B Ash.

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**HMVPG23M202** **SEMESTER – II** **Credits: 5**

## Paper - II: Lebesgue Measure and Integration

### Unit- I

**Algebra of sets** - Borel sets - Outer measure - Measurable sets and Lebesgue measure - A non -measurable set - Measurable functions – Littlewood's three principles.

### Unit- II

**The Riemann integral** - The Lebesgue integral of a bounded function over a set of finite measure The integral of a non - negative function - The general Lebesgue integral.

### Unit- III

**Convergence in measure** - Differentiation of monotone functions - Functions of bounded variation.

### Unit- IV

**Differentiation of an integral** - Absolute continuity - The $L_p$ - spaces - The Minkowski and Holderinequalities - Convergence and completeness.

**Text Book:**

- **Real Analysis** (3rd Edition)(Chapters 3, 4, 5 ) by H. L. Royden, *Prentice-Hall India*.

**References:**

- **Lebesgue measure and Integration** by G.de Barra.
- **Measure and Integral** by Richard L.Wheeden, Anotoni Zygmund.

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**HMVPG23M203** **SEMESTER – II** **Credits:5**

## Paper III: Complex Analysis

### Unit- I

**Regions in the Complex Plane** - Functions of a Complex Variable - Limits - Continuity – Derivatives Cauchy – Riemann Equations - Sufficient Conditions for Differentiability - Analytic Functions -Harmonic Functions - Reflection Principle - The Exponential Function - The Logarithmic Function - Complex Exponents- Trigonometric functions- Hyperbolic functions .

### Unit- II

Derivatives of Functions $w(t)$ - Definite Integrals of Functions $w(t)$ - Contours - Contour Integrals - Some Examples - Upper Bounds for Moduli of Contour Integrals – Anti derivatives - Cauchy – Goursat Theorem - Simply Connected Domains - Multiply Connected Domains - Cauchy Integral Formula - An Extension of the Cauchy Integral Formula - Liouville's Theorem and the Fundamental Theorem of Algebra - Maximum Modulus Principle.

### Unit- III

Convergence of Sequences - Convergence of Series - Taylor Series - Laurent Series - Absolute and Uniform Convergence of Power Series - Isolated Singular Points - Residues - Cauchy's Residue Theorem - Residue at Infinity - The Three Types of Isolated Singular Points - Residues at Poles - Examples - Zeros of Analytic Functions - Zeros and Poles - Behavior of Functions Near Isolated Singular Points.

### Unit- IV

Evaluation of Improper Integrals - Improper Integrals from Fourier Analysis - Jordan's Lemma Definite Integrals Involving Sines and Cosines - Argument Principle - Rouche's Theorem - Linear Transformations - The Transformation $w = 1/z$ - Mappings by $1/z$ - Linear Fractional Transformations - An Implicit Form.

**Text Book:**

- **Complex Variables with Applications** by James Ward Brown and Ruel V Charcill. *McGraw- Hill International Edition.*

**References:**

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

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**HMVPG23M204** **SEMESTER – II** **Credits: 5**

## Paper - IV: Topology

### Unit- I

**Topological Spaces**: The Definition and examples - Elementary concepts - Open bases and opensubbases- Weak topologies. (Page No. 91-106)

### Unit- II

**Compactness**: Compact spaces - Products of spaces - Tychonoff's theorem and locally compactspaces - Compactness for metric spaces - Ascoli's theorem. (Page No. 110-128)

### Unit- III

**Separation**: $T_1$ - spaces and Hausdorff spaces - Completely regular spaces and normal spaces -Urysohn's lemma and the Tietze extension theorem - The Urysohn imbedding theorem. (Page No. 129-141)

### Unit- IV

**Connectedness**: Connected spaces - The components of spaces - Totally disconnected spaces -Locally connected spaces. (Page No. 142-152)

**Text Book:**

- **Introduction to Topology and Modern Analysis** By G.F. Simmon's. *Tata Mc Graw Hill Edition*.

**References:**

- **Introductory Topology** by Mohammed H. Mortad.
- **Explorations in Topology** by David Gay.
- **Encyclopedia of General Topology** by Hart, Nagata, Vanghan.
- **Elementary Topology** by Michael C. Gemignani.

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## DEPARTMENT OF MATHEMATICS

***M.SC. MATHEMATICS SECOND YEAR***

**(With effect from batch of students admitted from the Academic Year 2023-24 under CBCS semester system)**

## Semester III

# SYLLABUS

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**HMVPG24M301** **SEMESTERS – III** **Credits: 5**

# 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 andcontinuous 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 – Orthogonalsets 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,unitaryand 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 - OpenMapping 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 Wileyand sons, NewYork.

