अध्ययन मंडल बैठक दिनांक 17.07.2025

विषय – गणित

राष्ट्रीय शिक्षा नीति 2020 के अनुरूप विश्वविद्यालय अन्तर्गत संचालित एम.एस.सी. गणित प्रोग्राम में अध्ययन मंडल द्वारा तैयार किये गये तृतीय एवं चतुर्थ सेमेस्टर के पाठ्यक्रम को निम्नानुसार लागू करने की अनुशंसा की जाती है:–

Program : M.Sc. Mathematics										
Course Type	Course Code	Course Title	Paper	Semester	Credits	Max Marks	MinMarks	CIA/ Prac.		ESE
Third Semester (NHEQF Level - 500)										
Compulsory papers										
DSC	MASC-09	Functional Analysis	T	III	04	100	40	30		70
DSC	MASC-10	Partial Differential Equations	T	III	04	100	40	30		70
Optional papers (Any three)										
DSE	MASE-13	Scientific Writing using LaTex	T/P	III	04	100	40	15	35	50
DSE	MASE-14	Operational Research	T	III	04	100	40	30		70
DSE	MASE-15	Special Functions	T	III	04	100	40	30		70
DSE	MASE-16	Programming in C with ANSI feature.	T/P	III	04	100	40	15	35	50
DSE	MASE-17	Statistical Methods and inference	T	III	04	100	40	30		70
Fourth Semester (NHEQF Level - 500)										
Compulsory papers										
DSC	MASC-11	Dissertation/ Project	-	IV	12	300	120	-		-
DSE	MASE-18	Scientific Computing using MATLAB	T/P	IV	04	100	40	15	35	50
DSE	MASE-19	Programming in C++	T/P	IV	04	100	40	15	35	50

टीप :– परीक्षा योजना एवं प्रश्न पत्र के प्रारूप को भी यथावत् लागू करने की अनुशंसा की जाती है।

आज दिनांक 17/07/2025 को **गणित** अध्ययन मंडल की बैठक में निम्नलिखित अध्यक्ष/सदस्य उपस्थित हुये।

क्र.	नाम	पदनाम	अध्यक्ष/सदस्य	हस्ताक्षर
01.	श्री फागूराम साहू	सहायक प्राध्यापक	अध्यक्ष	
02.	डॉ रवि द्विवेदी	सहायक प्राध्यापक	सदस्य	
03.	श्री बंशीधर चौहान	सहायक प्राध्यापक	सदस्य	17/07/25
04.	श्री डोमेश कुमार	सहायक प्राध्यापक	सदस्य	
05.	श्री द्वास लाल	सहायक प्राध्यापक	सदस्य	17-7-25
06.	श्री सोनू राम	सहायक प्राध्यापक	सदस्य	

POST GRADUATE PROGRAM (2025-2026)
DEPARTMENT OF MATHEMATICS
COURSE CURRICULUM

Part A: Introduction			
Program: Master in Science		**Semester-III**	**Session: 2025-26**
1.	Course Code	MASC-09	
2.	Course Title	**Functional Analysis**	
3.	Course Type	**Compulsory**	
4.	Pre-requisite (If any)		
5.	Course Learning Outcomes (CLO)	This Course will enable the students to: ➢ Explain and analyze the structure of normed linear spaces and Banach spaces, including examples and properties such as compactness and completeness. ➢ Apply fundamental theorems such as the Hahn–Banach Theorem, Uniform Boundedness Theorem, Open Mapping Theorem, and Closed Graph Theorem to problems in functional analysis. ➢ Demonstrate understanding of bounded linear transformations and dual spaces, with examples from classical spaces like ℓ^p and L^p. ➢ Distinguish between weak and strong convergence, and apply concepts of reflexivity and weak sequential compactness in analysis. ➢ Study the solvability of linear equations in Banach spaces, compact operators, and use the Closed Range Theorem effectively.	
6.	Credit Value	4C	1 Credit = 15 hours-Learning and observation
7.	Total Marks	Maximum Marks: 100	Minimum Passing Marks: 40

