DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM & MARKING SCHEME

M.Sc. MATHEMATICS
Semester – I, II, III, IV

SESSION : 2025-26

ESTD: 1958

GOVT. V.Y.T. PG AUTONOMOUS COLLEGE, DURG, 491001 (C.G.)

(Former Name – Govt. Arts & Science College, Durg)

NAAC Accredited Grade A^+, College with CPE - Phase III (UGC), STAR COLLEGE (DBT)

Phone : 0788-2212030

Website - www.govtsciencecollegedurg.ac.in, Email – autonomousdurg2013@gmail.com

DEPARTMENT OF MATHEMATICS

GOVT. V.Y.T. PG. AUTONOMOUS COLLEGE DURG (C.G.)

Approved syllabus for M.Sc. Mathematics by the members of Board of Studies for the Sessions 2025 - 26

The Syllabus with the paper combinations is as under

Semester I

I : MMT 101 - Advanced Abstract Algebra (I)	**II : MMT 102 - Real Analysis (I)**
III : MMT 103 - Topology	**IV : MMT 104 - Complex Analysis (I)**
V : MMT 105 - Advanced Discrete Mathematics (I)	

The Syllabus for M.Sc. Mathematics is hereby approved for the sessions 2025 - 26

Chairperson / H.O.D - Dr. Padmavati	**Faculty Members**
Subject Expert - Dr. Madhu Srivastava	Dr. Rakesh Tiwari-
Subject Expert - Dr. Shabnam Khan	Dr. Prachi Singh-
Subject Expert - Dr. S. K. Bhatt	Dr. Shobha Rani –
Representative Members -	Smt. Nidhi Sharma –
(1) Dr. Anil Kashyap -	Ku. Ambalika Chouhan –
(2) Shri A. K. Pandey -	Ku. Bijma Kumari –
(3) Dr. Mayur Puri Goswami -	Ku. Deepak-

GENERAL INSTRUCTIONS FOR STUDENTS

1. The candidate has to obtain minimum 20% marks in each theory paper and internal assessment separately.
2. The candidate has to secure minimum 36% marks as an aggregate in order to pass that semester examination.
3. The internal assessment shall include class test, home assignment and seminar presentation.
4. Internal Assessment Examination will be as follows :
   i. Internal Test in each paper (20 marks)
   ii. Seminar (Power point presentation) in any one of the paper (20 marks)
   iii. Assignment in each of the remaining papers (excluding the paper of Seminar. (20 marks)
   iv. Average of marks obtained in internal test + seminar in any one paper and marks obtained in internal test + assignment in rest of the papers will be calculated and taken into consideration.

5. There shall be one seminar in each semester. In each semester, the paper in which seminar has to be presented will be allotted randomly .The marking of seminar shall be in terms of hard copy submission (10 marks) and presentation and open discussion 10 marks. In seminar the marks taken in to consideration will be the average marks given by two examiners.

Chairperson / H.O.D - Dr. Padmavati	**Faculty Members**
Subject Expert - Dr. Madhu Srivastava	Dr. Rakesh Tiwari -
Subject Expert - Dr. Shabnam Khan	Dr. Prachi Singh -
Subject Expert - Dr. S. K. Bhatt	Dr. Shobha Rani -
Representative Members -	Smt. Nidhi Sharma -
(1) Dr. Anil Kashyap -	Ku. Ambalika Chouhan -
(2) Shri A. K. Pandey -	Ku. Bijma Kumari -
(3) Dr. Mayur Puri Goswami -	Ku. Deepak-

DIRECTIVES FOR STUDENTS, FACULTY AND EXAMINERS

Question Paper Format and Distribution of Marks for PG Semester Examination

Question paper format for the Post-Graduate Examination has been revised from the Session 2023-24. The revised format will be applicable for all the question papers of Semester I, II, III & IV. The following are the main points of the new format:

1. The question paper will be of **80 marks** (as before)
2. Questions will be asked Unit-wise in each question paper.
3. From each Unit, the questions will be asked as follows :

Very short answer type question **(Answer in one or two sentences)**	**(02 Marks)**
Very short answer type question **(Answer in one or two sentences)**	**(02 Marks)**
Short answer type question	**(04 Marks)**
Long answer type questions	**(12 Marks)**

Type of Question	Unit-I	Unit-II	Unit-III	Unit-IV
Very Short (2 Questions)	2 x 2 = 4 Marks	2 x 2 = 4 Marks	2 x 2 = 4 Marks	2 x 2 = 4 Marks
Short (1 Question)	1 x 4 = 4 Marks	1 x 4 = 4 Marks	1 x 4 = 4 Marks	1 x 4 = 4 Marks
Long answer (1 Question)	1 x 12 = 12 Marks	1 x 12 = 12 Marks	1 x 12 = 12 Marks	1 x 12 = 12 Marks

Note:

1. Question no. 1 and Question 2 will be compulsory.
2. Question no. 3 and 4 will consist of 2 optional questions of which one has to be attempted.
3. As mentioned above, two compulsory very short answer type questions (2+2 marks), one short answer type question with internal choice (4 marks) and one

long answer type question with internal choice (12 marks) will be asked from each unit.
Thus there will be questions of 20 marks from each unit and of total 80 marks from all the four units of the syllabus / syllabi

4 The students are required to study the content mentioned in the curriculum exhaustively.

CREDIT ALLOTMENTS

Theory 80 marks = 04 Credits

Internal Assessment 20 marks = 01 credit

Theory Paper + Practical = 05 credits (04+01)

Chairperson / H.O.D - Dr. Padmavati	**Faculty Members**
Subject Expert - Dr. Madhu Srivastava	Dr. Rakesh Tiwari -
Subject Expert - Dr. Shabnam Khan	Dr. Prachi Singh-
Subject Expert - Dr. S. K. Bhatt	Dr. Shobha Rani –
Representative Members -	Smt. Nidhi Sharma –
(1) Dr. Anil Kashyap -	Ku. Ambalika Chouhan –
(2) Shri A. K. Pandey -	Ku. Bijma Kumari –
(3) Dr. Mayur Puri Goswami -	Ku. Deepak-

Syllabus and Marking Scheme for M.Sc. Mathematics First Semester Session 2025-26.

Paper No.	Title of the Paper	Marks Allotted in Theory		Marks Allotted in Internal Assessment		Credits
		Max	Min	Max.	Min.	
I	**Advanced Abstract Algebra (I)**	80	16	20	04	05
II	**Real Analysis (I)**	80	16	20	04	05
III	**Topology**	80	16	20	04	05
IV	**Complex Analysis (I)**	80	16	20	04	05
V	**Advanced Discrete Mathematics (I)**	80	16	20	04	05
	Total	**400**		**100**		**25**

05 Theory papers - 400
05 Internal Assessments - 100
Total Marks - 500
Note: 20 marks = 01 credit in Theory Papers.

Chairperson / H.O.D - Dr. Padmavati

Subject Expert - Dr. Madhu Srivastava

Subject Expert - Dr. Shabnam Khan

Subject Expert - Dr. S. K. Bhatt

Representative Members -

(1) Dr. Anil Kashyap -
(2) Shri A. K. Pandey -
(3) Dr. Mayur Puri Goswami -

Faculty members

Dr. Rakesh Tiwari-

Dr. Prachi Singh-

Dr. Shobha Rani –

Smt. Nidhi Sharma –

Ku. Ambalika Chouhan –

Ku. Bijma Kumari –

Ku. Deepak-

PG Department of Mathematics

Program Outcomes:

PO No.	Program outcomes upon completion of the M. Sc. Degree program, the student will be able to
PO No. - 1	Pursue higher studies in mathematics in reputed institute of our country and clear Competitive exams like SET / NET / TET etc.
PO No. – 2	Read and identify mathematical and computational methods in order to solve comprehensive problems in several competitive examinations.
PO No. – 3	Well prepared to take jobs in schools and colleges as Mathematic Teachers and Professors, Software Industries, Research and Development Organizations.
PO No.- 4	Learn and apply Mathematics in real life situations aiming at service to the society.

Program Specific Outcomes:

PSO No.	Program specific outcomes : upon completion of the M. Sc. Degree program, the student will be able to
PSO - 1	**Understand the fundamental axioms in mathematics and capable to develop ideas based on them.**
PSO – 2	**Inculcate mathematical reasoning and develop own learning capacity.**
PSO – 3	**Explain the core ideas and the techniques of mathematics and developabstract mathematical thinking.**
PSO - 4	**Assimilate the logical approach to take decision in complicated situations.**
PSO - 5	**Prepare and motivate for research studies in mathematics and relatedfields.**

Learning Outcomes:

After learning this course students are able to recognize and explain all about algebra.

Course Title	M. Sc. Previous, Advance Abstract Algebra
CO No.	**Course Outcomes - This course will enable the student to :**
CO No. – 1	Remember properties of group especially normal series and use of series in Jorden Holder Theorem.
CO No. – 2	Understand field extension with types of extension as- algebraic, transcendental, separable, inseparable and normal extension, Galois theory and solvability.
CO No.- 3	Apply module, Noetherian, Artinian modules and examples, Hilbert basis theorem and Wedderzburn Artin theorem.
CO No.- 4	Analyze Linear transformation, canonical form and nilpotent transformation, understand Jorden blocks and Jorden forms, Smith normal form and rational canonical form.

Learning Outcomes:

Student able to go to deep analytic approach which is elegant proves of research.

Course Title	M. Sc. Previous, Real Analysis
CO No.	**Course Outcomes - This course will enable the student to :**
CO No. – 1	Remember sequences and series of functions and their convergence, various test for convergence.
CO No. – 2	Analyze Function of several variables, derivatives in open subsets, derivatives of higher order, partition of unity and Stock's Theorem.
CO No.- 3	Understand Riemman and Stieltjes integral and its properties.
CO No.- 4	Apply Idea of measures, measurable sets, Borel and Lebesgue measures.

Learning Outcomes:

Student able to go to deep concept of topological spaces which is useful in research.

Course Title	M. Sc. Previous, Topology
CO No.	**Course Outcomes - This course will enable the student to :**
CO No. – 1	Remember the concept of topology and algebraic topology.
CO No. – 2	Apply the concept of separation axioms, connectedness, compactness and related topics.
CO No.- 3	Understand the product topology, embedding, metrization and paracompactness.
CO No.- 4	Analyze Nets, Filters and ultra filters. Fundamental group and covering spaces.

Learning Outcomes:

Student able to go to deep concept valued function and their analytic approach in mathematics.

Course Title	M. Sc. Previous, Complex Analysis
CO No.	**Course Outcomes - This course will enable the student to :**
CO No. – 1	Remember the concept and consequences of analyticity and the Cauchy Riemman equations and results on harmonic and entire functions including the fundamental theorem of algebra.
CO No. – 2	Understand the application of the power series, expansion of analytic functions.
CO No.- 3	Apply Conformal mapping and bilinear transformation and their properties.
CO No.- 4	Analyze the Cauchy residue theorem to evaluate integral and sum series, analytic continuation and its properties, canonical products, Little picard theorem, Montel theorem etc.

Learning Outcomes:

Student able to learn how to apply discrete mathematics in the field of engineering.

Course Title	M. Sc. Previous, Advance Discrete Mathematics
CO No.	**Course Outcomes - This course will enable the student to:**
CO No. – 1	Understand Algebraic structure, semigroups, monoids and operations on strings. Specially using in concatenation operations
CO No. – 2	Remember various types of grammars, Application of pumping lemma, Polish Notations.
CO No.- 3	Apply Finite autometa acceptors, nondeterministic finite autometa
CO No.- 4	Analyze mean terms, max terms, Boolean forms, Karnaugh mappings and minimization of Boolean function, cosets, Partial order relations, Lattices and its various types.

M.Sc. Mathematics (First Semester)

2025 - 2026

PAPER – I
Code- MMT 101

Advanced Abstract Algebra

Max. Marks 80

Unit-I Groups - Normal and Subnormal series. Composition series. Jordan-Holder theorem. Solvable groups. Nilpotent groups.

Unit-II Field theory- Extension fields. Algebraic and transcendental extensions. Separable and inseparable extensions. Algebraically closed fields.

Unit-III Perfect fields. Finite fields. Primitive elements. Normal extensions and splitting fields.

Unit-IV Automorphism of extensions. Galois extension. Fundamental theorem of Galois Theory. Solution of polynomial equations by radicals. Insolvability of the general equation of degree 5 by radicals.

Books Recommended:

1. P.B. Bhattacharya, S.K. Jain, S.R. Nagpaul : Basic Abstract Algebra, Cambridge University press
2. I. N.Herstein : Topics in Algebra, Wiley Eastern Ltd.
3. Quazi Zameeruddin and Surjeet Singh : Modern Algebra

References:

1. M. Artin, Algeabra, Prentice -Hall of India, 1991.
2. P .M. Cohn, Algebra, Vols. I,II &III, John Wiley & Sons, 1982,1989,1991.
3. N. Jacobson, Basic Algebra, Vols. I ,W. H. Freeman, 1980 .
4. S. Lang, Algebra, 3rd edition, Addison-Wesley, 1993.
5. I.S. Luther and I.B.S. Passi, Algebra, Vol. I-Groups, Vol.II-Rings, Narosa Publishing House (Vol.I-1996,Vol. II-1999)

6. D. S.Malik, J. N. Mordeson, and M. K. Sen, Fundamentals of Abstract Algebra, Mc Graw-Hill, International Edition, 1997.
7. Vivek Sahai and Vikas Bist, Algebra, Narosa Publishing House, 1999.
8. I. Stewart, Galois theory, 2nd edition, Chapman and Hall, 1989.
9. J.P. Escofier, Galois theory, GTM Vol.204, Springer, 2001..
10. Fraleigh, A first course in Algebra, Narosa,1982.

Chairperson / H.O.D - Dr. Padmavati	**Faculty Members**
Subject Expert - Dr. Madhu Srivastava	Dr. Rakesh Tiwari-
Subject Expert - Dr. Shabnam Khan	Dr. Prachi Singh-
Subject Expert - Dr. S. K. Bhatt	Dr. Shobha Rani –
Representative Members -	Smt. Nidhi Sharma –
(1) Dr. Anil Kashyap -	Ku. Ambalika Chouhan –
(2) Shri A. K. Pandey -	Ku. Bijma Kumari –
(3) Dr. Mayur Puri Goswami -	Ku. Deepak-

M. Sc. Mathematics (First Semester)

2025 - 2026
PAPER-II
Code- MMT 102

Real Analysis (I)

Max. Marks. 80

Unit-I Sequences and series of functions. Pointwise and uniform convergence. Cauchy criterion for uniform convergence. Weierstrass M-test, Abel's and Dirichlet's tests for uniform convergence. Uniform convergence and continuity. Uniform convergence and differentiation, Weierstrass approximation theorem.