**References:**

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

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**HMVPG24M302** **SEMESTER – III** **Credits: 5**

## Paper - II: Elementary Number Theory

### Unit- I

**The Fundamental Theorem of Arithmetic**: Divisibility- GCD- Prime numbers, Fundamental theorem of arithmetic- the series of reciprocal of the primes- The Euclidean algorithm. (Page No. 13 - 23)

### Unit- II

**Arithmetical Functions and Dirichlet Multiplication**: The functions $\phi(n)$, $\mu(n)$ and a relation connecting them- Product formula for $\phi(n)$ - Dirichlet product- Dirichlet inverse and Mobius inversion formula -The Mangoldt function $\Lambda(n)$- Multiplicative functions and Dirichlet multiplication- The inverse of a completely multiplicative function- Liouville's function $\lambda(n)$- Thedivisor functions $\sigma_a(n)$. (Page No. 24-39 & 46-51)

### Unit- III

**Congruences**: Properties of congruence's- Residue classes and complete residue system- Linear congruences-Reduced residue systems and Euler-Fermat theorem- Polynomial congruence modulo p - Lagrange's theorem- Application of Lagrange's theorem- Chinese remainder theorem and its applications. (Page No. 106-120 & 126-128)

### Unit- IV

**Quadratic Residues and The Quadratic Reciprocity Law**: Quadratic residues- Legendre's symbol and its properties- Evaluation of $(-1|p)$ and $(2|p)$ - Gauss' lemma- The quadratic reciprocity law and its applications-The Jacobi symbol. (Page No. 178-190 & 201-203)

**Text Book:**

- **Introduction to Analytic Number Theory** by Tom M. Apostol. *Narosa publishing house*

**References**:

- **Number Theory** by Joseph H. Silverman.
- **Theory of Numbers** by K.Ramchandra.
- **Elementary Number Theory** by James K Strayer.
- **Elementary Number Theory** by James Tattusall.

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**HMVPG24M303 (A)** **SEMESTER – III** **Credits:5**

## Paper-III(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, variance of 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, 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:

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

### References:

- **Introduction to Probability Models** by Sheldon M.Ross(2010), Academic Press, Elsevier,10th Edition. (chapters 4 to 13).
- **Fundamental of Mathematical Statistics** by by S. C. Gupta and V. K. Kapoor S. Chand.

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**HMVPG24M303 (B)** **SEMESTER – III** **Credits: 5**

## Paper-III(B) : Discrete Mathematics

### Unit- I

Propositional logic, Propositional Equivalences, Predicates and Quantifiers, Rules of Inference– Valid Arguments in Propositional Logic. Rules of Inference for Quantified Statements. Introduction to Proofs – Direct Proofs, Proofs by Contraposition, Proofs by Contradiction. Normal Forms–Disjunctive Normal Form, Conjunctive Normal Forms, Principal Disjunctive Normal Form, Principal Conjunctive Normal Form. Boolean Algebra – Boolean Functions and Boolean Expressions, Identities of Boolean Algebra, Representing Boolean Functions. Logic Gates, Minimization of Circuits–K- maps. (1.1 *to* 1.3, 1.5 *to* 1.7, 10.1 *to* 10.4 *of* [1])

### Unit- II

Elementary Combinatorics – Basics of Counting, Two Basic Counting Principles, Indirect Counting. Combinations and Permutations – Enumeration of Combinations and Permutations, Enumerating Combinations and Permutations with Repetitions, Enumerating Permutations with Constrained Repetitions. Binomial Coefficients – Pascal's Identity, Pascal's Triangle. Multinomial Theorem, The Principleof Inclusion–Exclusion and its Applications. (2.1 *to* 2.8 *of* [2])

### Unit- III

Recurrence Relations – Generating Functions of Sequences, Generating Function Models, Calculating Coefficients of Generating Functions. Solutions of Recurrence Relations, the Fibonacci Relation.Solving Recurrence Relations by Substitution and by Generating Functions, Method of Characteristic Roots. Solution of Inhomogeneous Linear Recurrence Relations, the Method of Undetermined Coefficients: Solving Nonlinear Recurrence Relations. (3.1 *to* 3.6 *of* [2])

### Unit- IV

Graphs – Graphs and Graph Models, Graph Terminology and Special Types of Graphs, The Hand shaking Theorem, Representing Graphs and Graph Isomorphism. Connectivity, Euler and Hamiltonian Paths and Circuits,Shortest Path Problems, Dijkstra's Algorithm,Planar Graphs,Euler formula. Trees – Introduction to Trees, Tree Traversal. Spanning Trees, DFS, BFS Algorithms, Minimum Spanning Trees. Prim's and Kruskal's Algorithms. (8.1 *to* 8.7, 9.1, 9.3, 9.5 *of* [1])

**Text Book:**

- **Discrete Mathematics and its Applications** by Kenneth HRosen, Seventh Edition, Mc GrawHill Education (India)Private Ltd, New Delhi.
- **Discrete Mathematics for Computer Scientists** & **Mathematicians** by JoeL.Mott, Abraham Kandel and Theodore P. Baker, Second Edition, Prentice Hall of India, Private Ltd, NewDelhi.