Part B: Content of the course

Total no of teaching-learning period = 60 periods

Unit	Topic	No. of Periods
Unit I	Normed Linear spaces. Banach Spaces and examples. Quotient spaces of normed linear spaces and its completeness. Equivalent Norms. Riesz Lemma. Basic properties of finite dimensional normed linear spaces and compactness.	**15**
Unit II	Week convergence and bounded linear transformations. Normed linear spaces of bounded linear transformations. Dual spaces with examples.	**15**
Unit III	Uniform boundedness theorem and some of its consequences. Open mapping and closed graph theorems.	**15**
Unit IV	Hahn- Banach theorem for real linear spaces, complex linear spaces and normed linear spaces. Reflexive spaces. Weak Sequential Compactness. Compact Operators. Solvability of linear equations in Banach spaces. The closed Range Theorem.	**15**

Part C-Learning resources

Text books, Reference Books and other resources

Text Book recommended

1. B. Choudary and S. Nanda, Functional Analysis with Applications: Wiley Eastern Ltd. 1989.
2. H. L. Royden , Real Analysis, Macmillan Publishing Co. Inc., New York, 4'h Edition, 1993.

Reference Books

1. B.V. Limaye, Functional Analysis, New Age International Publishers, New Delhi, 2nd Edition, 2004.
2. Erwin Kreyszig, Introductory Functional Analysis with Applications, Wiley Eastern Ltd., New Delhi, 1989.
3. Walter Rudin, Functional Analysis, McGraw-Hill Education, New York, 2nd Edition, 1991.
4. G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, New York, 1963.
5. Rynne & Youngson, Linear Functional Analysis, Springer Undergraduate Mathematics Series, Springer, London, 2008.
6. J.B. Conway, A Course in Functional Analysis, Springer-Verlag, New York, 2nd Edition, 1990.
7. K. Yosida, Functional Analysis, Springer-Verlag, Berlin Heidelberg, 6th Edition, 1980.
8. M. Thamban Nair, Functional Analysis: A First Course, Prentice-Hall of India Pvt. Ltd., New Delhi, 2008.

E-resources

- MIT OpenCourseWare – Functional Analysis Lectures
- NPTEL Course – Functional Analysis by Prof. S.K. Ray (IIT Kharagpur)
- YouTube – Functional Analysis Series by Prof. V. Balakrishnan and others
- Khan Academy – Linear Algebra and Vector Spaces (as prerequisites)

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum marks:	**100 Marks**
Continuous internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous internal Assessment (CIA) (Conducted by Course Teacher)	**Two Test/Quiz- 20 Marks** **Assignment/Seminar- 10 Marks**	Best out of two test/quiz + obtained marks in Assignment/Seminar shall be considered against 30 marks
End Semester Exam (ESE)	**Two Section A & B** Section-A: Q1. Objective- 10 X 1 = 10 marks. Q2. Short answer type question 5 X 4 = 20 marks. Section B: Descriptive answer type question, 1 out of 2 from each unit- 10 X 4 = 40 Marks.	

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DEPARTMENT OF MATHEMATICS
COURSE CURRICULUM

Part A: Introduction			
Program: Master in Science		**Semester-III**	**Session: 2025-26**
1.	Course Code	**MASC-10**	
2.	Course Title	**Partial Differential Equations**	
3.	Course Type	**Compulsory**	
4.	Pre-requisite (If any)	Basic knowledge of arithmetic operations	
5.	Course Learning Outcomes (CLO)	This Course will enable the students to: ➢ Classify and analyze partial differential equations and their solutions using standard methods. ➢ Solve the classical PDEs such as transport, heat, wave, and Laplace equations using fundamental solutions and transforms. ➢ Apply Green's function techniques and energy methods to boundary value problems. ➢ Investigate nonlinear PDEs using characteristic methods, weak solutions, and conservation laws. ➢ Utilize integral transforms, similarity solutions, and asymptotic methods for solving complex PDEs.	
6.	Credit Value	4C	1 Credit = 15 hours-Learning and observation
7.	Total Marks	Maximum Marks: 100	Minimum Passing Marks: 40