Unit-II Power series uniqueness theorem for power series. Abel's and Tauber's theorems. Rearrangements of terms of a series. Riemann's theorem.

Unit-III Functions of several variable linear transformations, derivatives in an open subset of R^n, Chain rule, Partial derivatives, Interchange of the order of differentiation, Derivatives of higher orders, Taylor's theorem, Inverse function theorem, Implicit function theorem.

Unit-IV Extremum problems with constraints. Lagrange's multiplier method. Differentiation of integrals. Partitions of unity. Differential forms. Stoke's theorem.

Recommended Books:

1. Principle of Mathematical Analysis By Walter Rudin McGraw-Hill, Kogakusha, 1976, International student edition.
2. Real Analysis By H.L. Roydon Macmillan Pub.Co.Inc.4th Edition, New York .1962.

References:

1. T. M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi,1985.
2. Gabriel Klambauer, Mathematical Analysis, Marcel Dekkar,Inc. New York,1975.
3. A. J. White, Real Analysis; an introduction, Addison-Wesley Publishing Co.,Inc.,1968.
4. G. de Barra, Measure Theory and Integration, Wiley Eastern Limited, 1981.
5. E. Hewitt and K. Stromberg. Real and Abstract Analysis, Berlin, Springer, 1969.
6. P. K. Jain and V.P. Gupta, Lebesgue Measure and Integration, New Age International (P) Limited Published, New Delhi, 1986 Reprint 2000).
7. I. P. Natanson, Theory of Functions of a Real Variable. Vol. l, Frederick Ungar Publishing Co., 1961.

8. Richard L. Wheeden and Antoni Zygmund, Measure and Integral: An Introduction to Real Analysis, Marcel Dekker Inc.1977.
9. J. H. Williamson, Lebesgue Integration, Holt Rinehart and Winston, Inc. New York. 1962.
10. A. Friedman, Foundations of Modern Analysis, Holt, Rinehart and Winston, Inc., New York, 1970.
11. P. R. Halmos, Measure Theory, Van Nostrand, Princeton, 1950.
12. T.G. Hawkins, Lebesgue's Theory, of Integration: Its Origins and Development, Chelsea, New York, 1979.
13. K. R. Parthasarathy, Introduction to Probability and Measure, Macmillan Company of India Ltd., Delhi, 1977.
14. R. G. Bartle, The Elements of Integration, John Wiley & Sons, Inc. New York, 1966.
15. Serge Lang, Analysis I & II, Addison-Wesley Publishing Company, Inc. 1969.
16. Inder K. Rana, An Introduction to Measure and Integration, Norosa Publishing House, Delhi, 1997.
17. Walter Rudin, Real & Complex Analysis, Tata McGraw-Hill Publishing Co.Ltd. New Delhi, 1966.

Chairperson / H.O.D - Dr. Padmavati	**Faculty Members**
Subject Expert - Dr. Madhu Srivastava	Dr. Rakesh Tiwari -
Subject Expert - Dr. Shabnam Khan	Dr. Prachi Singh-
Subject Expert - Dr. S. K. Bhatt	Dr. Shobha Rani –
Representative Members -	Smt. Nidhi Sharma –
(1) Dr. Anil Kashyap -	Ku. Ambalika Chouhan –
(2) Shri A. K. Pandey -	Ku. Bijma Kumari –
(3) Dr. Mayur Puri Goswami -	Ku. Deepak-

M. Sc. Mathematics (First Semester)

2025 - 2026

PAPER-III

Code- MMT 103

Topology

Max. Marks. 80

Unit-I Countable and uncountable sets. Infinite sets and the axiom of Choice. Cardinal numbers and its arithmetic. Schroeder-Bernstein theorem. Cantor's theorem and the continuum hypothesis. Zorn's lemma. Well-ordering theorem. Definition and examples of topological spaces, Closed sets, Closure, Dense subsets, Neighborhoods, Interior, Exterior and Boundary. Accumulation points and derived sets. Bases and sub-bases. Subspaces and relative topology.

Unit-II Alternate methods of defining a topology in terms of Kuratowski Closure Operator, Neighborhood Systems. Continuous functions and homeomorphism. First and Second Countable Spaces. Lindelof's theorems. Separable spaces. Second countability and separability.

Unit-III Separation axioms, their Characterizations and basic properties. Urysohn's Lemma. Tietze extension theorem. Compactness. Continuous functions and compact sets. Basic properties of Compactness. Compactness and finite intersection property.

Unit-IV Sequentially and Countably compact sets. Local compactness and one point compactification. Stone-Cech compactification. Compactness in Metric spaces. Equivalence of compactness. Countable compactness and sequential compactness in metric space. Connected spaces. Connectedness on the real line. Components. Locally connected spaces.

Recommended Books:

1. K. D. Joshi, Introduction to General Topology, Wiley Eastern Ltd., 1983.

References:

1. J. Dugundji, Topology, Allyn and Bacon, 1966 (reprinted in India by Prentice Hall of India Pvt. Ltd.).
2. George F.Simmons, Introduction to Topology and modern Analysis, McGraw-Hill Book Company, 1963.
3. J.Hocking and G Young, Topology, Addison-Wiley Reading, 1961.
4. J.L. Kelley, General Topology, Van Nostrand, Reinhold Co., New York,1995.

5. L. Steen and J. Seebach, Counter examples in Topology, Holt, Rinehart and Winston, New York, 1970.
6. W.Thron, Topologically Structures, Holt, Rinehart and Winston, New York,1966.
7. N. Bourbaki, General Topology Part I (Transl.),Addison Wesley, Reading, 1966.
8. R. Engelking, General Topology, Polish Scientific Publishers, Warszawa, 1977.
9. W. J. Pervin, Foundations of General Topology, Academic Press Inc. New York,1964.
10. E. H.Spanier, Algebraic Topology, McGraw-Hill, New York,1966.
11. S. Willard, General Topology, Addison-Wesley, Reading, 1970.
12. Crump W. Baker, Introduction to Topology, Wm C. Brown Publisher, 1991.
13. Sze-Tsen Hu, Elements of General Topology, Holden-Day,Inc.1965.
14. D. Bushaw, Elements of General Topology, John Wiley & Sons, New York, 1963.
15. M.J. Mansfield, Introduction to Topology, D.Van Nostrand Co. Inc.Princeton,N.J.,1963.
16. B. Mendelson, Introduction to Topology, Allyn & Bacon, Inc., Boston,1962.
17. C. Berge, Topological Spaces, Macmillan Company, New York,1963.
18. S.S. Coirns, Introductory Topology, Ronald Press, New York, 1961.
19. Z.P. Mamuzic, Introduction to General Topology, P. Noordhoff Ltd.,Groningen, 1963.
20. K. K. Jha, Advanced General Topology, Nav Bharat Prakashan, Delhi.
21. Seymour Lipschutz, General Topology, Tata McGraw Hill Publishing Company Ltd.(Schaum's out Lines.)

Chairperson / H.O.D - Dr. Padmavati	**Faculty Members**
Subject Expert - Dr. Madhu Srivastava	Dr. Rakesh Tiwari -
Subject Expert - Dr. Shabnam Khan	Dr. Prachi Singh-
Subject Expert - Dr. S. K. Bhatt	Dr. Shobha Rani –
Representative Members -	Smt. Nidhi Sharma –
(1) Dr. Anil Kashyap -	Ku. Ambalika Chouhan –
(2) Shri A. K. Pandey -	Ku. Bijma Kumari –
(3) Dr. Mayur Puri Goswami -	Ku. Deepak-

M. Sc. Mathematics (First Semester)
2025 - 2026
PAPER-IV
Code- MMT 104

Complex Analysis (I)

Max. Marks. 80

Unit-I Complex integration. Cauchy-Goursat theorem. Cauchy's integral formula. Higher order derivatives. Morera's theorem. Cauchy's inequality and Liouville's theorem. Taylor's theorem. Laurent's series.

Unit-II The zero of an analytic function. Singular and classification of singularity. Meromorphic functions. The argument principle. Rouche's theorem.The fundamental theorem of algebra. Maximum modulus principle. Schwarz lemma.Inverse function theorem. Residues. Cauchy's residue theorem. Evaluation of integrals. Branches of many valued functions with special reference to ***arg z, logz*** and z^a.

Unit-III Definitions and examples of Conformal mappings. Bilinear transformations- their properties and classifications. Some special bilinear transformations. The transformation of $w = z^2$, $z = \sqrt{w}$,$w = e^z$, $w = \tan^2(\pi /4a \sqrt{z})$

Unit-IV Spaces of analytic functions. Hurwitz's theorem. Montel's theorem. Riemann mapping theorem. Weierstrass Factorization theorem.

Recommended Books:

1. L.V. Ahlfors: Complex Analysis, MCGraw - Hill, 1979.
2. D. Sarason: Complex Function Theory, Hindustan Book Agency, Delhi, 1994.
3. H. K. Pathak, Complex Analysis and Applications, Springer, 2019.

References:

1. H.A. Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford 1990.
2. Liang-shin Hahn & Bernard Epstein, Classical Complex Analysis, Jones and Bartlett Publishers International, London, 1996.
3. S. Lang, Complex Analysis, Addison Wesley, 1977.
4. Mark J.Ablowitz and A.S. Fokas, Complex Variables: Introduction and Applications, Cambridge University press, South Asian Edition, 1998.
5. W.H.J. Fuchs, Topics in the Theory of Functions of one Complex Variable, D.Van Nostrand Co., 1967.
6. C. Caratheodory, Theory of Functions (2 Vols.) Chelsea Publishing Company, 1964.

7. M. Heins, Complex Function Theory, Academic Press, 1968.
8. Walter Rudin, Real and Complex Analysis, McGraw-Hill Book Co., 1966..
9. E.C Titchmarsh, The Theory of Functions, Oxford University Press, London.
10. W. A. Veech, A Second Course in Complex Analysis, W.A. Benjamin, 1967.
11. S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, 1997.

Chairperson / H.O.D - Dr. Padmavati	**Faculty Members**
Subject Expert - Dr. Madhu Srivastava	Dr. Rakesh Tiwari -
Subject Expert - Dr. Shabnam Khan	Dr. Prachi Singh-
Subject Expert - Dr. S. K. Bhatt	Dr. Shobha Rani –
Representative Members -	Smt. Nidhi Sharma –
(1) Dr. Anil Kashyap -	Ku. Ambalika Chouhan –
(2) Shri A. K. Pandey -	Ku. Bijma Kumari –
(3) Dr. Mayur Puri Goswami -	Ku. Deepak-

M. Sc. Mathematics (First Semester)
2025 - 2026
PAPER-V
Code- MMT 105

Advanced Discrete Mathematics (I)

Max. Marks. 80

Unit-I Formal Logic-Statements. Symbolic representation and Tautologies. Quantifiers. Predicates and Validity. Propositional Logic. Semigroups & Monoids-Definitions and Examples of Semigroups and monoids (including those pertaining to concatenation operation). Homomorphism of Semigroups and monoids. Congruence relation and Quotient Semigroups. Subsemigroup and submonoids. Direct Products. Basic Homomorphism Theorem.

Unit-II Lattices-Lattices as partially ordered sets- their properties. Lattices as Algebraic Systems. Sublattices. Direct products and Homomorphisms. Some special Lattices e.g., Complete, Complemented and Distributive Lattices. Boolean Algebras. Boolean Algebras as Lattices. Various Boolean Identities. The Switching Algebra example. Subalgebras.

Unit-III Direct Products and Homomorphisms. Join-Irreducible elements. Atoms and Minterms. Boolean Forms and Their Equivalence. Minterm Boolean Forms. Sum of Products Canonical Forms. Minimization of Boolean Functions. Applications of Boolean Algebra to Switching Theory (using AND,OR & NOT gates). The Karnaugh Map Method.

Unit-IV Grammars and Languages- Phrase–structure Grammars. Rewriting rules. Derivations. Sententia forms. Language generated by a Grammar. Regular, Context-Free and Context Sensitive Grammars and Languages. Regular sets. Regular expressions and the Pumping Lemma. Kleen's theorem. Notions of Syntax Analysis. Polish Notations. Conversion of Infix Expressions to Polish Notation. The Reverse Polish Notations.

Recommended Books:

1. Elements of Discrete Mathematics By C.L. Liu.
2. J.P. Tremblay & R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 1997.

References:

1. C.L Liu, Elements of Discrete Mathematics, McGraw-Hill Book Co.
2. N. Deo. Graph Theory with Application to Engineering and Computer Sciences. Prentice Hall of India.
3. J. L. Gersting, Mathematical Structures for Computer Science, (3rd edition), Computer Science Press, New York.
4. Seymour Lepschutz, Finite Mathematics (International) edition 1983), McGraw-Hill Book Company, New York.
5. S.Wiitala, Discrete Mathematics-A Unified Approach, McGraw-Hill Book Co.

Chairperson / H.O.D - Dr. Padmavati	**Faculty Members**
Subject Expert - Dr. Madhu Srivastava	Dr. Rakesh Tiwari -
Subject Expert - Dr. Shabnam Khan	Dr. Prachi Singh-
Subject Expert - Dr. S. K. Bhatt	Dr. Shobha Rani –
Representative Members -	Smt. Nidhi Sharma –
(1) Dr. Anil Kashyap -	Ku. Ambalika Chouhan –
(2) Shri A. K. Pandey -	Ku. Bijma Kumari –
(3) Dr. Mayur Puri Goswami -	Ku. Deepak-

DEPARTMENT OF MATHEMATICS

GOVT. V.Y.T. PG. AUTONOMOUS COLLEGE DURG (C.G.)

Approved syllabus for M.Sc. Mathematics by the members of Board of Studies for the Sessions 2025 - 26

The Syllabus with the paper combinations is as under

Semester II

Paper I: MMT 201 - Advanced Abstract Algebra (II)	**Paper II: MMT 202 -Real Analysis (II)**
Paper III:MMT 203 -General and Algebraic Topology	**Paper IV: MMT 204 - Complex Analysis (II)**
Paper V: MMT 205 - Advanced Discrete Mathematics (II)	

The Syllabus for M.Sc. Mathematics is hereby approved for the sessions 2025 - 26

GENERAL INSTRUCTIONS FOR STUDENTS

1. The candidate has to obtain minimum 20% marks in each theory paper and internal assessment separately.
2. The candidate has to secure minimum 36% marks as an aggregate in order to pass that semester examination.
3. The internal assessment shall include class test, home assignment and seminar presentation.
4. Internal Assessment Examination will be as follows :
   i. Internal Test in each paper (20 marks)
   ii. Seminar (Power point presentation) in any one of the paper (20 marks)
   iii. Assignment in each of the remaining papers (excluding the paper of Seminar. (20 marks)
   iv. Average of marks obtained in internal test + seminar in any one paper and marks obtained in internal test + assignment in rest of the papers will be calculated and taken into consideration.