**References:**

- **Elements of Discrete Mathematics** by C L Liu and D P Mohapatra, Third Edition, TheMcGraw-Hill Companies.
- **Discrete and Combinatorial Mathematics** by Ralph P. Grimaldi and B. V. Ramana,5th Edition,PEARSON education.

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**HMVPG24M303 (C)** **SEMESTER – III** **Credits:5**

# Paper-III(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, Ignorablecoordinates, D'Alembert Principle-Generalized 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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**HMVPG24M304 (A)** **SEMESTER – III** **Credits:5**

## Paper-IV(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, RevisedSimplex 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, Kedar Nath Ram NathPublications.

**References:**

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

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**HMVPG24M304 (B)** **SEMESTER – III** **Credits:5**

## Paper-IV(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:**

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

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**HMVPG24M304 (C)** **SEMESTER – III** **Credits:5**

## Paper-IV(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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## DEPARTMENT OF MATHEMATICS

***M.SC. MATHEMATICS SECOND YEAR***

**(With effect from batch of students admitted from the Academic Year 2023-24 under CBCS semester system)**

# Semester IV

# SYLLABUS

**HINDI MAHAVIDYALAYA, NALAAKUNTA, HYDERABAD**
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**HMVPG24M401** **SEMESTERS – IV** **Credits: 5**

## 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 Functional –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:**

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

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**HMVPG24M402** **SEMESTER – IV** **Credits: 5**

## Paper-II: Partial Differential Equations

### Unit- I

First order Nonlinear Equations, Cauchy's method of Characteristics, compatible systems of first order equations, Charpit's method, and 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:**

- **Introduction to Partial Differential Equations** by K. Shankar Rao, PHI, Third Edition.

**References:**

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

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**HMVPG24M403 (A)** **SEMESTER – IV** **Credits: 5**

## Paper-III(A): 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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**HMVPG24M403 (B)** **SEMESTER – IV** **Credits: 5**

## Paper-III(B): 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 visible on a the origin-The average order of $\mu(n)$ and $\Lambda(n)$ - The partial sums of 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 $\vartheta(x)$ - Relation connecting $\vartheta(n)$ 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 Asymptotic 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 dirichlet characters the non vanishing of $L(1, \chi)$ for real non principal $\chi$. (Sections 6.4to 6.10)

### Text Book:

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

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**HMVPG24M403 (C)** **SEMESTER – IV** **Credits:5**

## Paper-III(C): 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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**HMVPG24M403 (D)** **SEMESTER – IV** **Credits:5**

## Paper-III(D): 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, 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

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:**

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

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**Paper IV Mathematics Project**

# Project Evaluation Process

The total marks allotted for **Mathematics Project Work** are 100 marks and these marks are divided into the following way.

➢ **Internal Assessment (40 marks)**

| **First Seminar – 20 Marks** |
|---|
| **First seminar** (15 marks – in between 35 to 40 days after commencement of class work). This seminar includes the study of existing system, literature survey and problem definition.<br>**Day to Day Mathematics Project Report for 5 Marks** |
| **Second seminar – 20 Marks** |
| **Second seminar** (15 marks – in between 80 to 85 days after commencement of class work). This seminar includes the requirements specification, analysis, design and partial implementation.<br>**Day to Day Mathematics Project Report for 5 Marks** |

➢ **External Assessment (60 marks)**

- The students should submit one page of synopsis on the project work for display on the notice board.
- The project presentation is for 10 minutes followed by 05 minutes for discussion.
- The student should submit a dissertation/technical write-up on the project. At least two project evaluators (External Evaluators) will be associated with the project seminar to evaluate students for the award of seasonal marks which will be on the basis of performance in all the 3 items (synopsis, presentation, dissertation/technical write-up).

| | |
|---|---|
| Dissertation | : 40 Marks |
| Presentation | : 10 Marks |
| Viva | : 10 Marks |
| | Total : 60 Marks |

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## DEPARTMENT OF MATHEMATICS

***M.SC. MATHEMATICS I & II YEARS***

***I – IV Semesters***

**(With effect from batch of students admitted from the Academic Year 2023-24 under CBCS semester system)**

# PATTERN OF INTERNAL ASSESSMENT QUESTION PAPER AND THEORY QUESTION PAPER

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The Internal Assessment pattern from the academic year 2023 – 24 with the following specifications:

| | | | |
|---|---|---|---|
| Two internal Assessment Tests | : | 20 Marks | |
| Report Writing / Two Paraphrasing | : | 10 Marks | |
| Student Seminar & Student Assignment | : | 10 Marks | (5 + 5) |
| Student Attendance | : | 10 Marks | |
| Total | : | 50 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).