Part B: Content of the course

Total no of teaching-learning period = 60 periods

Unit	Topic	No. of Periods
Unit I	Examples of PDE. Classification. Transport Equation-Initial value Problems. Non-homogeneous Equations. Laplace's Equation-Fundamental Solution, Mean Value Formulas, Properties of Harmonic Functions, Green's Function, Energy Methods.	**15**
Unit II	Heat Equation-Fundamental Solution, Mean Value Formula, Properties of Solutions, Energy Methods, Wave Equation-Solution by Spherical Means, Non-homogeneous Equations, and Energy Methods.	**15**
Unit III	Nonlinear First Order PDE-Complete Integrals, Envelopes, Characteristics, Hamilton Jacobi Equations (Calculus of Variations, Hamilton's Legendre Transform), Hopf-Lax Formula, Weak Solutions, Uniqueness), Conservation Law (Shocks Entropy Condition, LaxOleinik formula, Weak Solutions, Uniqueness Riemann's Problem Long Time Behaviour).	**15**
Unit IV	Representation of solutions separation of variables, Similarity solutions (Planes and travelling waves, Solitons, Similarity under scaling), Fourier and Laplace Transform Hopf-Cole Transform, Hodograph and Legendre Transforms, Potential Functions.Asymptotic (Singular Perturbations, Laplace's	**15**

	Method, Geometric Optics, Stationary phase, Homogenization), Power Series (Non-characteristics surfaces Real Analysis functions , Cauchy – Kovalevskaya Theorem).	

Part C-Learning resources

Text books, Reference Books and other resources

Text Book recommended

1. L.C. Evans, Partial Differential Equations, Graduate Studies in Mathematics, Volume 19, AMS, 1998.
2. R.C. Mondal, Classical Mechanics, Prentice Hall of India.
3. F. Gantmacher, Lectures in Analytic Mechanics, MIR Publishers, Moscow, 1975.

Reference Books

1. L.N. Sneddon, Elements of Partial Differential Equations, McGraw-Hill.
2. F. John, Partial Differential Equations, Springer.
3. P. Prasad and Ravindran Amarnath, Partial Differential Equations.
4. A.S. Ramsey, Dynamics Part II, Cambridge University Press, 1972.
5. H. Goldstein, Classical Mechanics, 2nd Edition, Narosa Publishing House.
6. I.M. Gelfand and S.V. Fomin, Calculus of Variations, Prentice Hall.
7. Narayan Chandra Rana & Pramod Sharad Chandra Joag, Classical Mechanics, McGraw Hill, 1991.
8. Louis N. Hand and Janet D. Finch, Analytical Mechanics, Cambridge University Press, 1998.

E-resources

- MIT OpenCourseWare – 18.152 Partial Differential Equations
- Khan Academy – Differential Equations
- Coursera – PDE courses from top universities
- YouTube – NPTEL Lectures on PDEs (e.g., Prof. A.K. Nandakumaran)
- Paul's Online Math Notes – PDE Section

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum marks:	**100 Marks**
Continuous internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous internal Assessment (CIA) (Conducted by Course Teacher)	**Two Test/Quiz- 20 Marks** **Assignment/Seminar- 10 Marks**	Best out of two test/quiz + obtained marks in Assignment/Seminar shall be considered against 30 marks
End Semester Exam (ESE)	**Two Section A & B** Section-A: Q1. Objective- 10 X 1 = 10 marks. Q2. Short answer type question 5 X 4 = 20 marks. Section B: Descriptive answer type question, 1 out of 2 from each unit- 10 X 4 = 40 Marks.	