5. There shall be one seminar in each semester. In each semester, the paper in which seminar has to be presented will be allotted randomly .The marking of seminar shall be in terms of hard copy submission (10 marks) and presentation and open discussion 10 marks. In seminar the marks taken in to consideration will be the average marks given by two examiners.

Chairperson / H.O.D - Dr. Padmavati Subject Expert - Dr. Madhu Srivastava Subject Expert - Dr. Shabnam Khan Subject Expert - Dr. S. K. Bhatt **Representative Members** - (1) Dr. Anil Kashyap - (2) Shri A. K. Pandey - (3) Dr. Mayur Puri Goswami -	**Faculty Members** Dr. Rakesh Tiwari Dr. Prachi Singh Dr. Shobha Rani – Smt. Nidhi Sharma – Ku. Ambalika Chouhan – Ku. Bijma Kumari – Ku. Deepak-

DIRECTIVES FOR STUDENTS, FACULTY AND EXAMINERS

Question Paper Format and Distribution of Marks for PG Semester Examination

Question paper format for the Post-Graduate Examination has been revised from the Session 2018-19. The revised format will be applicable for all the question papers of Semester I, II, III & IV. The following are the main points of the new format:

1. The question paper will be of **80 marks** (as before)
2. Questions will be asked Unit-wise in each question paper.
3. From each Unit, the questions will be asked as follows :

   Very short answer type question
   (Answer in one or two sentences) **(02 Marks)**
   Very short answer type question
   (Answer in one or two sentences) **(02 Marks)**
   Short answer type question **(04 Marks)**
   Long answer type questions **(12 Marks)**

Type of Question	Unit-I	Unit-II	Unit-III	Unit-IV
Very Short (2 Questions)	2 x 2 = 4 Marks	2 x 2 = 4 Marks	2 x 2 = 4 Marks	2 x 2 = 4 Marks
Short (1 Question)	1 x 4 = 4 Marks	1 x 4 = 4 Marks	1 x 4 = 4 Marks	1 x 4 = 4 Marks
Long answer (1 Question)	1 x 12 = 12 Marks	1 x 12 = 12 Marks	1 x 12 = 12 Marks	1 x 12 = 12 Marks

Note:

1. Question no. 1 and Question 2 will be compulsory.
2. Question no. 3 and 4 will consist of 2 optional questions of which one has to be attempted.
3. As mentioned above, two compulsory very short answer type questions (2+2 marks), one short answer type question with internal choice (4 marks) and one

long answer type question with internal choice (12 marks) will be asked from each unit.

Thus there will be questions of 20 marks from each unit and of total 80 marks from all the four units of the syllabus/syllabi.

4The students are required to study the content mentioned in the curriculum exhaustively.

CREDIT ALLOTMENTS

Theory 80 marks= 04 Credits

Internal Assessment 20 marks = 01 credit

Theory Paper + Practical = 05 credits (04+01)

Chairperson / H.O.D - Dr. Padmavati	**Faculty Members**
Subject Expert - Dr. Madhu Srivastava	Dr. Rakesh Tiwari
Subject Expert - Dr. Shabnam Khan	Dr. Prachi Singh
Subject Expert - Dr. S. K. Bhatt	Dr. Shobha Rani –
Representative Members -	Smt. Nidhi Sharma –
(1) Dr. Anil Kashyap -	Ku. Ambalika Chouhan –
(2) Shri A. K. Pandey -	Ku. Bijma Kumari –
(3) Dr. Mayur Puri Goswami -	Ku. Deepak-

Syllabus and Marking Scheme for M.Sc. Mathematics Second Semester Session 2025-26

Paper No.	Title of the Paper	Marks Allotted in Theory		Marks Allotted in Internal Assessment		Credits
		Max	Min	Max.	Min.	
I	**Advanced Abstract Algebra (II)**	80	16	20	04	05
II	**Real Analysis (II)**	80	16	20	04	05
III	**Topology**	80	16	20	04	05
IV	**Complex Analysis (II)**	80	16	20	04	05
V	**Advanced Discrete Mathematics (II)**	80	16	20	04	05
	Total	**400**		**100**		**25**

05 Theory papers - 400

05 Internal Assessments -100

Total Marks- 500

Note: 20 marks = 01 credit in Theory Papers.

Chairperson / H.O.D - Dr. Padmavati Subject

Expert - Dr. Madhu Srivastava

Subject Expert - Dr. Shabnam Khan

Subject Expert - Dr. S. K. Bhatt

Representative Members -

(1) Dr. Anil Kashyap -

(2) Shri A. K. Pandey -

(3) Dr. Mayur Puri Goswami

Faculty Members

Dr. Rakesh Tiwari -

Dr. Prachi Singh-

Dr. Shobha Rani –

Smt. Nidhi Sharma –

Ku. Ambalika Chouhan –

Ku. Bijma Kumari –

Ku. Deepak-

PG Department of Mathematics

Program Outcomes:

PO No.	Program outcomes upon completion of the M. Sc. Degree program, the student will be able to
PO No. - 1	Pursue higher studies in mathematics in reputed institute of our country and clear Competitive exams like SET / NET / TET etc.
PO No. – 2	Read and identify mathematical and computational methods in order to solve comprehensive problems in several competitive examinations.
PO No. – 3	Well prepared to take jobs in schools and colleges as Mathematic Teachers and Professors, Software Industries, Research and Development Organizations.
PO No.- 4	Learn and apply Mathematics in real life situations aiming at service to the society.

Program Specific Outcomes:

PSO No.	Program specific outcomes :upon completion of the M. Sc. Degreeprogram, the student will be able to
PSO - 1	Understand the fundamental axioms in mathematics and capable todevelop ideas based on them.
PSO – 2	Inculcate mathematical reasoning and develop own learning capacity.
PSO – 3	Explain the core ideas and the techniques of mathematics anddevelopabstract mathematical thinking.
PSO - 4	Assimilatethe logical approach to take decision in complicated situations.
PSO - 5	Prepare and motivate for research studies in mathematics and relatedfields.

Learning Outcomes:

After learning this course students are able to recognize and explain all about algebra.

Course Title	M. Sc. previous,Advance Abstract Algebra
CO No.	Course Outcomes - This course will enable the student to :
CO No. – 1	Remember properties of group especially normal series and use of series in Jorden Holder Theorem.
CO No. – 2	Understand field extension with types of extension as- algebraic, transcendental, separable, inseparable and normal extension.
CO No.- 3	Apply Galois theory and evaluate general equation by radicals. Recall Linear transformation, canonical form and nilpotent transformation, Jorden blocks and Jorden forms.
CO No.- 4	Analyze module, Noetherian, Artinian modules and examples, Hilbert basis theorem and WedderzburnArtin theorem.

Learning Outcomes:

Student able to go to deep analytic approach which is elegant proves of research.

Course Title	M. Sc. previous,Real Analysis
CO No.	Course Outcomes - This course will enable the student to :
CO No. – 1	Remember sequences and series of functions and their convergence, various test for convergence.
CO No. – 2	Analyze Function of several variables, derivatives in open subsets, derivatives of higher order, partition of unity and Stock's Theorem.
CO No.- 3	Understand Riemman and Stieltjes integral and its properties.
CO No.- 4	Understand Idea of measures, measurable sets, Borel and Lebesgue measures.

Learning Outcomes:

Student able to go to deep concept of topological spaces which is useful in research.

Course Title	M. Sc. previous,Topology
CO No.	**Course Outcomes This course will enable the student to :**
CO No. – 1	Remember the concept of topology and algebraic topology.
CO No. – 2	Apply the concept of separation axioms, connectedness, compactness and related topics.
CO No.- 3	Understand the product topology, embedding, metrization and paracompactness.
CO No.- 4	Analyze Nets, Filters and ultra filters. Fundamental group and covering spaces and prove some related theorems.

Learning Outcomes:

Student able to go to deep concept valued function and their analytic approach in mathematics.

Course Title	M. Sc. previous,Complex Analysis
CO No.	**Course Outcomes This course will enable the student to :**
CO No. – 1	Remember the concept and consequences of analyticity and the Cauchy Riemman equations and results on harmonic and entire functions including the fundamental theorem of algebra.
CO No. – 2	Understand the application of the power series, expansion of analytic functions.
CO No.- 3	Analyze Conformal mapping and bilinear transformation and their properties.
CO No.- 4	Apply the Cauchy residue theorem to evaluate integral and sum series, analytic continuation and its properties, canonical products.

Learning Outcomes:

Student able to learn how to apply discrete mathematics in the field of engineering.

Course Title	M. Sc. previous,Advance Discrete Mathematics
CO No.	**Course Outcomes**
CO No. – 1	Understand Algebraic structure, semigroups, monoids and operations on strings. Specially using in concatenation operations
CO No. – 2	Remember various types of grammars, Application of pumping lemma, Polish Notations.
CO No.- 3	Create Finite autometa acceptors, nondeterministic finite autometa.
CO No.- 4	Analyze mean terms, max terms, Boolean forms, Karnough mappings and minimization of Boolean function, Partial order relations, Lattices and its various types.

M. Sc. Mathematics (Second Semester)
2025 – 2026
Code- MMT 201
PAPER-I
Advanced Abstract Algebra (II)

Max. Marks. 80

Unit-I Modules- Cyclic modules. Simple modules. Semi-simple modules. Schur's Lemma. Free modules. Noetherian and Artinian modules and Rings-Hilbert basis theorem. Wedderburn Artin theorem. Uniform modules. Primary modules.

Unit-II Linear Transformations - Algebra of linear transformation. Singular and non-singular transformations. Characteristic roots. Matrices and linear transformations.

Unit-III Canonical Forms - Similarity of linear transformations. Invariant subspaces. Reduction to triangular forms. Nilpotent transformations. Index of Nilpotency. Invariants of a nilpotent transformation. The primary decomposition theorem. Jordan blocks and Jordan forms.

Unit-IV Smith normal form over a principal ideal domain and rank. Fundamental structure theorem for finitely generated modules over a Principal ideal domain and its applications to finitely generated abelian groups. Rational Canonical forms. Generalized Jordan form over any field .

Books Recommended:

1. P.B. Bhattacharya, S.K.Jain, S.R.Nagpaul : Basic Abstract Algebra, Cambridge University press
2. I.N. Herstein : Topics in Albegra, Wiley Eastern Ltd.
3. QuaziZameeruddin and Surjeet Singh : Modern Algebra

References:

1. M.Artin, Algeabra, Prentice -Hall of India, 1991.
2. P.M. Cohn, Algebra,Vols. I,II &III, John Wiley & Sons, 1982,1989,1991.

3. N.Jacobson, Basic Algebra, Vols. I & II,W.H. Freeman, 1980 (also published by Hindustan Publishing Company).
4. S.Lang, Algebra, 3rd edition, Addison-Wesley, 1993.
5. D.S.Malik, J.N.Mordeson, and M.K.Sen, Fundamentals of Abstract Algebra, Mc Graw-Hill, International Edition,1997.
6. K.B. Datta, Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd., New Delhi,2000.
7. S.K.jain,A. Gunawardena and P.B Bhattacharya, Basic Linear Algebra with MATLAB, Key College Publishing (Springer-Verlag),2001.
8. S.Kumaresan, Linear Algebra, A Geometric Approach, Prentice-Hall of India, 2000.
9. Vivek Sahai and Vikas Bist, Algebra, Narosa Publishing House, 1999.
10. J.P. Escofier, Galois theory, GTM Vol.204, Springer, 2001.
11. T.Y. Lam, lectures on Modules and Rings, GTM Vol. 189, Springer-Verlag,1999.

Chairperson / H.O.D - Dr. Padmavati	**Faculty Members**
Subject Expert - Dr. Madhu Srivastava	Dr. Rakesh Tiwari -
Subject Expert - Dr. Shabnam Khan	Dr. Prachi Singh-
Subject Expert - Dr. S. K. Bhatt	Dr. Shobha Rani –
Representative Members -	Smt. Nidhi Sharma –
(1) Dr. Anil Kashyap -	Ku. Ambalika Chouhan –
(2) Shri A. K. Pandey -	Ku. Bijma Kumari –
(3) Dr. Mayur Puri Goswami-	Ku. Deepak-

M. Sc. Mathematics (Second Semester)
2025 – 2026
Code- MMT 202
PAPER-II
Real Analysis (II)

Max.Marks.80

Unit-I Definition and existence of Riemann-Stieltjes Integral. Properties of the integral. Integration and differentiation. The fundamental theorem of calculus. Integration of Vector-valued functions. Rectifiable curves.

Unit-II Lebesgue outer measure. Measurable sets. Regularity. Measurable functions. Borel and Lebesgue measurability. Non-measurable sets. Integration of non-negative functions. The general integral. Integration of series.

Unit-III Measures and outer measures, Extension of a measure. Uniqueness of extension. Completion of a measure. Measure spaces. Integration with respect to a measure. Riemann and Lebesgue Integrals.

Unit-IV The four derivatives. Functions of bounded variation. Lebesgue differentiation theorem. Differentiation and integration. The L^p-spaces. Convex functions. Jensen's inequality. Holder and Minkowski inequalities. Completeness of L^p. Convergence in measure. Almost uniform convergence.

Recommended Books:

1. Walter Rudin, Principles of Mathematical Analysis (3rd edition) McGraw-Hill, Kogakusha, 1976, International student edition.
2. Real Analysis by H. L. Roydon.

References:

1. T.M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.
2. Gabriel Klambauer, Mathematical Analysis, Marcel Dekkar,Inc. New York, 1975.
3. A.J. White, Real Analysis; an introduction, Addison-Wesley Publishing Co.,Inc.,1968.
4. G. de Barra, Measure Theory and Integration, Wiley Eastern Limited, 1981.