**Report Writing / Two Paraphrasing**
Report Writing / Two Paraphrasing to be conducted at middle / end of the Semester of instruction in the presences of faculty. Total marks for Report Writing / Two Paraphrasing 10 Marks.

**Student seminar presentation**
Student seminar to be conducted at end of the 13th week of instruction in the presences of faculty. Total marks for Student Seminar 5 Marks

**Student Assignment**
Assignment Topics to be assigned from the 6th week of instruction to the 14th week of instruction. The assignment will consist of hand written (students own handwriting).

Definition /Explication of 20 key concepts worth ¼ mark each. To be submitted for assessment in the 13th week of instruction. Total marks for assignment 20 x ¼ =10 Marks.

**Student Attendance**
**Attendance:** A portion of the assessment, accounting for 10 marks, is dedicated to tracking student's attendance. This aspect serves as an incentive for active engagement in the learning and teaching process.

**Weightage for Attendance**

| Attendance Percentage | Marks |
|---|---|
| 95% - 100% | 10 Marks |
| 86% - 94% | 8 Marks |
| 81% - 85% | 6 Marks |
| 75% - 80% | 5 Marks |
| 65% - 75% | 4 Marks * |

*** Applicable only to those who provide a valid reason with condonation.**

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**INTERNAL ASSESSMENT MODEL (I-IV SEMESTER)**

**Duration: 30 Minutes**

**1st Internal Assessment**

**Note answer all the questions**

| | | |
|---|---|---|
| **I.** | **Multiple choice questions** Q1. – Q10. | **10 x ½ = 5 Marks** |
| **II.** | **Fill in the Blanks** Q1. – Q10. | **10 x ½ = 5 Marks** |

**2nd Internal Assessment**

**Note answer all the questions**

| | | |
|---|---|---|
| **I.** | **Short Answer questions** Q1. – Q10. | **10 x 1 = 10 Marks** |

**3rd Internal Assessment**

**Report Writing / Two Paraphrasing** **10 Marks**

**4th Internal Assessment**

**10 Marks**

**Student Seminar for 5 marks**

**Student Assignment for 5 Marks**

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**MODEL QUESTION PAPER FOR END SEMESTER EXAMINATION**
**(I-IV SEMESTER)**

**Time: 2 Hours** **Max. Marks: 50**

**SECTION-A**

**Answer all the Questions. Each question carries 2 ½ marks** **5 X 2 = 10 Marks**

1. ( Unit I )
2. ( Unit II )
3. ( Unit III )
4. ( Unit IV )
5. ( Unit I **OR** Unit II **OR** Unit III **OR** Unit IV )

**SECTION-B**

**Answer all the Questions. Each question carries 10 marks** **5 X 8 = 40 Marks**

6. a) (OR) b) ( Unit I )
7. a) (OR) b) ( Unit II )
8. a) (OR) b) ( Unit III )
9. a) (OR) b) (Unit IV )
10. a) (OR) b) ( Unit I **OR** Unit II **OR** Unit III **OR** Unit IV )

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# HINDI MAHAVIDYALAYA

**(AUTONOMOUS & NAAC RE-ACCREDITED)**

**(Affiliated to Osmania University)**

**Nallakunta, Hyderabad-44**

## DEPARTMENT OF MATHEMATICS

***HINDI MAHAVIDYALAYA Arts, Commerce, Science& PG Centre***

*(Autonomous & NAAC Re-Accredited) (Affiliated To Osmania University)*

*Nallakunta,Hyderabd-44*

Department Of Mathematics

Academic Year - 2023-24

**Certificate Course Syllabus**

*Title:* ***Logical Reasoning & Arithmetic Ability***

**The following are the objectives of *Logical Reasoning & Arithmetic Ability:***

1. To teach the learner mathematical type of thought, to understand the statement to analyze them and to arrive at right conclusions.
2. To develop fundamental arithmetic concepts like the concept of number, order, units of measurement, size and shape etc.
3. To give accuracy and facility in simple computation of the fundamental process.
4. To develop speed and accuracy in arithmetical calculation and computation.
5. To impart a working knowledge of practical arithmetical applications which are useful in life.
6. To help in the learning of other branches and higher studies in mathematics.
7. Enable students to critically analyze material (information) to order to evaluate evidence, construct reasoned arguments, and communicate inferences and conclusions.
8. Solve and devise solutions to a range of elementary real-world problems in mathematics