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Part A: Introduction			
Program: Master in Science		**Semester-III**	**Session: 2025-26**
1.	Course Code	MASE-13	
2.	Course Title	Scientific Writing using LaTeX	
3.	Course Type	**Optional**	
4.	Pre-requisite (If any)	Basic knowledge in computer	
5.	Course Learning Outcomes (CLO)	This Course will enable the students to: ➢ Be able to create well-structured academic documents using LaTeX. ➢ Typeset mathematical content and research-level formulas. ➢ Prepare professional-quality reports, articles, and presentations. ➢ Use LaTeX for thesis preparation and scientific communication.	
6.	Credit Value	4C	1 Credit = 15 hours-Learning and observation
7.	Total Marks	Maximum Marks: 100	Minimum Passing Marks: 40

Part B: Content of the course		
Total no of teaching-learning period = 60 periods		
Unit	**Topic**	**No. of Periods**
Unit I: Introduction to LaTeX.	Installation and LaTeX editors (TeXworks, Overleaf). Structure of a LaTeX document. Creating documents: article, report, book. Formatting: sections, paragraphs, lists, page layout	**8T + 16P**
Unit II: Mathematical Typesetting	Inline and display math. Fractions, roots, powers, subscripts. Greek letters and special symbols. Matrices, aligned equations, cases. Equation numbering and referencing.	**8T + 16P**
Unit III: Tables, Figures, and Citations	Creating tables using tabular and array. Importing and positioning images. Figure and table captions and references. Bibliography management using BibTeX. Citation styles and referencing.	**8T + 16P**
Unit IV: Advanced Features	Using packages (amsmath, graphicx, geometry, etc.). Creating presentations using Beamer. Writing assignments, theses, and research articles. Cross-referencing, index and glossary creation. Troubleshooting LaTeX errors	**6T + 12P**
List of Practical's based on LateX: 1. Create a basic article with title, author, date, and sections 2. Typeset inline and display mathematical expressions using amsmath 3. Construct matrices, cases, and piecewise functions		

4. Insert images and provide figure captions and labels 5. Create and format tables using the tabular environment 6. Implement cross-referencing for equations, tables, and figures 7. Write a bibliography using BibTeX and cite sources 8. Typeset theorems, definitions, and proofs using amsthm 9. Create a Beamer presentation with multiple slides and transitions 10. Design a résumé or CV using LaTeX templates 11. Format algorithms using algorithm2e or algorithmic packages 12. Write a scientific report using the report class 13. Use packages like geometry, graphicx, hyperref effectively 14. Prepare a LaTeX document with custom headers/footers using fancyhdr 15. Compile a multi-chapter thesis template using book class	

Part C-Learning resources

Text books, Reference Books and other resources

Text Book recommended

1. Stefan Kottwitz – LaTeX Beginner's Guide
2. Leslie Lamport – LaTeX: A Document Preparation System
3. Tobias Oetiker et al. – The Not So Short Introduction to LaTeX2e

Reference Books

1. George Grätzer – More Math into LaTeX
2. Nicola L. C. Talbot – LaTeX for Complete Novices

E-resources

- Overleaf (Online Editor): https://www.overleaf.com
- LaTeX Wikibook: https://en.wikibooks.org/wiki/LaTeX
- ShareLaTeX tutorials: https://www.sharelatex.com/learn
- SWAYAM/NPTEL Courses on LaTeX

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum marks:	**100 Marks**
Continuous internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**50 Marks**
Presentation & Viva Voce:	**35 Marks**

Continuous internal Assessment (CIA) (Conducted by Course Teacher)	Two Test/Quiz- 10 Marks Assignment/Seminar- 05 Marks	Best out of two test/quiz + obtained marks in Assignment/Seminar shall be considered against 15 marks
End Semester Exam (ESE)	**Two Section A & B** Section-A: Q1. Objective- 10 X 1 = 10 marks. Q2. Short answer type question 4 X 2 = 08 marks. Section B: Descriptive answer type question, 1 out of 2 from each unit- 08 X 4 = 32 Marks.	