5. E. Hewitt and K. Stromberg. Real and Abstract Analysis, Berlin, Springer, 1969.
6. P.K. Jain and V.P. Gupta, Lebesgue Measure and Integration, New Age International (P) Limited Published, New Delhi, 1986 Reprint 2000).
7. I.P. Natanson, Theory of Functions of a Real Variable. Vol. I, Frederick Ungar Publishing Co., 1961.
8. H.L. Royden, Real Analysis, Macmillan Pub.Co.Inc.4th Edition, New York .1962.
9. Richard L. Wheeden and Antoni Zygmund, Measure and Integral: An Introduction to Real Analysis, Marcel Dekker Inc.1977.
10. J.H. Williamson, Lebesgue Integration, Holt Rinehart and Winston, Inc. New York. 1962.
11. A. Friedman, Foundations of Modern Analysis, Holt, Rinehart and Winston, Inc., N.Y. 1970.
12. P.R. Halmos, Measure Theory, Van Nostrand, Princeton, 1950.
13. T.G. Hawkins, Lebesgue's Theory, of Integration: Its Origins and Development, Chelsea, New York, 1979.
14. K.R. Parthasarathy, Introduction to Probability and Measure, Macmillan Company of India Ltd., Delhi, 1977.
15. R.G. Bartle, The Elements of Integration, J. Wiley & Sons, Inc. New York, 1966.
16. Serge Lang, Analysis I & II, Addison-Wesley Publishing Company, Inc. 1969.
17. Inder K. Rana, An Introduction to Measure and Integration, Norosa Publishing House, Delhi, 1997.

Chairperson / H.O.D - Dr. Padmavati	**Faculty Members**
Subject Expert - Dr. Madhu Srivastava	Dr. Rakesh Tiwari-
Subject Expert - Dr. Shabnam Khan	Dr. Prachi Singh-
Subject Expert - Dr. S. K. Bhatt	Dr. Shobha Rani –
Representative Members -	Smt. Nidhi Sharma –
(1) Dr. Anil Kashyap -	Ku. Ambalika Chouhan –
(2) Shri A. K. Pandey -	Ku. Bijma Kumari –
(3) Dr. Mayur Puri Goswami -	Ku. Deepak-

M. Sc. Mathematics (Second Semester)
2025 – 2026
Code- MMT 203
PAPER-III
Topology(II)

Max.Marks.80

Unit-I Product Topology: Product Spaces, Projection maps, Tychonoff product topology in terms of standard sub-base and its characterizations. Connectedness and product spaces. Compactness and product spaces (Tychonoff's theorem). Countability and Product spaces.

Unit-II Embedding and Metrization: Embedding and metrization. Embedding Lemma and Tychonoff embedding. The Urysohn metrization theorem. Local finiteness.

Unit-III Nets and Filters: Directed Set, Nets, Topology and convergence of nets, Hausdorffness and nets. Compactness and nets, Finite Intersection Property, Filters and their convergence. Canonical way of converting nets to filters and vice-versa.

Unit-IV Advanced Topological Theorems: Ultrafilters and Compactness, Paracompactness, The Nagata-Smirnov metrization theorem, The Smirnov metrization theorem.

Recommended Books:

1. K.D. Joshi, Introduction to General Topology, Wiley Eastern Ltd., 1983.

References:

1. J. Dugundji, Topology, Allyn and Bacon, 1966 (reprinted in India by Prentice Hall of India Pvt. Ltd.).
2. George F. Simmons, Introduction to Topology and modern Analysis, McGraw-Hill Book Company, 1963.
3. J. Hocking and G Young, Topology, Addison-Wiley Reading, 1961.
4. J. L. Kelley, General Topology, Van Nostrand, Reinhold Co., New York, 1995.
5. L. Steen and J. Seebach, Counter examples in Topology, Holt, Rinehart and Winston, New York, 1970.
6. W. Thron, Topologically Structures, Holt, Rinehart and Winston, New York, 1966.
7. N. Bourbaki, General Topology Part I (Transl.), Addison Wesley, Reading, 1966.
8. R. Engelking, General Topology, Polish Scientific Publishers, Warszawa, 1977.
9. W. J. Pervin, Foundations of General Topology, Academic Press Inc. New York,1964.

10. S. Willard, General Topology, Addison-Wesley, Reading, 1970.
11. Crump W. Baker, Introduction to Topology, Wm C. Brown Publisher, 1991.
12. D. Bushaw, Elements of General Topology, John Wiley & Sons, New York, 1963.
13. M. J. Mansfield, Introduction to Topology, D. Van Nostrand Co. Inc.Princeton, N. J., 1963.
14. B. Mendelson, Introduction to Topology, Allyn & Bacon, Inc., Boston,1962.
15. C. Berge, Topological Spaces, Macmillan Company, New York,1963.
16. S. S. Coirns, Introductory Topology, Ronald Press, New York, 1961.
17. Z. P. Mamuzic, Introduction to General Topology, P. Noordhoff Ltd., Groningen, 1963.
18. Seymour Lipschutz, General Topology, Tata McGraw Hill Publishing Company Ltd. (Schaum's out Lines.)

Chairperson / H.O.D - Dr. Padmavati Subject Expert - Dr. Madhu Srivastava Subject Expert - Dr. Shabnam Khan Subject Expert - Dr. S. K. Bhatt **Representative Members -** (1) Dr. Anil Kashyap - (2) Shri A. K. Pandey - (3) Dr. Mayur Puri Goswami	**Faculty Members** Dr. Rakesh Tiwari Dr. Prachi Singh- Dr. Shobha Rani – Smt. Nidhi Sharma – Ku. Ambalika Chouhan – Ku. Bijma Kumari – Ku. Deepak-

M. Sc. Mathematics (Second Semester)
2025 – 2026
Code- MMT 204
PAPER-IV
Complex Analysis (II)

Max. Marks. 80

Unit-I Gamma function and its properties. Riemann Zeta function. Riemann's functional equation. Runge's theorem. Mittag-Leffler's theorem.

Unit-II Analytic Continuation. Uniqueness of direct analytic continuation. Uniqueness of analytic continuation along a curve. Power series method of analytic continuation. Schwarz Reflection principle. Monodromy theorem and its consequences. Harmonic functions on a disk. Harnack's inequality and theorem.

Unit-III Dirichlet Problem. Green's function. Canonical products. Jensen's formula. Poisson-Jensen formula. Hadamard's three circles theorem. Order of an entire function. Exponent of Convergence. Borel's theorem,. Hadamard's factorization theorem.

Unit-IV The range of an analytic function. Bloch's theorem. The Little Picard theorem. Schottky's theorem. Montel Caratheodory and the Great Picard theorem. Univalent functions. Bieberbach's conjecture (Statement only) and the "**1/4**-theorem".

Recommended Books:

1. L.V. Ahlfors: Complex Analysis, MCGraw - Hill, 1979.
2. D. Sarason: Complex Function Theory, Hindustan Book Agency, Delhi, 1994.
3. J. B. Conway: Functions of one Complex variable, Springer-Verlag, International student-Edition, Narosa Publishing House, 1980.
4. H. K. Pathak, Complex Analysis and Applications, Springer, 2019.

References:

1. H.A. Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford 1990.
2. Liang-shin Hahn & Bernard Epstein, Classical Complex Analysis, Jones and Bartlett Publishers International, London, 1996.
3. S. Lang, Complex Analysis, Addison Wesley, 1977.

4. Mark J.Ablowitz and A.S. Fokas, Complex Variables: Introduction and Applications, Cambridge University press, South Asian Edition, 1998.
5. W.H.J. Fuchs, Topics in the Theory of Functions of one Complex Variable, D.Van Nostrand Co., 1967.
6. C. Caratheodory, Theory of Functions (2 Vols.) Chelsea Publishing Company, 1964.
7. M. Heins, Complex Function Theory, Academic Press, 1968.
8. Walter Rudin, Real and Complex Analysis, McGraw-Hill Book Co., 1966.
9. W.A. Veech, A Second Course in Complex Analysis, W.A. Benjamin, 1967.
10. S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, 1997.

Chairperson / H.O.D - Dr. Padmavati Subject Expert - Dr. Madhu Srivastava Subject Expert - Dr. Shabnam Khan Subject Expert - Dr. S. K. Bhatt **Representative Members -** (1) Dr. Anil Kashyap - (2) Shri A. K. Pandey - (3) Dr. Mayur Puri Goswami -	**Faculty Members** Dr. Rakesh Tiwari Dr. Prachi Singh Dr. Shobha Rani – Smt. Nidhi Sharma – Ku. Ambalika Chouhan – Ku. Bijma Kumari – Ku. Deepak-

M. Sc. MATHEMATICS (Second Semester)
2025 – 2026
Code- MMT 205
PAPER-V
Advanced Discrete Mathematics (II)

Max. Marks. 80

Unit-I Graph Theory- Definition of (Undirected) Graphs. Paths. Circuits. Cycles and Subgraphs. Induced Subgraphs. Degree of a vertex. Connectivity. Planar Graphs and properties, Trees. Euler's Formula for connected planar Graphs, Complete & Complete Bipartite Graphs, Kuratowski's Theorem (statement only) and its use. Spanning Trees, Cut-sets, Fundamental Cut -sets, and Cycle. Minimal Spanning Trees and Kruskal's Algorithm.

Unit-II Matrix Representations of Graphs. Euler's Theorem on the Existence of Eulerian Paths and Circuits. Directed Graphs. In degree and out degree of a Vertex. Weighted undirected Graphs. Dijkstra's Algorithm. Strong Connectivity and Warshall's Algorithm. Directed Trees. Search Trees. Tree Traversals.

Unit-III Introductory Computability Theory, Finite State Machines and their Transition Table Diagrams. Equivalence of finite State Machines. Reduced Machines. Homomorphism.

Unit-IV Finite Automata. Acceptors. Non-deterministic Finite Automata and equivalence of its power to that of Deterministic Finite Automata. Moore and mealy Machines. Turing Machine and Partial Recursive Functions.

Recommended Books:

1. Elements of Discrete Mathematics by C.L. Liu.
2. Graph Theory and its application By N. Deo.
3. Theory of Computer Science by K. L. P. Mishra and N. Chandrashekaran.

References:

1. J.P. Tremblay & R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 1997.
2. J.L. Gersting, Mathematical Structures for Computer Science, (3rd edition), Computer Science Press, New York.
3. Seymour Lepschutz, Finite Mathematics (International) edition 1983), McGraw-Hill Book Company, New York.

4. J.E. Hopcroft and J.D Ullman, Introduction to Automata Theory, Languages & Computation, Narosa Publishing House.
5. N. Deo. Graph Theory with Application to Engineering and Computer Sciences. Prentice Hall of India.

Chairperson / H.O.D - Dr. Padmavati Subject Expert - Dr. Madhu Srivastava Subject Expert - Dr. Shabnam Khan Subject Expert - Dr. S. K. Bhatt **Representative Members** - (1) Dr. Anil Kashyap - (2) Shri A. K. Pandey - (3) Dr. Mayur Puri Goswami -	**Faculty Members** Dr. Rakesh Tiwari Dr. Prachi Singh Dr. Shobha Rani – Smt. Nidhi Sharma – Ku. Ambalika Chouhan – Ku. Bijma Kumari – Ku. Deepak-

DEPARTMENT OF MATHEMATICS

GOVT. V.Y.T. PG. AUTONOMOUS COLLEGE DURG (C.G.)

Approved syllabus for M.Sc. Mathematics by the members of Board of Studies for the

Sessions 2025 - 26

The Syllabus with the paper combinations is as under

Semester III

I: MMT 301 - Integration Theory and Functional Analysis (I)	**II: MMT 302 - Partial Differential Equations**
III: MMT 302 - Programming in C(with ANSI features) (I)	**IV: MMT 304 - (A) Operations Research (I) (B) Fundamentals of Computer Science (Object Oriented Programming & Data Structure)**
V: MMT 305(A) - (A) Fuzzy Sets and Their Applications (I) **MMT 305(B) - (B) Graph Theory (I)**	**Lab Course/Practical :** **(A) Programming in C** **(B) Fundamentals of Computer Science**

The Syllabus for M.Sc. Mathematics is hereby approved for the sessions 2025 -26.

Name and Signatures

Chairperson / H.O.D - Dr. Padmavati – Subject Expert - Dr. Madhu Shrivastava Subject Expert - Dr. Shabnam Khan Subject Expert - Dr. S. K. Bhatt **Representative Members** • Dr. Anil Kashyap – • Shri A. K. Pandey – • Dr. Mayur Puri Goswami –	**Faculty members –** Dr. Rakesh Tiwari – Dr. (Smt.) Prachi Singh Dr. Shobha Rani – Smt. Nidhi Sharma - Ku. Ambalika Chouhan - Ku. Bijma Kumari – Ku. Deepak –

GENERAL INSTRUCTIONS FOR STUDENTS

1. The candidate has to obtain minimum 20% marks in each theory paper and internal assessment separately.
2. The candidate has to secure minimum 36% marks as an aggregate in order to pass that semester examination.
3. The internal assessment shall include class test, home assignment and seminar presentation.
4. Internal Assessment Examination will be as follows :
   i. Internal Test in each paper (20 marks)
   ii. Seminar (Power point presentation) in any one of the paper (20 marks)
   iii. Assignment in each of the remaining papers (excluding the paper of Seminar. (20 marks)
   iv. Average of marks obtained in internal test + seminar in any one paper and marks obtained in internal test + assignment in rest of the papers will be calculated and taken into consideration.

5. There shall be one seminar in each semester. In each semester, the paper in which seminar has to be presented will be allotted randomly .The marking of seminar shall be in terms of hard copy submission (10 marks) and presentation and open discussion 10 marks. In seminar the marks taken in to consideration will be the average marks given by two examiners.

Chairperson / H.O.D - Dr. Padmavati –	**Faculty members** –
Subject Expert - Dr. Madhu Shrivastava	Dr. Rakesh Tiwari –
Subject Expert - Dr. Shabnam Khan	Dr. (Smt.) Prachi Singh –
Subject Expert - Dr. S. K. Bhatt	Dr. Shobha Rani –
Representative Members • Dr. Anil Kashyap – • Shri A. K. Pandey – • Dr. Mayur Puri Goswami –	Smt. Nidhi Sharma - Ku. Ambalika Chouhan - Ku. Bijma Kumari – Ku. Deepak –

DIRECTIVES FOR STUDENTS, FACULTY AND EXAMINERS

Question Paper Format and Distribution of Marks for PG Semester Examination

Question paper format for the Post-Graduate Examination has been revised from the Session 2018-19. The revised format will be applicable for all the question papers of Semester I, II, III & IV. The following are the main points of the new format:

1. The question paper will be of **80 marks** (as before)
2. Questions will be asked Unit-wise in each question paper.
3. From each Unit, the questions will be asked as follows :

Very short answer type question **(Answer in one or two sentences)**	**(02 Marks)**
Very short answer type question **(Answer in one or two sentences)**	**(02 Marks)**
Short answer type question	**(04 Marks)**
Long answer type questions	**(12 Marks)**

Type of Question	Unit-I	Unit-II	Unit-III	Unit-IV
Very Short (2 Questions)	2 x 2 = 4 Marks	2 x 2 = 4 Marks	2 x 2 = 4 Marks	2 x 2 = 4 Marks
Short (1 Question)	1 x 4 = 4 Marks	1 x 4 = 4 Marks	1 x 4 = 4 Marks	1 x 4 = 4 Marks
Long answer (1 Question)	1 x 12 = 12 Marks	1 x 12 = 12 Marks	1 x 12 = 12 Marks	1 x 12 = 12 Marks

Note:

1. Question no. 1 and Question 2 will be compulsory.
2. Question no. 3 and 4 will consist of 2 optional questions of which one has to be attempted.
3. As mentioned above, two compulsory very short answer type questions (2+2 marks), one short answer type question with internal choice (4 marks) and one long answer type question with internal choice (12 marks) will be asked from each unit.