## Content

| LOGICAL REASONING | ARITHMETIC ABILITY |
|---|---|
| 1. CODING- DECODING | 1. PERCENTAGE |
| 2. BLOOD RELATIONS | 2. DECIMALS |
| 3. CALENDERS | 3. NUMBER SYSTEM |
| 4. CLOCKS | 4. SIMPLIFICATION/APPROXIMATION |
| 5. DIRECTIONS | 5. RATIO&PROPORTION |
| 6. SEATING ARRANGEMENT | 6. BODMAS |
| 7. ORDER & RANKING | 7. AVERAGE |
| 8. PUZZLES | 8. PROFIT&LOSS |
| 9. ALPHANUMERIC SERIES | 9. SIMPLE&COMPOUND INTEREST |
| 10. PATTERN SERIES & SEQUENCES | 10. MENSURATION |
| 11. MIRROR IMAGES | 11. TIME AND WORK |
| 12. INPUT-OUTPUT | 12. PROBLEMS ON AGE |
| | 13. FACTORS AND MULTIPLES |
| | 14. SQUARE ROOT |

**Learning Outcomes:**

1. Identify and re-construct arguments in articles, news, editorials, advertisements etc.
2. Evaluate both deductive and inductive arguments, and identify fallacies in argumentative discourse
3. Effectively communicate the substance and meaning of mathematical problems and solutions.
4. Solve the problems easily by using Short-cut method with time management which will be helpful to them to clear the competitive exams for better job opportunity.
5. Analyze the Problems logically and approach the problems in a different manner.

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Department Of Mathematics

Academic Year - 2023-24 for I year ( Students Only UG & PG)

**Certificate Course Syllabus**

***Title:* Vedic Mathematics Made Easy**

## The Learning Objectives of the course are:

- Foster love for mathematics and remove its fear through Vedic Mathematics
- Enhance computation skills in students through Vedic Mathematics ·
- Develop logical and analytical thinking
- Promote joyful learning of mathematics
- Discuss the rich heritage of mathematical temper of Ancient India

## Content

| Unit I | | Unit II | |
|---|---|---|---|
| 1. SIMPLE METHOD | 2 HOURS | 1. BASE METHOD FOR SQUARING | 3 HOURS |
| 2. MULTIPLICATION | 3 HOURS | 2. MAGIC SQUARES | 3 HOURS |
| 3. SQUARING NUMBERS | 3 HOURS | 3. DATES & CALENDER | 3 HOURS |
| 4. CUBE ROOTS OF PERFECT CUBES | 3 HOURS | 4. GENERAL EQUATIONS | 3 HOURS |
| 5. SQUARE ROOTS OF PERFECT SQUARES | 3 HOURS | 5. SIMULTANIOUSLY LINEAR EQUATIONS | 3 HOURS |
| 6. BASE METHOD FOR MULTIPLICATION | 3 HOURS | | |

## Learning Outcomes:

- Overcome the fear of mathematics.
- Improved critical thinking
- Familiarity with the mathematical underpinnings and techniques
- Ability to do basic mathematics faster and with ease.
- Appreciate the Mathematical advancements of Ancient India.

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## COURSE OUTCOMES

### SEM I

#### PAPER – I Abstract Algebra

After the completion of the course, Students will be able to

**CO1:** Define the external direct product and be able to compute the direct product of groups.
**CO2:** Define normal subgroups and be able to prove that given subgroups are normal.
**CO3:** Concept of group action and theorems about group actions.
**CO4:** Structure of permutation groups.
**CO5:** Polynomial rings, EDs, PIDs, & UFDs, and relations among them. Universality of Polynomial rings
**CO6:** Solving problems using the powerful concept of group action.
**CO7:** Facility in understanding the structure of a problem where the problem involves a permutation group
**CO8:** Ability to understand a large class of commutative rings by regarding them as quotients of polynomial rings by suitable ideals.
**CO9:** Apply Lagrange's theorem.

#### Paper – II Mathematical Analysis

After the completion of the course, Students will be able to

**CO1:** Describe fundamental properties of the real numbers that lead to the formal development of mathematical analysis.
**CO2:** Comprehend regions arguments developing the theory underpinning mathematical analysis.
**CO3:** Demonstrate an understanding of limits and how that is used in sequences, series and differentiation.
**CO4:** Construct rigorous mathematical proofs of basic results in mathematical analysis.
**CO5:** Appreciate how abstract ideas and rigorous methods in mathematical analysis can be applied to important practical problems.