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Part A: Introduction			
Program: Master in Science		**Semester-III**	**Session: 2025-26**
1.	Course Code	**MASE-14**	
2.	Course Title	**Operations Research**	
3.	Course Type	**Optional**	
4.	Pre-requisite (If any)		
5.	Course Learning Outcomes (CLO)	This Course will enable the students to: ➢ Understand the scope and necessity of Operations Research (OR) in industrial and organizational decision-making environments. ➢ Formulate and solve Linear Programming Problems using methods like the Simplex, Dual Simplex, Parametric, and Interior Point algorithms. ➢ Apply optimization techniques to Transportation, Assignment, and Goal Programming Problems, including sensitivity and duality analysis. ➢ Solve network-based problems, including Shortest Path, Maximum Flow, Minimum Cost Flow, and Minimum Spanning Tree, using appropriate algorithms like the Network Simplex Method. ➢ Utilize project planning tools such as PERT (Program Evaluation and Review Technique) and CPM (Critical Path Method) for time and resource management in project execution.	
6.	Credit Value	4C	1 Credit = 15 hours-Learning and observation
7.	Total Marks	Maximum Marks: 100	Minimum Passing Marks: 40

Part B: Content of the course

Total no of teaching-learning period = 60 periods

Unit	Topic	No. of Periods
Unit I	Operations Research and its Scope. Necessity of Operations Research in Industry Linear Programming – Simplex Method. Theory of the Simplex Method. Duality and Sensitivity Analysis.Dual Simplex Method.	**15**
Unit II	Parametric Linear Programming. Upper Bound Technique. Interior Point Algorithm Linear Goal Programming.	**15**
Unit III	Transportation and Assignment Problems.	**15**
Unit IV	Network Analysis – Shortest Path Problem. Minimum Spanning Tree Problem Maximum Flow The Problem. Minimun Cost Flow Problem. Network Simplex Method Project Planning and Control I with PERT – CPM.	**15**

Part C-Learning resources

Text books, Reference Books and other resources

Text Book recommended

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. Hadley, Nonlinear and Dynamic Programming, Addison- Wesley, Reading Mass.
4. H.A. Taha, Operations Research – An introduction, Macmillan Publishing CO., Inc., New York.
5. Kanti Swarup, P.K. Gupta and Man Mohan, Operations Research, Sultan Chand & Sons New Delhi.
6. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, Linear Programming and Network flows, John Wiley & Sons, New York, 1990.

Reference Books

1. S.S. Rao, Optimization Theory and Applications, Wiley Eastern Ltd., New Delhi.
2. Prem Kumar Gupta and D.S. Hira, Operations Research – An Introduction. S. Cliand & Company Ltd, New Delhi.
3. N.S. Kambo, Mathematical Programming Techniques, Affiliated East – West Press Pvt. Ltd., New Delhi, Madras.
4. R.K. Rathy, An Introduction to Fluid Dynamics, Oxford and IBH Publishing Company , New Delhi, 1976.
5. A.D. Young, Boundary Layers, AIAA Education Series, Washington DC, 1989.
6. S.W. Yuan, Foundations of Fluid Mechanics, Prentice Hall of India Private Limited, New Delhi, 1976.
7. UNDOSystems Products (Visit websitehttp://www.Hndo.com/productsf.html)
    i. UNDO (the linear programming solver)
    ii. UNDO Callable Library (the premier optimization engine)
    iii. LINGO (the linear, non-linear, and integer programming solver with mathematical modeling language).

E-resources

- NPTEL Online Courses – Operations Research by Prof. G. Srinivasan (IIT Madras)
- MIT OpenCourseWare – Introduction to Operations Research
- YouTube Channels – Tutorials on OR problems from Unacademy, Gate Academy, and Study Tonight.
- Operations Research Models and Applications (OR-Tools) by Google – https://developers.google.com/optimization
- Khan Academy – Introduction to linear programming and optimization.