Thus there will be questions of 20 marks from each unit and of total 80 marks from all the four units of the syllabus / syllabi.

4. The students are required to study the content mentioned in the curriculum exhaustively.

CREDIT ALLOTMENTS

Theory 80 marks = 04 Credits

Internal Assessment 20 marks = 01 credit

Theory Paper + Practical = 05 credits (04+01)

Chairperson / H.O.D - Dr. Padmavati –	**Faculty members** –
Subject Expert - Dr. Madhu Shrivastava	Dr. Rakesh Tiwari –
Subject Expert - Dr. Shabnam Khan	Dr. (Smt.) Prachi Singh –
Subject Expert - Dr. S. K. Bhatt	Dr. Shobha Rani –
Representative Members • Dr. Anil Kashyap – • Shri A. K. Pandey – • Dr. Mayur Puri Goswami –	Smt. Nidhi Sharma - Ku. Ambalika Chouhan - Ku. Bijma Kumari – Ku. Deepak –

Syllabus and Marking Scheme for M. Sc. Mathematics Third Semester Session 2025-26

Paper No.	Title of the Paper	Marks Allotted in Theory		Marks Allotted in Internal Assessment		Credits
		Max	Min	Max.	Min.	
I	**Integration theory and Functional analysis**	80	16	20	04	05
II	**Partial Differential Equations**	80	16	20	04	05
III	**Programming in C(with ANSI features) (I)**	80	16	20	04	05
IV	**Operations Research (I)**	80	16	20	04	05
V	**Fuzzy Sets and Their Applications (I)**	80	16	20	04	05
IV	**Practical in Paper III**	50	18			02
	Total	**450**		**100**		**27**

05 Theory papers - 400 ; 01 Practical - 50 ; 05 Internal Assessments - 100
Total Marks - 550

Note: 20 marks = 01 credit in Theory Papers and 26 Marks = 01 Credit in Practical.

Chairperson / H.O.D - Dr. Padmavati –

Subject Expert - Dr. Madhu Shrivastava

Subject Expert - Dr. Shabnam Khan

Subject Expert - Dr. S. K. Bhatt

Representative Members

- Dr. Anil Kashyap –
- Shri A. K. Pandey –
- Dr. Mayur Puri Goswami –

Faculty members –

Dr. Rakesh Tiwari –

Dr. (Smt.) Prachi Singh –

Dr. Shobha Rani –

Smt. Nidhi Sharma -

Ku. Ambalika Chouhan -

Ku. Bijma Kumari –

Ku. Deepak -

PG Department of Mathematics

PO No.	Program outcomes upon completion of the M. Sc. Degree program, the student will be able to
PO No. - 1	Pursue higher studies in mathematics in reputed institute of our country and clear Competitive exams like SET / NET / TET etc.
PO No. – 2	Read and identify mathematical and computational methods in order to solve comprehensive problems in several competitive examinations.
PO No. – 3	Well prepared to take jobs in schools and colleges as Mathematic Teachers and Professors, Software Industries, Research and Development Organizations.
PO No.- 4	Learn and apply Mathematics in real life situations aiming at service to the society.

Program Specific Outcomes:

PSO No.	Program specific outcomes : upon completion of the M. Sc. Degree program, the student will be able to
PSO - 1	Understand the fundamental axioms in mathematics and capable to develop ideas based on them.
PSO – 2	Inculcate mathematical reasoning and develop own learning capacity.
PSO – 3	Explain the core ideas and the techniques of mathematics and developabstract mathematical thinking.
PSO - 4	Assimilate the logical approach to take decision in complicated situations.
PSO - 5	Prepare and motivate for research studies in mathematics and relatedfields.

Learning Outcomes:

Student able to learn various types of spaces, week and strong convergence and contraction mapping which are very powerful tools of research in fixed point theory.

Course Title	M. Sc. Final, Integration Theory & Functional Analysis
CO No.	**Course Outcomes This course will enable the student to :**
CO No. – 1	Understand Sign measures and various theorems on measures, Riesz representation theorem, Fubinious Theorem.
CO No. – 2	Remember Normlinear space and their completeness, Finite dimension norm linear space and compactness.
CO No.- 3	Analyze Nonlinear operators, convex functions, epi-graphs, Coercive mapping etc.
CO No.- 4	Understand uniform boundedness theorem, Open and closed graph theorem and Hahn Banach theorem, Hilbert space, Reflexiblity of Hilbert space. Self adjoint, Normal, Unitary operators..

Learning Outcomes:

Upon completion of this course student should be able to learn various types of partial differential equations in different fields.

Course Title	M. Sc. Final, Partial Differential Equations
CO No.	**Course Outcomes This course will enable the student to :**
CO No. – 1	Understand Laplace equations, Heat equations, wave equations, solution by spherical means.
CO No. – 2	Analyze Geometric optics, Stationary phase and Homogenization.
CO No.- 3	Apply the modeling assumptions and derivations that leads to PDEs.

Learning outcomes:

Students able to understand specially natural events, forces, gravitational and attraction forces to bodies.

Course Title	M. Sc. Final, Mechanics
CO No.	**Course Outcomes This course will enable the student to :**
CO No. – 1	Remember Generalized coordinates langranges equation of first kind cyclic coordinates.
CO No. – 2	Understand Poisson's bracket hamilton's principle, principle of least action Poincare cardan integral invariant.
CO No.- 3	Apply Whittaker equations hamillton Jacobi equation invariation of lagrange bracket under canonical transformation.
CO No - 4	Evaluate the attraction for different types of objects.

Learning outcomes:

Application of computers using 'C'- Language and different fields of mathematical problem.

Course Title	M. Sc. Final, Programming in "C" (with ANSCI features)
CO No.	**Course Outcomes This course will enable the student to :**
CO No. – 1	Remember over view of programming, Anatomy of C-functions, variables and constants.
CO No. – 2	Evaluate Different types of data.
CO No.- 3	Analyze the main function Complex declaration, Conditional Compilation, Line Control, Input and output streams, Buffering, closing and opening files. The slandered library for input \ output etc.
CO No - 4	Apply an objects and pointers, Control flow conditional branching various types of loop.

Learning outcomes:

Application of Marketing field using this (Operation Research) and different fields of mathematical problems.

Course Title	M. Sc. Final, Operations Research
CO No.	**Course Outcomes This course will enable the student to :**
CO No. – 1	Remember the scope of operation research.
CO No. – 2	Evaluate real world problems to linear programming problems. Solve this problem with various methods, acquired with various algorithm and techniques of above used methods.
CO No.- 3	Understand mathematical formulation and solution of assignment problems and transportation problems.
CO No - 4	Apply the use of dynamic programming in various fields, Game theory, theory of queveing system and Inventory control to particle problems.

Learning outcomes:

After the study of this paper, students are familiar with the new branch of which is nearer to the real world.

Course Title	M. Sc. Final, (A) Fuzzy Sets and their Logics
CO No.	**Course Outcomes This course will enable the student to :**
CO No. – 1	Apply mathematical logic with real life. In this unit some models are explained.
CO No. – 2	Create an expert system, this unit gives basic propositional rules.
CO No.- 3	Remember the application of fuzzy set theory in the topic decision making, which is somewhat vague in nature?
CO No - 4	Understand Introduction and operation between fuzzy sets and fuzzy numbers, the difference between probability and possibility theory is explained through fuzzy sets..

Learning outcomes:

After the study of this paper, students are familiar with the new branch of which is nearer to the real world as well as graphics.

Course Title	M. Sc. Final, (B) Graph Theory
CO No.	**Course Outcomes This course will enable the student to :**
CO No. – 1	Apply mathematical logic with real life. In this unit some models are explained.
CO No. – 2	Create Polynomials and Graph Enumeration: The colour polynomials, The chromatic polynomial, bivariate coloring polynomials.
CO No.- 3	Remember the concept of Perfectness-preserving operations, Forbidden Subgraph orientations, Ramsey numbers and Ramsey graphs.
CO No - 4	Understand the spectrum, Spectrum properties, Coloring packing and covering i. e. colorable graphs, edge-colorings, Face coloring.

M. Sc. Mathematics (Third Semester)
2025 – 2026

PAPER –I
Code- MMT 301
Integration Theory and Functional Analysis (I)

Integration Theory
Max Marks. 80

Unit-I Signed measure. Hahn decomposition theorem. mutually singular measures. Radon-Nikodym theorem. Lebesgue decomposition. Riesz representation theorem. Extension theorem (Caratheodory). Product measures. Fubini's theorem.

Functional Analysis

Unit-II Normed linear spaces. Banach spaces and examples. Quotient space of normed linear spaces and its completeness. equivalent norms. Riesz Lemma. basic properties of finite dimensional normed linear spaces and compactness.

Unit-III Weak convergence and bounded linear transformations, normed linear spaces bounded linear transformations, dual spaces with examples.

Unit-IV Contraction mapping theorem and its application. Banach fixed point theorem. Picard's theorem. Banach fixed point theorem as a source of existence and uniqueness theorem for integral equations. Nonlinear operator, examples convex function, epigraph, monotone mapping, α-monotone, coercive mapping duality maps.

Recommended Books:

1. H.L. Royden, Real Analysis, Macmillan Publishing Co. Inc., New York, 4th Edition, 1993.

2. B.Choudhary and Sudarsan Nanda, Functional Analysis with Applications Wiley Eastern Ltd., 1989.

References:

1. J.H. Williamson, Lebesgue Integration, Holt Rinehart and Winston, Inc. New York. 1962
2. P.R. Halmos, Measure Theory, Van Nostrand, Princeton, 1950. T.G. Hawkins, Lebesgue's Theory of Integration: Its Origins and Development, Chelsea, New York,1979.
3. J.H. Williamson, Lebesgue Integration, Holt Rinehart and Winston, Inc. New York. 1962
4. P.R. Halmos, Measure Theory, Van Nostrand, Princeton, 1950.

5. T.G. Hawkins, Lebesgue's Theory of Integration: Its Origins and Development, Chelsea, New York, 1979.
6. K.R. Parthasarathy, Introduction to Probability and Measure, Macmillan Company of India Ltd., Delhi, 1977.
7. R.G. Bartle, The Elements of Integration, John Wiley & Sons, Inc. New York, 1966.
8. Inder K. Rana, An Introduction to Measure and Integration, Narosa Publishing House, Delhi, 1997.
9. Walter Rudin, Real & Complex Analysis, Tata McGraw-Hill Publishing.
10. Edwin Hewitt and Korl Stromberg, Real and Abstract Analysis, Springer-Verlag, New York.
11. Edwin Hewitt and Kenneth A. Ross, Abstract Harmonic Analysis, Vol. 1, Springer-Verlag, 1993.
12. G. Bachman and L. Narici, Functional Analysis, Academic Press, 1966.
13. N. Dunford and J.T. Schwartz, Linear Operators, Part I, Interscience, New York, 1958.
14. R.E. Edwards, Functional Analysis, Holt Rinehart and Winston, New York, 1965.
15. C. Goffman and G. Pedrick, First Course in Functional Analysis, Prentice Hall of India, New Delhi, 1987.
16. P.K. Jain, O.P. Ahuja and Khalil Ahmad, Functional Analysis, New Age International (P) Ltd. & Wiley Eastern Ltd., New Delhi, 1997.
17. R.B. Holmes, Geometric Functional Analysis and its Applications, Springer-Verlag, 1975.
18. K.K. Jha, Functional Analysis, Students' Friends, 1986.
19. L.V. Kantorovich and G.P. Akilov, Functional Analysis, Pergamon Press, 1982.
20. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, New York, 1978.
21. B.K. Lahiri, Elements of Functional Analysis, The World Press Pvt. Ltd., Calcutta, 1994.

Chairperson / H.O.D - Dr. Padmavati –	**Faculty members** –
Subject Expert -Dr. Madhu Shrivastava	Dr. Rakesh Tiwari –
Subject Expert - Dr. Shabnam Khan	Dr. (Smt.) Prachi Singh
Subject Expert - Dr. S. K. Bhatt	Dr. Shobha Rani –
Representative Members • Dr. Anil Kashyap – • Shri A. K. Pandey – • Dr. Mayur Puri Goswami	Smt. Nidhi Sharma - Ku. Ambalika Chouhan - Ku. Bijma Kumari – Ku. Deepak –

M. Sc. Mathematics (Third Semester)
2025 – 2026

PAPER –II
Code- MMT 302
Partial Differential Equations

Unit-I Examples of PDE. Classification.Transport Equation - Initial value Problem. Non-homogeneous equation. Laplace's Equation - Fundamental Solution. Mean Value Formulas. Properties of Harmonic Functions. Green's Function. Energy Methods. Heat Equation - Fundamental Solution. Mean Value Formula. Properties of Solutions. Energy Methods. Wave Equation - Solution by Spherical Means. Non-homogeneous Equations. Energy Methods.

Unit-II Nonlinear First Order PDE-Complete Integrals. Envelopes, Characteristics. Hamilton Jacobi Equations (Calculus of Variations. Hamilton's ODE. Legendre Transform. Hopf-Lax Formula. Weak Solutions. Uniqueness). Conservation Laws (Shocks. Entropy Condtion. LaxOleinik formula. Weak Solutions. Uniqueness. Riemann's Problem. Long Time Behaviour)

Unit-III Representation of Solutions - Separation of Variables. Similarity Solutions (Plane and Travelling Waves. Solitons. Similarity under Scaling). Fourier and Laplace Transform. Hopf-Cole Transform. Hodograph and Legendre Transforms. Potential Functions.

Unit-IV Asymptotic (Singular Perturbations. Laplace's Method. Geometric Optics. Stationary Phase. Homogenization). Power Series (Non-characteristic Surfaces. Real Analytic Functions. Cauchy-Kovalevskaya Theorem).