#### Paper – III Ordinary Differential Equations

After the completion of the course, Students will be able to

CO1: The study of Differential course on the existence and uniqueness of solutions and also analysis the rigorous justification of methods for approximating solutions in pure and applied mathematics.
CO2: Theory of ordinary differential equations is widely used in formulating many fundamental laws of physics and chemistry.
CO3: Theory of differential equation is used in economics and biology to model the behaviour of Complex systems.
CO4: Differential equations have a remarkable ability to predict the world around us.
CO5: They can describe exponential growth and decay population growth of species or change in investment return over time.
CO6: Analyze real world scenarios to recognize when ordinary differential equations (ODEs) or systems of ODEs are appropriate, formulate problems about the scenarios, creatively model these scenarios (using technology, if appropriate) in order to solve the problems using multiple approaches, judge if the results are reasonable, and then interpret and clearly communicate the results.
CO7: Recognize ODEs and system of ODEs concepts that are encountered in the real world, understand and be able to communicate the underlying mathematics involved to help another person gain insight into the situation.
CO8: Work with ODEs and systems of ODEs in various situations and use correct mathematical terminology, notation, and symbolic processes in order to engage in work, study, and conversation on topics involving ODEs and systems of ODEs with colleagues in the field of mathematics, science or engineering.

#### PAPER – IV Linear Algebra

After the completion of the course, Students will be able to

CO1: Find the dimension and basis of a given vector space.

CO2 : 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.
CO3 : Determine the rank, determinant, eigen values and eigenvectors, Diagonalization and different factorizations of a matrix.
CO4 : Carry out matrix operations, including inverses and determinants.
CO5 : Demonstrate understanding of the concepts of vector space and subspace.
CO6 : Demonstrate understanding of linear independence, span, and basis.
CO7 : Determine eigen values and eigenvectors and solve eigen value problems.
CO8 : Apply principles of matrix algebra to linear transformations.
CO9 : Demonstrate understanding of inner products and associated norms.

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**COURSE OUTCOMES**

## SEM II

### PAPER – I Galois's Theory

After the completion of the course, Students will be able to

CO1 : Explain the fundamental concepts of Golois Theory and their role in modern mathematics applied contexts.

CO2 : Explain Demonstrate accurate and efficient use of advanced algebraic techniques.

CO3 : Demonstrate capacity for mathematical reasoning through analyzing, proving and concepts from advanced algebra.

CO4 : Apply problem solving using Galois Theory techniques applied to diverse situations in physics, engineering and other mathematical finance.

### Paper – II Lebesgue Measure and Integrations

After the completion of the course, Students will be able to

**CO1:** Read analyze and write logical arguments to prove mathematical concepts.

**CO2:** Communicate mathematical ideas with clarity and coherence both written and verbally.

**CO3:** Fundamental objects, techniques and theorems in the mathematical sciences including the fields of analysis.

**CO4:** Master the object material in the four required core course that forms the academic pillars of the program.

**CO5:** Demonstrate a competence in formulating, analyzing and solving problems in several core areas ofmathematics at a detailed level, including analysis.

### Paper – III Complex Analysis

After the completion of the course, Students will be able to

CO1 : Students will be able to understand the concept of limit for real functions and be able to

CO2 : calculate limits of standard functions and construct simple proofs involving this concept;

CO3 : Student will be introduced to the concept of continuity and be familiar with the statements and proofs of the standard results about continuous real functions;

CO4 : Student will understand the concept of the differentiability of a real valued function and be

CO5 : familiar with the statements and proofs of the standard results about differentiable real functions.

CO6 : Student will have a working knowledge of differentiability for complex functions and be familiar with the Cauchy-Riemann equations;

CO7 : Student will evaluate integrals along a path in the complex plane and understand the statement of Cauchy's Theorem.

CO8 : Justify the need for a Complex Number System and explain how is related to other existing number systems.

CO9 : Define a function of complex variable and carry out basic mathematical operation with complex numbers.

CO10 : Know the condition(s) for a complex variable function to be analytic and/or harmonic functions

CO11 : Equation and use it to show that a function is analytic define singularities of a function, know the different types of singularities, and be able to determine the points of singularities of a function

CO12 : Demonstrate familiarity with a range of examples of these concepts.

CO13 : Apply the methods of complex analysis to evaluate definite integrals and infinite series.