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum marks:	**100 Marks**
Continuous internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous internal Assessment (CIA) (Conducted by Course Teacher)	**Two Test/Quiz- 20 Marks** **Assignment/Seminar- 10 Marks**	Best out of two test/quiz + obtained marks in Assignment/Seminar shall be considered against 30 marks
End Semester Exam (ESE)	**Two Section A & B** Section-A: Q1. Objective- 10 X 1 = 10 marks. Q2. Short answer type question 5 X 4 = 20 marks. Section B: Descriptive answer type question, 1 out of 2 from each unit- 10 X 4 = 40 Marks.	

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Part A: Introduction			
Program: Master in Science		**Semester-III**	**Session: 2025-26**
1.	Course Code	**MASE-15**	
2.	Course Title	Special Functions	
3.	Course Type	**Optional**	
4.	Pre-requisite (If any)		
5.	Course Learning Outcomes (CLO)	This Course will enable the students to: ➢ Understand and use classical special functions in solving integrals and differential equations. ➢ Analyze the properties of hypergeometric functions and their confluent forms. ➢ Apply orthogonal polynomials in approximation and modeling. ➢ Use Bessel and related functions in applied contexts like wave propagation and statistical models.	
6.	Credit Value	4C	1 Credit = 15 hours-Learning and observation
7.	Total Marks	Maximum Marks: 100	Minimum Passing Marks: 40

Part B: Content of the course

Total no of teaching-learning period = 60 periods

Unit	Topic	No. of Periods
Unit I	Gamma and Beta Functions: Definition and elementary properties. Evaluation of integrals using Gamma and Beta functions. Duplication and multiplication formulas. Stirling's approximation. Relationship between Beta and Gamma functions.	**15**
Unit II	Generalized hypergeometric function ${}_pF_q$: definition and convergence. Gauss hypergeometric function 2F1: properties and transformation formulas. Differential equation satisfied by ${}_2F_1$. Confluent hypergeometric function ${}_1F_1$: properties and applications	**15**
Unit III	Classical orthogonal polynomials: Legendre, Chebyshev, Hermite, Laguerre. Rodrigues' formula and recurrence relations. Orthogonality relations and weight functions. Generating functions and differential equations. Applications in statistics and physics	**15**
Unit IV	Bessel functions of first and second kind: Recurrence relations and orthogonality. Spherical Bessel functions. Introduction to Airy, Struve, and Error functions	**15**

Part C-Learning resources

Text books, Reference Books and other resources		
Text Book recommended		
1. Rainville, E. D. – Special Functions 2. A. R. Vasishtha and R. K. Gupta – Special Functions 3. George E. Andrews, Richard Askey, Ranjan Roy – Special Functions **Reference Books** 1. Lebedev, N.N. – Special Functions and Their Applications 2. Abramowitz and Stegun – Handbook of Mathematical Functions 3. Andrews & Askey – Special Functions in Mathematical Physics 4. Ravi Dwivedi (2025), Gauss Hypergeometric function, DeGruyter, Berlin Germany.		
E-resources • NPTEL Courses: Special Functions and Applications (IIT Kanpur) • Wolfram Functions Site: https://functions.wolfram.com • Paul's Online Notes – Special function overviews: https://tutorial.math.lamar.edu		
Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum marks:** **100 Marks** **Continuous internal Assessment (CIA):** **30 Marks** **End Semester Exam (ESE):** **70 Marks**		
Continuous internal Assessment (CIA) (Conducted by Course Teacher)	**Two Test/Quiz- 20 Marks** **Assignment/Seminar- 10 Marks**	Best out of two test/quiz + obtained marks in Assignment/Seminar shall be considered against 30 marks
End Semester Exam (ESE)	**Two Section A & B** Section-A: Q1. Objective- 10 X 1 = 10 marks. Q2. Short answer type question 5 X 4 = 20 marks. Section B: Descriptive answer type question, 1 out of 2 from each unit- 10 X 4 = 40 Marks.	