References:

1. L.C. Evans, Partial Differential Equations, Graduate Studies in Mathematics, Volume 19, AMS, 1998.
2. Books with the above title by I. N. Sneddon, F. John, P. Prasad and R. Ravindran, Amarnath etc.

Chairperson / H.O.D - Dr. Padmavati –	**Faculty members** –
Subject Expert -Dr. Madhu Shrivastava	Dr. Rakesh Tiwari –
Subject Expert - Dr. Shabnam Khan	Dr. (Smt.) Prachi Singh –
Subject Expert - Dr. S. K. Bhatt	Dr. Shobha Rani –
Representative Members	Smt. Nidhi Sharma -
• Dr. Anil Kashyap –	Ku. Ambalika Chouhan -
• Shri A. K. Pandey –	Ku. Bijma Kumari –
• Dr. Mayur Puri Goswami -	Ku. Deepak –

M. Sc. Mathematics (Third Semester)
2025 – 2026
PAPER –III
Code- MMT 303
Programming in C (with ANSI features) Theory and Practical

Max. Marks. 80
(Theory-50 +Practical-30)

Unit-I An overview of programming. Programming language. Classification. C Essentials-Program Development. Functions. Anatomy of a C Function. Variables and Constants. Expressions. Assignment Statements. Formatting Source Files. Continuation Character. The Preprocessor.

Unit-II Scalar Data Types-Declarations. Different Types of Integers. Different kinds of Integer Constants. Floating-Point Types. Initialization. Mixing Types. Explicit Conversions-Casts. Enumeration Types. The Void Data Type. Typedefs. Finding the Address of an object. Pointers.

Unit-III Control Flow-Conditional Branching. The Switch Statement. Looping. Nested Loops. The break and continue Statements. The goto statement. Infinite Loops. Operators and Expressions-Precedence and Associability. Unary Plus and Minus operators. Binary Arithmetic Operators. Arithmetic Assignment Operators. Increment and Decrement Operators. Comma Operator. Relational Operators. Logical Operators. Bit - Manipulation Operators. Bitwise Assignment Operators. Cast Operator. Size of Operators. Conditional Operator. Memory Operators.

Unit-IV Arrays -Declaring an Array. Arrays and Memory. Initializing Arrays. Encryption and Decryption.

References:

1. Peter A. Darnell and Philip E. Margolis, C: A Software Engineering Approach, Narosa Publishing House (Springer International Student Edition) 1993.
2. Samuel P. Harkison and Gly L. Steele Jr., C : A Reference Manual, 2nd Edition, Prentice Hall, 1984.
3. Brian W. Kernighan & Dennis M. Ritohie, The C Programme Language, 2nd Edition (ANSI Features), Prentice Hall 1989.

4. Yashwant Kanetkar, Let Us C, 8th Edison, B P B Publications 2007.
5. E. Balagurusamy, Programming in C (ANSI), 4th Edison, Tata Mac Graw Hill.

List of C programmings for 3rd sem Mathematics

1. WAP for create a mark sheet and providing them grade.
2. WAP to sum of first n numbers.
3. WAP for calculating average and standard deviation.
4. WAP to check the number is palindrome or not.
5. WAP to find roots of quadratic equation.
6. WAP to check the given number is Armstrong number or not.
7. WAP to find Fibonacci series.
8. WAP for finding LCM of given number.
9. WAP using switch statement to convert a number into corresponding days.
10. WAP for finding sum of series (Cos, Sin, Tan)
11. WAP to construct pyramid of *.
12. WAP to sum of array for any 10 elements.
13. WAP to sort a string in alphabetic order.
14. WAP to remove or delete vowels from a string.
15. WAP to add one string after another string.

Chairperson / H.O.D - Dr. Padmavati –	**Faculty members** –
Subject Expert - Dr. Madhu Shrivastava	Dr. Rakesh Tiwari –
Subject Expert - Dr. Shabnam Khan	Dr. (Smt.) Prachi Singh –
Subject Expert - Dr. S. K. Bhatt	Dr. Shobha Rani –
Representative Members • Dr. Anil Kashyap – • Shri A. K. Pandey – • Dr. Mayur Puri Goswami –	Smt. Nidhi Sharma - Ku. Ambalika Chouhan - Ku. Bijma Kumari – Ku. Deepak -

M. Sc. Mathematics (Third Semester)
2025 – 2026

PAPER –IV
Code- MMT 304

Operations Research (I)

Max .Marks. 80

Unit-I Operations Research and its Scope. Necessity of Operations Research in Industry. Linear Programming-graphical method of solutions, Simplex Method. Theory of the Simplex Method. Two phase method. Big M method of solution to an LPP.

Unit-II Duality in linear programming. Duality theorems, Duality Simplex method. Dual Simplex Method. Parametric Linear Programming.

Unit-III Transportation problems. Formulation of transportation problems. Solutions of Transportation problems, North-West corner method. Least cost method. Assignment Problems. It's mathematical formulation, Solution of assignment problems. Optimality test.

Unit-IV Network Analysis-Shortest Path Problem. Minimum Spanning Tree Problem. Maximum Flow Problem. Minimum Cost Flow Problem. Network Simplex Method. Project Planning and Control with PERT-CPM.

Recommended Book:

1. K. Swarup, P. K. Gupta and M. Mohan, Operations Research, Sultan Chand & Sons, N. Delhi.

References:

2. F. S. Hillier and G. J. Ueberman. Introduction to Operations ResBareft (Sixth Edition), McGraw Hill International Edition, Industrial Engineering Series, 1995. (This book comes with a CD containing tutorial software Techniques, Affiliated East-West Press Pvt. Ltd., New Delhi, Madras.
3. G. Hadley, Linear Programming, Narosa Publishing House, 1995.
4. G. Hadly, Nonlinear and Dynamic Programming, Addison-Wesley, Reading Mass.
5. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, Linear Programming and Network flows, John Wiley I & Sons, New York, 1990.

6. H. A. Taha, Operations Researc~-An introduction, Macmillan Publishing Co., Inc., New Yark.
7. S. S. Rao, Optimization Theory and Applications, Wiley Eastern Ltd., New Delhi.
8. P. K. Gupla and D.S. Hira, O. R.-An Introduction. S. Chand & Co. Ltd., N. Delhi.
9. N.S. Kambo, Mathematical Programming Techniques, Affiliated East-West Press Pvt. Ltd., New Delhi, Madras.

Chairperson / H.O.D - Dr. Padmavati – Subject Expert - Dr. Madhu Shrivastava Subject Expert - Dr. Shabnam Khan Subject Expert - Dr. S. K. Bhatt **Representative Members** • Dr. Anil Kashyap – • Shri A. K. Pandey – • Dr. Mayur Puri Goswami -	**Faculty members** – Dr. Rakesh Tiwari – Dr. (Smt.) Prachi Singh Dr. Shobha Rani – Smt. Nidhi Sharma - Ku. Ambalika Chouhan - Ku. Bijma Kumari – Ku. Deepak -

M. Sc. Mathematics (Third Semester)
2025 – 2026
Paper- V (A)
Code- MMT 305 (A)
Fuzzy Set and their Applications (I)

Max. Marks. 80

Unit-I Fuzzy sets. Basic definitions. α-level sets. Convex fuzzy sets. Basic operations on fuzzy sets. Type of fuzzy sets. The Extension principle-the Zadeh's extension Principle. Cartesian products. Algebraic products. Bounded sum and difference,t-norms and t- conorms. ,Image and inverse image of fuzzy sets.

Unit-II Fuzzy numbers. Elements of fuzzy arithmetic. Fuzzy Relations and Fuzzy Graphs. Fuzzy relations on fuzzy sets. Composition of fuzzy relations.

Unit-III Min-max Composition and its properties. Fuzzy equivalence. Relations. Fuzzy compatibility. Relations. Fuzzy relation equation. Fuzzy graphs. Similarity relation.

Unit-IV Possibility Theory. Fuzzy measures. Evidence theory. Necessity measure. Possibility measure. Possibility distribution. Possibility theory and fuzzy sets. Possibility theory versus probability theory.

References:

1. Fuzzy sets and fuzzy logic by G. K. Klir and B. Yuan, Prentice-Hall of, New Delhi, 1995.
2. Fuzzy set theory and its Applictions, By H.J.Zimmermann , Allied Publishers Ltd., New Delhi, 1991.

Chairperson / H.O.D - Dr. Padmavati –	**Faculty members** –
Subject Expert - Dr. Madhu Shrivastava	Dr. Rakesh Tiwari –
Subject Expert - Dr. Shabnam Khan	Dr. (Smt.) Prachi Singh –
Subject Expert - Dr. S. K. Bhatt	Dr. Shobha Rani –
Representative Members • Dr. Anil Kashyap – • Shri A. K. Pandey – • Dr. Mayur Puri Goswami –	Smt. Nidhi Sharma - Ku. Ambalika Chouhan - Ku. Bijma Kumari – Ku. Deepak -

M. Sc. Mathematics (Third Semester)

2025 – 2026

Paper- V (B)

Code- MMT 305 (B)

Graph theory (I)

Max. Marks - 80

Unit-I: Operations on graphs, matrices and vector spaces: Topological operations, Homeomerphism, homomorphism, contractions, derived graphs, Binary operations.

Unit-II: Matrices and vector spaces: Matrices and vector spaces : The adjacency matrix, The determinant and the spectrum, Spectrum properties, The incidence matrix, cycle space and Bond space, Cycle bases and cycle graphs.

Unit-III: Coloring packing and covering: Vertex coverings, critical graphs, Girth and chromatic number, uniquely colourable graphs, edge-colourings, Face colourings and Beyond, The achromatic and the Adjoint Numbers.

Unit-IV: Combinational formulations: Setting up of combinational formulations, the classic pair of duals, Gallai, Norman-Rabin Theorems, Clique parameters, The Rosenfeld Numbers.

Unit-V: Perfect Graphs: Introduction to the "SPGC", Triangulated (Chordal) graphs, Comparability graphs, Interval graphs, permutation graphs, circular arc graphs, split graphs, weakly triangulated graphs.

REFERENCES :

1. Gary Chartrand and Ping Zhang Introduction to Graph Theory, graw Hill publishing company limited .
2. J. A. Bondy and U. S. R. Murthy, Graph Theory with Applications, Noth Holland Publisher.
3. K. R. Parthasarathy, Basic graph theory, Tata Mc graw Hill publishing company limited , 1994.
4. R. J. Wilson, Introduction to graph theory, Longman Harlow, 1985.
5. John Clark, Derek Allon Holton, A first look at graph Theory, World Scientific Singapore, 1991.
6. Frank Hararary, Graph Theory Narosa, New Delhi, 1995.
7. Ronald Gould and Benjamin Cummins, Graph Theory, California.

8. Narsingh Deo, Graph Theory with applications to Engineering and Computer Science, Prentice-Hall of India Private Limited, New Delhi, 2002.

Chairperson / H.O.D - Dr. Padmavati – Subject Expert - Dr. Madhu Shrivastava Subject Expert - Dr. Shabnam Khan Subject Expert - Dr. S. K. Bhatt **Representative Members** • Dr. Anil Kashyap – • Shri A. K. Pandey – • Dr. Mayur Puri Goswami -	**Faculty members** – Dr. Rakesh Tiwari – Dr. (Smt.) Prachi Singh – Dr. Shobha Rani – Smt. Nidhi Sharma - Ku. Ambalika Chouhan - Ku. Bijma Kumari – Ku. Deepak -

DEPARTMENT OF MATHEMATICS

GOVT. V.Y.T. PG. AUTONOMOUS COLLEGE DURG (C.G.)

Approved syllabus for M.Sc. Mathematics by the members of Board of Studies

for theSessions 2025 - 26

The Syllabus with the paper combinations is as under

Semester IV

I: MMT 401 - Functional Analysis (II)	**II: MMT 402 - Mechanics**
III: MMT 403 - Programming in C (with ANSI features) (II)	**IV: MMT 404 - Operations Research (II)**
V: MMT 405 (A) - (A) Fuzzy Sets and Their Applications (II) **MMT 405 (B) - (B) Graph Theory (II)**	**Lab Course/Practical :** **(A) Programming in C**

The Syllabus for M.Sc. Mathematics is hereby approved for the sessions 2025 – 26.

Name and Signatures

Chairperson / H.O.D - Dr. Padmavati Subject Expert - Dr. Madhu Srivastava Subject Expert - Dr. Shabnam Khan Subject Expert - Dr. S. K. Bhatt **Representative Members -** (1) Dr. Anil Kashyap - (2) Shri A. K. Pandey - (3) Dr. Mayur Puri Goswami -	**Faculty members -** Dr. Rakesh Tiwari Dr. (Smt.) Prachi Singh Dr. Shobha Rani Smt. Nidhi Sharma Ku. Ambalika Chauhan Ku. Bijma Kumari Ku. Deepak -

GENERAL INSTRUCTIONS FOR STUDENTS

1. The candidate has to obtain minimum 20% marks in each theory paper and internal assessment separately.
2. The candidate has to secure minimum 36% marks as an aggregate in order to pass that semester examination.
3. The internal assessment shall include class test, home assignment and seminar presentation.
4. Internal Assessment Examination will be as follows :
   i. Internal Test in each paper (20 marks)
   ii. Seminar (Power point presentation) in any one of the paper (20 marks)
   iii. Assignment in each of the remaining papers (excluding the paper of Seminar. (20 marks)
   iv. Average of marks obtained in internal test + seminar in any one paper and marks obtained in internal test + assignment in rest of the papers will be calculated and taken into consideration.

5. There shall be one seminar in each semester. In each semester, the paper in which seminar has to be presented will be allotted randomly. The marking of seminar shall be in terms of hard copy submission (10 marks) and presentation and open discussion 10 marks. In seminar the marks taken in to consideration will be the average marks given by two examiners.