### Paper – IV Topology

After the completion of the course, Students will be able to

**CO1:** Demonstrate an understanding of the concepts of metric spaces and topological spaces, and their role in mathematics.
**CO2:** Demonstrate familiarity with a range of examples of these structures.
**CO3:** Prove basic results about completeness, compactness, connectedness and convergence within these structures.
**CO4:** Use the Banach fixed point theorem to demonstrate the existence and uniqueness of solutions to differential equations.
**CO5:** Demonstrate an understanding of the concepts of Hilbert spaces and Banach spaces, and their role in mathematics.
**CO6:** Demonstrate familiarity with a range of examples of these structures.
**CO7:** Prove basic results about Hilbert spaces and Banach spaces and operators between such spaces.
**CO8:** Apply the theory in the course to solve a variety of problems at an appropriate level of difficulty.

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## COURSE OUTCOMES

### SEM III

### PAPER – I Functional Analysis

After the completion of the course, Students will be able to

CO1 : To learn to recognize the fundamental properties of normed spaces and of the transformations between them.
CO2 : Understand the notions of dot product and Hilbert space and apply the spectral theorem to the resolution of integral equations.
CO3 : Correlate Functional Analysis to problems arising in Partial Differential Equations, Measure Theory and other branches of Mathematics.
CO4 : Appreciate how functional analysis uses and unifies ideas from vector spaces, the theory of metrics, and complex analysis.
CO5 : Understand and apply fundamental theorems from the theory of normed and Banach spaces, including the Hahn-Banach theorem, the open mapping theorem, the closed graph theorem, and the Stone-Weierstrass theorem.
CO6 : Appreciate the role of Zorn's lemma.
CO7 : Understand and apply ideas from the theory of Hilbert spaces to other areas, including Fourier series, the theory of Fredholm operators, and wavelet analysis.
CO8 : Understand the fundamentals of spectral theory, and appreciate some of its power.

### Paper – II Elementary Number Theory

After the completion of the course, Students will be able to

**CO1:** Prove results involving divisibility and greatest common divisors. Solve systems of linear congruence's.
**CO2:** Find integral solutions to specified linear Diophantine Equations.
**CO3:** Apply Euler-Fermat's Theorem to prove relations involving prime numbers.
**CO4:** Apply the Wilson's theorem.
**CO5:** Demonstrate knowledge and understanding of topics including, but not limited to divisibility, prime numbers, congruences, quadratic reciprocity, Diophantine equations. □
**CO6:** Learn methods and techniques used in number theory. □
**CO7:** Write programs/functions to compute number theoretic functions. □
**CO8:** Use mathematical induction and other types of proof writing techniques.

### PAPER – IIIA Mathematical Statistics

After the completion of the course, Students will be able to

CO1 : Graduates 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.
CO2 : Graduates 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.
CO3 : Graduates should be able to describe important theoretical results and understand how they can be applied to answer statistical questions.
CO4 : Graduates should have familiarity with a standard statistical software packages and encourage study of data management and algorithmic problem solving.
CO5 : Graduates should have strong communication skills which are necessary to effectively collaborate as part of interdisciplinary teams including the ability to interpret and communicate the results of a statistical analysis through oral and written reports.

### Paper – III B Discrete Mathematics

After the completion of the course, Students will be able to

**CO1:** Understand the basic principles of sets and operations in sets.

**CO2:** Apply counting principles to determine probabilities Demonstrate different traversal methods for trees and graphs.
**CO3:** Write model problems in computer science using tree and graphs.
**CO4:** Write an argument using logical notation and determine if the argument is or is not valid.
**CO5:** Determine when a function is one-one and onto.
**CO6:** Demonstrate the ability to write and evaluate a proof.

**PAPER – III C Mechanics**

After the completion of the course, Students will be able to

CO1 : Relative motion, Inertial and non inertial reference frames.
CO2 : Parameters defining the motion of mechanical systems and their degrees of freedom.
CO3 : Study of the interaction of forces between solids in mechanical systems.
CO4 : Centre of mass and inertia tensor of mechanical systems.
CO5 : Application of the vector theorems of mechanics and interpretation of their results.
CO6 : Newton's laws of motion and conservation principles.
CO7 : Introduction to analytical mechanics as a systematic tool for problem solving.
CO8 : Use of mechanical simulation software.

**PAPER – IV A Operation Research**

After the completion of the course, Students will be able to

CO1 : To formulate a given simplified description of a suitable real-world problem as a linear programming model in general, standard and canonical forms
CO2 : To sketch a graphical representation of a two-dimensional linear programming model given in general, standard or canonical form
CO3 : To classify a two-dimensional linear programming model by the type of its solution
CO4 : To solve a two-dimensional linear programming problem graphically
CO5 : To use the simplex method to solve small linear programming models by hand, given a basic feasible point.
CO6 : To express the concepts of factorial and the basic principal of counting.