Chairperson / H.O.D - Dr. Padmavati Subject Expert - Dr. Madhu Srivastava Subject Expert - Dr. Shabnam Khan Subject Expert - Dr. S. K. Bhatt **Representative Members -** (1) Dr. Anil Kashyap - (2) Shri A. K. Pandey - (3) Dr. Mayur Puri Goswami -	**Faculty members -** Dr. Rakesh Tiwari Dr. (Smt.) Prachi Singh Dr. Shobha Rani Smt. Nidhi Sharma Ku. Ambalika Chauhan Ku. Bijma Kumari Ku. Deepak -

DIRECTIVES FOR STUDENTS, FACULTY AND EXAMINERS

Question Paper Format and Distribution of Marks for PG Semester Examination

Question paper format for the Post-Graduate Examination has been revised from the Session 2018-19. The revised format will be applicable for all the question papers of Semester I, II, III & IV. The following are the main points of the new format:

1. The question paper will be of **80 marks** (as before)
2. Questions will be asked Unit-wise in each question paper.
3. From each Unit, the questions will be asked as follows :

Very short answer type question **(Answer in one or two sentences)**	**(02 Marks)**
Very short answer type question **(Answer in one or two sentences)**	**(02 Marks)**
Short answer type question	**(04 Marks)**
Long answer type questions	**(12 Marks)**

Type of Question	Unit-I	Unit-II	Unit-III	Unit-IV
Very Short (2 Questions)	2 x 2 = 4 Marks	2 x 2 = 4 Marks	2 x 2 = 4 Marks	2 x 2 = 4 Marks
Short (1 Question)	1 x 4 = 4 Marks	1 x 4 = 4 Marks	1 x 4 = 4 Marks	1 x 4 = 4 Marks
Long answer (1 Question)	1 x 12 = 12 Marks	1 x 12 = 12 Marks	1 x 12 = 12 Marks	1 x 12 = 12 Marks

Note:

1. Question no. 1 and Question 2 will be compulsory.
2. Question no. 3 and 4 will consist of 2 optional questions of which one has to be attempted.
3. As mentioned above, two compulsory very short answer type questions (2+2 marks), one short answer type question with internal choice (4 marks) and one long answer type question with internal choice (12 marks) will be asked from each unit.

Thus there will be questions of 20 marks from each unit and of total 80 marks from all the four units of the syllabus / syllabi.

4. The students are required to study the content mentioned in the curriculum exhaustively.

CREDIT ALLOTMENTS

Theory 80 marks = 04 Credits

Internal Assessment 20 marks = 01 credit

Theory Paper + Practical = 05 credits (04+01)

Chairperson / H.O.D - Dr. Padmavati Subject Expert - Dr. Madhu Srivastava Subject Expert - Dr. Shabnam Khan Subject Expert - Dr. S. K. Bhatt **Representative Members -** (1) Dr. Anil Kashyap - (2) Shri A. K. Pandey - (3) Dr. Mayur Puri Goswami	**Faculty members -** Dr. Rakesh Tiwari Dr. (Smt.) Prachi Singh Dr. Shobha Rani Smt. Nidhi Sharma Ku. Ambalika Chauhan Ku. Bijma Kumari Ku. Deepak -

Syllabus and Marking Scheme for M. Sc. Mathematics Forth Semester Session 2025-26

Paper No.	Title of the Paper	Marks Allotted in Theory		Marks Allotted in Internal Assessment		Credits
		Max	Min	Max.	Min.	
I	Integration theory and Functional analysis	80	16	20	04	05
II	Partial Differential Equations	80	16	20	04	05
III	Programming in C(with ANSI features) (II)	80	16	20	04	05
IV	Operations Research (II)	80	16	20	04	05
V	Fuzzy Sets and Their Applications (II)	80	16	20	04	05
IV	Practical in Paper III	50	18			02
	Total	450		100		27

05 Theory papers - 400 ; 01 Practical - 50 ; 05 Internal Assessments - 100
Total Marks - 550

Note: 20 marks = 01 credit in Theory Papers and 25 Marks = 01 Credit in Practical.

Chairperson / H.O.D - Dr. Padmavati

Subject Expert - Dr. Madhu Srivastava

Subject Expert - Dr. Shabnam Khan

Subject Expert - Dr. S. K. Bhatt

Representative Members -

(1) Dr. Anil Kashyap -

(2) Shri A. K. Pandey -

(3) Dr. Mayur Puri Goswami -

Faculty members -

Dr. Rakesh Tiwari

Dr. (Smt.) Prachi Singh

Dr. Shobha Rani

Smt. Nidhi Sharma

Ku. Ambalika Chauhan

Ku. Bijma Kumari

Ku. Deepak -

PG Department of Mathematics

PO No.	Program outcomes upon completion of the M. Sc. Degree program, the student will be able to
PO No. - 1	Pursue higher studies in mathematics in reputed institute of our country and clear Competitive exams like SET / NET / TET etc.
PO No. – 2	Read and identify mathematical and computational methods in order to solve comprehensive problems in several competitive examinations.
PO No. – 3	Well prepared to take jobs in schools and colleges as Mathematic Teachers and Professors, Software Industries, Research and Development Organizations.
PO No.- 4	Learn and apply Mathematics in real life situations aiming at service to the society.

Program Specific Outcomes:

PSO No.	Program specific outcomes : upon completion of the M. Sc. Degree program, the student will be able to
PSO - 1	Understand the fundamental axioms in mathematics and capable to develop ideas based on them.
PSO – 2	Inculcate mathematical reasoning and develop own learning capacity.
PSO – 3	Explain the core ideas and the techniques of mathematics and developabstract mathematical thinking.
PSO - 4	Assimilate the logical approach to take decision in complicated situations.
PSO - 5	Prepare and motivate for research studies in mathematics and relatedfields.

Learning Outcomes:

Student able to learn various types of spaces, week and strong convergence and contraction mapping which are very powerful tools of research in fixed point theory.

Course Title	M. Sc. Final, Integration Theory & Functional Analysis
CO No.	**Course Outcomes This course will enable the student to :**
CO No. – 1	Understand Sign measures and various theorems on measures, Riesz representation theorem, Fubinious Theorem.
CO No. – 2	Remember Normlinear space and their completeness, Finite dimension norm linear space and compactness.
CO No.- 3	Analyze Nonlinear operators, convex functions, epi-graphs, Coercive mapping etc.
CO No.- 4	Understand uniform boundedness theorem, Open and closed graph theorem and Hahn Banach theorem, Hilbert space, Reflexiblity of Hilbert space. Self adjoint, Normal, Unitary operators..

Learning Outcomes:

Upon completion of this course student should be able to learn various types of partial differential equations in different fields.

Course Title	M. Sc. Final, Partial Differential Equations
CO No.	**Course Outcomes This course will enable the student to :**
CO No. – 1	Understand Laplace equations, Heat equations, wave equations, solution by spherical means.
CO No. – 2	Analyze Geometric optics, Stationary phase and Homogenization.
CO No.- 3	Apply the modeling assumptions and derivations that leads to PDEs.

Learning outcomes:

Students able to understand specially natural events, forces, gravitational and attraction forces to bodies.

Course Title	M. Sc. Final, Mechanics
CO No.	**Course Outcomes This course will enable the student to :**
CO No. – 1	Remember Generalized coordinates langranges equation of first kind cyclic coordinates.
CO No. – 2	Understand Poisson's bracket hamilton's principle, principle of least action Poincare cardan integral invariant.
CO No.- 3	Apply Whittaker equations hamillton Jacobi equation invariation of lagrange bracket under canonical transformation.
CO No - 4	Evaluate the attraction for different types of objects.

Learning outcomes:

Application of computers using 'C'- Language and different fields of mathematical problem.

Course Title	M. Sc. Final, Programming in "C" (with ANSCI features)
CO No.	**Course Outcomes This course will enable the student to :**
CO No. – 1	Remember over view of programming, Anatomy of C-functions, variables and constants.
CO No. – 2	Evaluate Different types of data.
CO No.- 3	Analyze the main function Complex declaration, Conditional Compilation, Line Control, Input and output streams, Buffering, closing and opening files. The slandered library for input \ output etc.
CO No - 4	Apply an objects and pointers, Control flow conditional branching various types of loop.

Learning outcomes:

Application of Marketing field using this (Operation Research) and different fields of mathematical problems.

Course Title	M. Sc. Final, Operations Research
CO No.	**Course Outcomes This course will enable the student to :**
CO No. – 1	Remember the scope of operation research.
CO No. – 2	Evaluate real world problems to linear programming problems. Solve this problem with various methods, acquired with various algorithm and techniques of above used methods.
CO No.- 3	Understand mathematical formulation and solution of assignment problems and transportation problems.
CO No - 4	Apply the use of dynamic programming in various fields, Game theory, theory of queveing system and Inventory control to particle problems.

Learning outcomes:

After the study of this paper, students are familiar with the new branch of which is nearer to the real world.

Course Title	M. Sc. Final, (A) Fuzzy Sets and their Logics
CO No.	**Course Outcomes This course will enable the student to :**
CO No. – 1	Apply mathematical logic with real life. In this unit some models are explained.
CO No. – 2	Create an expert system, this unit gives basic propositional rules.
CO No.- 3	Remember the application of fuzzy set theory in the topic decision making, which is somewhat vague in nature?
CO No - 4	Understand Introduction and operation between fuzzy sets and fuzzy numbers, the difference between probability and possibility theory is explained through fuzzy sets..

Learning outcomes:

After the study of this paper, students are familiar with the new branch of which is nearer to the real world as well as graphics.

Course Title	M. Sc. Final, (B) Graph Theory
CO No.	**Course Outcomes This course will enable the student to :**
CO No. – 1	Apply mathematical logic with real life. In this unit some models are explained.
CO No. – 2	Create Polynomials and Graph Enumeration: The colour polynomials, The chromatic polynomial, bivariate coloring polynomials.
CO No.- 3	Remember the concept of Perfectness-preserving operations, Forbidden Subgraph orientations, Ramsey numbers and Ramsey graphs.
CO No - 4	Understand the spectrum, Spectrum properties, Coloring packing and covering i. e. colorable graphs, edge-colorings, Face coloring.

M.Sc. Mathematics (Fourth Semester)

2025 – 2026

PAPER –I

Code- MMT 401

Functional Analysis (II)

Max. Marks. 80

Unit-I Uniform boundedness theorem and some of its consequences. Open mapping and closed graph theorems. Hahn-Banach theorem for real linear spaces, complex linear spaces and normed linear spaces.

Unit-II Reflexive spaces. Weak Sequential Compactness. Compact Operators. Solvability of Linear equations in Banach spaces (Fredholm alternatives). The closed Range Theorem. Inner product spaces. Hilbert spaces. Orthonormal Sets. Bessel's inequality. Complete orthonormal sets and Parseval's identity.

Unit-III Structure of Hilbert spaces. Projection theorem. Riesz representation theorem. Adjoint of an operator on a Hilbert space. Reflexivity of Hilbert spaces.

Unit-IV Self-adjoint operators, Positive, projection, normal and unitary operators. Abstract variational boundary-value problem. The generalized Lax-Milgram theorem.

Recommended Books:

B.Choudhary and Sudarsan Nanda, Functional Analysis with Applications Wiley Eastern Ltd., 1989.

References:

1. S.K. Berberian, Measure and integration, Chelsea Publishing Company, New York, 1965.
2. G. de Barra, Measure Theory and Integration, Wiley Eastern Limited, 1981.
3. P.K. Jain and V.P. Gupta, Lebesgue Measure and Integration, New Age International (P) Limited, New Delhi, 2000.
4. Richard L. Wheeden and Antoni Zygmund, Measure and Integral : An Introduction to Real Analysis, Marcel Dekker Inc. 1977.
5. J.H. Williamson, Lebesgue Integration, Holt Rinehart and Winston, Inc. New York. 1962.
6. P.R. Halmos, Measure Theory, Van Nostrand, Princeton, 1950.
7. T.G. Hawkins, Lebesgue's Theory of Integration: Its Origins and Development, Chelsea, New York, 1979.
8. K.R. Parthasarathy, Introduction to Probability and Measure, Macmillan Company of India Ltd., Delhi, 1977.
9. R.G. Bartle, The Elements of Integration, John Wiley & Sons, Inc. New York, 1966. .

10. Inder K. Rana, An Introduction to Measure and Integration, Narosa Publ. House, Delhi, 1997.
11. Walter Rudin, Real & Complex Analysis, Tata McGraw-Hill Publishing.
12. Edwin Hewitt and Korl Stromberg, Real and Abstract Analysis, Springer-Verlag, New York.
13. Edwin Hewitt and K. A. Ross, Abstract Harmonic Analysis, Vol. 1, Springer-Verlag, 1993.
14. G. Bachman and L. Narici, Functional Analysis, Academic Press, 1966.
15. N. Dunford and J.T. Schwartz, Linear Operators, Part I, Interscience, New York, 1958.
16. R.E. Edwards, Functional Analysis, Holt Rinehart and Winston, New York, 1965.
17. .C. Goffman and G. Pedrick, First Course in Functional Analysis, Prentice Hall of India, New Delhi, 1987.
18. P.K. Jain, O.P. Ahuja and Khalil Ahmad, Functional Analysis, New Age International (P) Ltd. & Wiley Eastern Ltd., New Delhi, 1997.
19. R.B. Holmes, Geometric Functional Analysis and its Applications, Springer-Verlag, 1975.
20. K.K. Jha, Functional Analysis, Students' Friends, 1986.
21. L.V. Kantorovich and G.P. Akilov, Functional Analysis, Pergamon Press, 1982.
22. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, New York, 1978.
23. B.K. Lahiri, Elements of Functional Analysis, The World Press Pvt. Ltd., Calcutta, 1994.

Chairperson / H.O.D - Dr. Padmavati Subject Expert - Dr. Madhu Srivastava Subject Expert - Dr. Shabnam Khan Subject Expert - Dr. S. K. Bhatt **Representative Members -** (1) Dr. Anil Kashyap - (2) Shri A. K. Pandey - (3) Dr. Mayur Puri Goswami -	**Faculty members -** Dr. Rakesh Tiwari Dr. (Smt.) Prachi Singh Dr. Shobha Rani Smt. Nidhi Sharma Ku. Ambalika Chauhan Ku. Bijma Kumari Ku. Deepak -

M.Sc. MATHEMATICS (Fourth Semester)
2025 – 2026

PAPER -II
Code- MMT 402
Mechanics

Max.Marks. 80

Analytical Dynamics:

Unit-I Generalized coordinates. Holonomic and Non-holonomic systems. Scleronomic and Rheonomic sytems. Generalized potential. Lagrange's equations of first kind. Lagrange's equations of second kind. Uniqueness of solution. Energy equation for conservative fields. Hamilton's variables. Donkin's theorem. Hamilton canonical equations. Cyclic coordinates. Routh's equations.

Unit-II Poisson's Bracket. Poisson's Identity. Jacobi-Poisson Theorem. Motivating problems of calculus of variations, Shortest distance. Minimum surface of revolution. Brachistochrone problem. Isoperimetric problem. Geodesic. Fundamental lemma of calculus of variations. Euler's equation for one dependent function and its generalization to (1) 'n' dependent functions, (ii) higher order derivatives. Conditional extremum under geometric constraints and under integral constraints. Hamilton's Principle. Principle of least action. Poincare Cartan Integral invariant.