**PAPER – IV B Graph Theory**

After the completion of the course, Students will be able to

CO1 : State all of the technical definitions covered in the course (such as a graph, tree, planar
CO2 : graph, colouring, digraph, generating function, linear extension, and other terms).
CO3 : State all of the relevant theorems covered in the course.
CO4 : Use these definitions and theorems from memory to construct solutions to problems and/or proofs.
CO5 : Formulate graph theoretic models to solve real world problems (e.g., scheduling problems).
CO6 : Analyze combinatorial objects satisfying certain properties and answer questions related to existence (proving the existence or non-existence of such objects), construction (describing how to create such objects in the case they exist), enumeration (computing the number of such objects), and optimization (determining which objects satisfy a certain extremal property).

**PAPER – IV C Finite Difference Method**

After the completion of the course, Students will be able to

CO1 : Ability to solve the system of linear equations and finding eigen values of the matrices.
CO2 : Perform polynomial interpolations using various techniques.
CO3 : Perform Cubic-spline interpolation and approximations.
CO4 : To understand numerical errors and obtain roots of system of nonlinear equations.

| |
|---|
| C05 : Perform Numerical Differentiation, Numerical Integration. |
| C06 : Solve IVP, BVP and numerical solutions of parabolic, elliptic and hyperbolic partial differential equations. |
| C07 : Apply various numerical techniques in real life problems. |

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**COURSE OUTCOMES**

## SEM IV

### PAPER – I
### Integral equations & Calculus of Variation

After the completion of the course, Students will be able to

CO1 : Understand the methods to reduce Initial value problems associated with linear differential equations to various integral equations.

CO2 : Categorise and solve different integral equations using various techniques.

CO3 : Describe importance of Green's function method for solving boundary value problems associated with nonhomogeneous ordinary and partial differential equations, especially the Sturm-Liouville boundary value problems.

CO4 : Learn methods to solve various mathematical and physical problems using variational techniques.

CO5 : understand what functionals are, and have some appreciation of their applications

CO6 : apply the formula that determines stationary paths of a functional to deduce the differential equations for stationary paths in simple cases

CO7 : use the Euler-Lagrange equation or its first integral to find differential equations for stationary paths

CO8 : solve differential equations for stationary paths, subject to boundary conditions, in straight forward cases.

### Paper – III Partial Differential Equation

After the completion of the course, Students will be able to

**CO1:** Classify partial differential equations and transform into canonical form.

**CO2:** Solve linear partial differential equations of both first and second order

**CO3:** Apply partial derivative equation techniques to predict the behavior of certain phenomena.

**CO4:** Apply specific methodologies, techniques and resources to conduct research and produce innovative results in the area of specialization.

**CO5:** Extract information from partial derivative models in order to interpret reality.

**CO6:** Identify real phenomena as models of partial derivative equations. Demonstrate familiarity with emerging mathematical techniques appropriate in banks and other financial institutions.

**CO7:** Demonstrate an ability to select and apply numerical methods appropriate for the solution of financial problems.

**CO7:** The principles of mathematical reasoning and their use in understanding analyzing and developing formal arguments.

**CO8:** The connect lens between the mathematical series and other scientific and humoristic disciplines.

### PAPER – III A Elementary Operator Theory

After the completion of the course, Students will be able to

CO1 : This is an introductory course in Operator Theory. It will introduce the student to terms, concepts and results for bounded linear operators which are commonly used in this particular area of Mathematics.

CO2 : It will also introduce the students which are relevant to current research and prepare the student to persue such a career.

CO3 : special classes of bounded linear operator and study why each of them is important and significant.

CO4 : a parallel study of unbounded linear operator is also done to give the student a complete perspective

**PAPER – III B Analytical Number Theory**

After the completion of the course, Students will be able to

CO1 : Demonstrate an understanding of Analytic Number Theory by proving unseen results using the methods of the course.

CO2 : Correctly state the main definitions and theorems in the course.

CO3 : Produce examples and counterexamples illustrating the mathematical concepts presented in the course.

CO4 : Explain their reasoning about rigorous Analytic Number Theory clearly and precisely,using appropriate technical language.

CO5 : Understand better the distribution of prime numbers

CO6 : Know the basic theory of zeta- and L-functions
Understand the proof of Dirichlet's Theorem

**PAPER – III C B Numerical Analysis**

After the completion of the course, Students will be able to

CO1 : Understanding the theoretical and practical aspects of the use of numerical methods

CO2 : Implementing numerical methods for a variety of multidisciplinary applications

CO3 : Establishing the limitations, advantages, and disadvantages of numerical methods

CO4 : It is used for solving a system of equations

CO5 : It has application in all branches of engineering.

CO6 : To know how to find the roots of transcendental equations.

CO7 : To learn how to interpolate the given set of values

CO8 : To understand the curve fitting for various polynomials To learn numerical solution of differential equations

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