Unit-III Whittaker's equations. Jacobi's equations. Statement of Lee Hwa Chung's theorem. Hamilton-Jacobi equation. Jacobi theorem. Method of separation of variables. Lagrange Brackets. Condition of canonical character of a transformation in terms of Lagrange brackets and Poisson brackets, invariance of Lagrange brackets and Poisson brackets under canonical transformations.

Gravitational :

Unit-IV Attraction of rod, disc, spherical shells and sphere. Surface integral of normal attraction (application & Gauss' theorem). Potential of rod, disc, spherical shells and sphere. Laplace and Poisson equations. Work done by self attracting systems. Distributions for a given potential. Equipotential surfaces. Surface and solid harmonics. Surface density in terms of surface harmonics.

References:

1. R. N. Tiwari and B. S. Thakur, Classical Mechanics, Analytical Dynamics, published by Prentice-Hall of India in 2007, ISBN No. 978-81-203-3126-6.
2. A.S. Ramsey, Dynamics Part II, The English Language Book Society and Cambridge University Press, 1972.
3. F. Gantmacher, Lectures in Analytic Mechanics, MIR Publishers, Moscow, 1975.
4. H. Goldstein, Classical Mechanics (2nd edition), Narosa Publishing House, New Delhi.
5. I.M. Gelfand and S.V. Fomin, Calculus of Variations, Prentice Hall.
6. S.L. Loney, An Elementary Treatise on Statics, Kalyani Publishers, New Delhi, 1979.
7. A.S. Ramsey, Newtonian Gravitation, The English Language Book Society and the Cambridge University Press.
8. Narayan Chandra Rana & Pramod Sharad Chandra Joag, Classical Mechanics, Tata McGraw Hill, 1991.
9. Louis N. Hand and Janet D. Finch., Analytical Mechanics, Cambridge University Press, 1998.

Chairperson / H.O.D - Dr. Padmavati Subject Expert - Dr. Madhu Srivastava Subject Expert - Dr. Shabnam Khan Subject Expert - Dr. S. K. Bhatt **Representative Members -** (1) Dr. Anil Kashyap - (2) Shri A. K. Pandey - (3) Dr. Mayur Puri Goswami -	**Faculty members -** Dr. Rakesh Tiwari Dr. (Smt.) Prachi Singh Dr. Shobha Rani Smt. Nidhi Sharma Ku. Ambalika Chauhan Ku. Bijma Kumari Ku. Deepak

M. Sc. Mathematics (Fourth Semester)
2025 – 2026

PAPER-III (A)
Code- MMT 403 (A)
Programming in C (with ANSI features) Theory and Practical (II)

Max. Marks. 80
(Theory-50 + Practical-30)

Unit-I Storage Classes-Fixed vs. Automatic Duration. Scope. Global variables. The register Specifier. ANSI rules for the syntax and Semantics of the storage-class keywords. Dynamic Memory Allocation

Unit-II Pointers- Pointer Arithmetic. Passing Pointers as Function Arguments. Accessing Array Elements through Pointers. Passing Arrays as Function Arguments. Sorting Algorithms. Strings. Multidimensional Arrays. Arrays of Pointers. Pointers to Pointers.

Unit-III Functions-Passing Arguments. Declarations and Calls. Pointers to Functions. Recursion. The main ( ) Function. Complex Declarations. The C Preprocessor-Macro Substitution. Conditional Compilation. Include Facility. Line Control.

Unit-IV Structures and Unions-Structures.Linked Lists. Unions, enum Declarations. Input and Output Streams,Buffering. The <Stdio.h> Header File. Error Handling. Opening and Closing a File. Reading and Writing Data. Selecting an I/O Method. Unbuffered I/O Random Access. The standard library for Input/Output.

References:

1. Peter A. Darnell and Philip E. Margolis, C: A Software Engineering Approach, Narosa Publishing House (Springer International Student Edition) 1993.
2. Samuel P. Harkison and Gly L. Steele Jr., C : A Reference Manual, 2nd Edition, Prentice Hall, 1984.

3. Brian W. Kernighan & Dennis M. Ritohie, The C Programme Language, 2nd Edition (ANSI Features), Prentice Hall 1989.
4. Yashwant Kanetkar, Let Us C, 8th Edison, B P B Publications 2007.
5. E. Balagurusamy, Programming in C (ANSI), 4th Edison, Tata Mac Graw Hill.

List of C programming for 4th sem. Mathematics

1. WAP to input any number and compute sum of its digits using
2. WAP to compute factorial of any number using recursive function.
3. WAP to perform different arithmetic operations using pointers.
4. WAP to print the element of an array using pointers.
5. WAP to calculate the sum of all elements stored in an array using pointer.
6. WAP to exchange two values using call by reference.
7. WAP to print the reverse of an integer number entered by user using recursion.
8. WAP for multi dimensional arrays.
9. WAP to count total number of alphabets, digit and special character in a string.
10. WAP for creating and storing of book record using following structure
    a. Book Acc No. b. Name c. Title d. Author e. Publication.
11. WAP to sorting element of an array in ascending order using insertion sort algorithm
12. WAP to sort elements using selection short algorithm.
13. WAP to calculate the length of the string using pointer.
14. WAP to find maximum element in array.
15. WAP to swap strings.

Chairperson / H.O.D - Dr. Padmavati Subject Expert - Dr. Madhu Srivastava Subject Expert - Dr. Shabnam Khan Subject Expert - Dr. S. K. Bhatt **Representative Members** - (1) Dr. Anil Kashyap - (2) Shri A. K. Pandey - (3) Dr. Mayur Puri Goswami -	**Faculty members** - Dr. Rakesh Tiwari Dr. (Smt.) Prachi Singh Dr. Shobha Rani - Smt. Nidhi Sharma Ku. Ambalika Chauhan Ku. Bijma Kumari Ku. Deepak -

M. Sc. Mathematics (Fourth Semester)
2025 – 2026

Paper- III
Code- MMT 403 (B)

WAVELETS (II)

Max.marks.80

UNIT -I Orthonormal bases of piecewise linear continuous function for $L^2(T)$. Orthonormal bases of periodi splines. Periodization of wavelets defined on the real line.

UNIT -II Characterizations in the theory of wavelets-The basic equation and some of its application. The characterization of MRA wavelets .

UNIT -III A characterization of Low-pass filters and scaling function. Non-existence of smooth wavelets in $H^2(R)$.

UNIT –IV Frames - The reconstruction formula and the Balian - Low theorem for frames. Frames from translations and dilations. Smooth frames for $H^2(R)$. Discrete Transforms and algorithms -The discrete and the fast Fourier transforms. The discrete and the fast cosine transforms. The discrete version of the local sine and cosine bases. and reconstruction algorithm for wavelets.

Recommended Books :

1. Eugenio Hernandez and Guido Weiss . A First course on Wavelets , CRC Press, New York , 1996.

References:

1. C. K . Chui, An Introduction to Wavelets , Academic Press,1992.
2. I. Daubechies , Ten Lectures on Wavelets , CBS-NSF Regional Conferences in

Applied Mahtematics , 61 ,SIAM , 1992.

3. Y. Meyer , Wavelets , Algorithms and applications (Translated by R. Rayan), SIAM , 1993.
4. M.V. Wickerhauser, Adapted wavelet analysis from theory to software, Wellesley, MA,A.K. Peters, 1994.

Chairperson / H.O.D - Dr. Padmavati Subject Expert - Dr. Madhu Srivastava Subject Expert - Dr. Shabnam Khan Subject Expert - Dr. S. K. Bhatt **Representative Members -** (1) Dr. Anil Kashyap - (2) Shri A. K. Pandey - (3) Dr. Mayur Puri Goswami -	**Faculty members** - Dr. Rakesh Tiwari Dr. (Smt.) Prachi Singh Dr. Shobha Rani - Smt. Nidhi Sharma Ku. Ambalika Chauhan Ku. Bijma Kumari Ku. Deepak -

M. Sc. Mathematics (Fourth Semester)

2025 – 2026

PAPER –IV

Code- MMT 404
Operations Research (II)

Max. Marks. 80

Unit-I Dynamic Programming-Deterministic and Probabilistic Dynamic programming. Integer Programming, Branch and Bound Technique.

Unit-II Game Theory-Two-Person, Zero-Sum Games. Games with Mixed Strategies. Graphical, Solution Solution by Linear Programming.

Unit-III Queueing system: Deterministic Queueing system, probability distribution in Queueing, classification of Queueing models, Poission Queueing system ((M/M/I): (∞/FIFO), (M/M/I): (SIRO) (M/M/I): (N/FIFO)), Inventory control : The concept of EOQ, Deterministic inventory problem with no shortages.

Unit-IV Nonlinear Programming-One and Multi-Variable Unconstrained Optimization. Kuhn-Tucker \ Conditions for Constrained Optimization. Graphical solution Quadratic Programming.

Recommended Book:

1. K. Swarup, P. K. Gupta and Man Mohan, Operations Research, S. Chand & Sons, N. Delhi.

References:

1. F. S. Hillier and G. J. Ueberman. Introduction to Operations ResBareft (Sixth Edition), McGraw Hill International Edition, Industrial Engineering Series, 1995. (This book comes with a CD containing tutorial software).
2. G. Hadley, Linear Programming, Narosa Publishing House, 1995.
3. G. Hadly, Nonlinear and Dynamic Programming, Addison-Wesley, Reading Mass.

4. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, Linear Programming and Network flows, John Wiley & Sons, New York, 1990.
5. H. A. Taha, Operations Researc~-An introduction, Macmillan Publishing Co., Inc., New Yark.
6. S. S. Rao, Optimization Theory and Applications, Wiley Eastern Ltd., New Delhi.
7. P. K. Gupla and D.S. Hira, O. R.- An Introduction. S. Chand & Co. Ltd., N. Delhi.
8. N. S. Kambo, Mathematical Programming Techniques, Affiliated East-West Press Pvt. Ltd., New Delhi

Chairperson / H.O.D - Dr. Padmavati Subject Expert - Dr. Madhu Srivastava Subject Expert - Dr. Shabnam Khan Subject Expert - Dr. S. K. Bhatt **Representative Members -** (1) Dr. Anil Kashyap - (2) Shri A. K. Pandey - (3) Dr. Mayur Puri Goswami -	**Faculty members -** Dr. Rakesh Tiwari Dr. (Smt.) Prachi Singh Dr. Shobha Rani - Smt. Nidhi Sharma Ku. Ambalika Chauhan Ku. Bijma Kumari Ku. Deepak -

M. Sc. Mathematics (Fourth Semester)

2025 - 2026

Paper- V (A)
Code – MMT 405 (A)

Fuzzy Set and their Applications (II)

Max.marks.80

Unit-I Fuzzy Logic - An overview of classical logic. Multivalued logics. Fuzzy propositions. Fuzzy Quantifiers. Linguistic variable and hedges. Inference from conditional fuzzy proposition. The compositional rule of inference.

Unit-II Approximate Reasoning. An overview of fuzzy expert system. Fuzzy implications andtheir selection Multiconditional approximate reasoning. The role of fuzzy relation equation.

Unit-III An introduction to Fuzzy Control - Fuzzy Controllers. Fuzzy Rule base. Fuzzy inference engine. Fuzzification. Defuzzification and various defuzzification method.

Unit-IV Decision Making in Fuzzy Environment-Individual decision making. Multiperson decision making. Multicriteria decision making. Multistage decision making. Fuzzy ranking methods. Fuzzy linear programming.

References:

1. Sets and fuzzy logic by G.J. Klir and B. Yuan, Prentice-Hall of, New Delhi, 1995.
2. Fuzzy set theory and its Applictions , By H.J.Zimmermann , Allied Publishers Ltd., New Delhi, 1991.

Chairperson / H.O.D - Dr. Padmavati Subject Expert - Dr. Madhu Srivastava Subject Expert - Dr. Shabnam Khan Subject Expert - Dr. S. K. Bhatt **Representative Members -** (1) Dr. Anil Kashyap - (2) Shri A. K. Pandey - (3) Dr. Mayur Puri Goswami -	**Faculty members -** Dr. Rakesh Tiwari Dr. (Smt.) Prachi Singh Dr. Shobha Rani - Smt. Nidhi Sharma Ku. Ambalika Chauhan Ku. Bijma Kumari Ku. Deepak -

M. Sc. Mathematics (Fourth Semester)
2024 – 2025

Paper- V (B)
Code – MMT 405 (B)
Graph theory-II

Max. Marks - 80

Unit-I: Ramsey Theory: Perpectness-preserving operations, Forbidden Subgraph orientations, Ramsey numbers and Ramsey graphs.

Unit-II: Groups: Permutation groups, The automorphism group, graphs with given group, symmetry concepts, pseudo-similarity and stability, spectral studies of the Automorphism group.

Unit-III: Polynomials and Graph Enumeration: The colour polynomials, The chromatic polynomial, The bivariate colouring polynomials.

Unit-IV: Graph Enumeration: Co-chromatic (co-dichromatic) graphs and chromatically unique graphs, Graph Enumeration.

Unit-V: Digraphs & Networks: Digraphs, Types of connectedness, Flows in Networks, Menger's and Konig's Theorem, Degree sequences.

REFERENCES:

1. K. R. Parthasarathy, Basic graph theory, Tata Mc graw Hill publishing company limited, 1994.
2. R. J. Wilson, Introduction to graph theory, Longman Harlow, 1985.
3. John Clark, Derek Allon Holton, A first look at graph Theory, World Scientific Singapore, 1991.
4. Frank Hararary, Graph Theory Narosa, New Delhi, 1995.
5. Ronald Gould and Benjamin Cummins, Graph Theory, California.
6. Narsingh Deo, Graph Theory with applications to Engineering and Computer Science, Prentice-Hall of India Private Limited, New Delhi, 2002.
7. J. A. Bondy and U. S. R. Murthy, Graph Theory with applications, North Holland.
8. Gary Chartrend and Ping Zhang, Introduction to graph theory, Mc Graw Hill publishing, reference book.

Chairperson / H.O.D - Dr. Padmavati Subject Expert - Dr. Madhu Srivastava Subject Expert - Dr. Shabnam Khan Subject Expert - Dr. S. K. Bhatt **Representative Members -** (4) Dr. Anil Kashyap - (5) Shri A. K. Pandey - (6) Dr. Mayur Puri Goswami	**Faculty members -** Dr. Rakesh Tiwari Dr. (Smt.) Prachi Singh Dr. Shobha Rani Smt. Nidhi Sharma Ku. Ambalika Chauhan Ku. Bijma Kumari Ku. Deepak