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DEPARTMENT OF MATHEMATICS
COURSE CURRICULUM

Part A: Introduction			
Program: Master in Science		**Semester-III**	**Session: 2025-26**
1.	Course Code	**MASE-16**	
2.	Course Title	**Programming in C (with ANSI features) Theory and Practical**	
3.	Course Type	**Optional**	
4.	Pre-requisite (If any)		
5.	Course Learning Outcomes (CLO)	This Course will enable the students to: ➢ Understand the structure and components of C programming, including program development steps, functions, variables, constants, and preprocessor directives. ➢ Demonstrate the use of scalar data types, pointers, and enumeration types, with an understanding of memory handling and address referencing. ➢ Implement control flow mechanisms such as conditionals, loops, switch statements, and the use of break, continue, and goto. ➢ Apply array manipulation techniques, including array initialization, memory mapping, and simple encryption-decryption logic. ➢ Analyze and use a wide variety of operators, including arithmetic, relational, logical, assignment, increment/decrement, and memory operators in complex expressions.	
6.	Credit Value	4C	1 Credit = 15 hours-Learning and observation
7.	Total Marks	Maximum Marks: 100	Minimum Passing Marks: 40

Part B: Content of the course

Total no of teaching-learning period = 60 periods

Unit	Topic	No. of Periods
Unit I	Introduction to C and C tokens, Operators, Expressions, Conversions, Enumeration, Typedefs. The Pre-processor.	**8T + 16P**
Unit II	Control Flow-Conditional Branching. The Switch Statement. Looping. Nested Loops. The Break and continue Statements. The goto statement. Infinite Loops.	**8T + 16P**
Unit III	Arrays- Declaring and Array. Arrays and Memory. Initializing Arrays.Pointers.	**8T + 16P**
Unit IV	Functions-Passing Arguments. Declarations and Calls. Pointers to Functions Recursion. The main Function. Structures and Unions – Structures. Dynamic Memory Allocation. Linked Lists. Unions enum Declarations.	**6T + 12P**

List of Practical's

1. Simple calculator program using scanf, printf
2. Use of if, if-else, switch-case statements
3. Looping: while, do-while, for for factorial, table, etc.
4. Recursive functions: factorial, Fibonacci
5. Arrays: sorting (bubble, insertion), searching (linear, binary)
6. Strings: length, copy, reverse, palindrome checker
7. Pointers: basic pointer usage, pointer arithmetic
8. Function with pointer arguments
9. Dynamic memory allocation (malloc, calloc, realloc, free)
10. Structures: creating, accessing, and nesting
11. Arrays of structures: student marksheet
12. File I/O: write and read from a file using fopen, fprintf, fscanf
13. Command-line arguments
14. Macros and preprocessor directives
15. Enumerations and typedef
16. Union usage in C
17. Implement stack and queue using arrays
18. Linked list: creation, insertion, deletion
19. Matrix operations: addition, multiplication
20. Create a basic menu-driven program (e.g., employee database)

Part C-Learning resources

Text books, Reference Books and other resources

Text Book recommended

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. Ritchie, the C Programme Language, 2nd Edition (ANS Features), Prentice Hall 1989.

Reference Books

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall, New Jersey, 2nd Edition, 1988.
2. Herbert Schildt, C: The Complete Reference, McGraw-Hill Education, New Delhi, 4th Edition, 2000.
3. Yashavant Kanetkar, Let Us C, BPB Publications, New Delhi, 17th Edition, 2020.
4. Jitender Chhabra, Programming with C, Katson Publishing House, Varanasi, 2015.

E-resources

- NPTEL Course – Programming in C by Prof. Anupam Basu (IIT Kharagpur)
- GeeksforGeeks C Programming Tutorials – https://www.geeksforgeeks.org/c-programming-language/
- TutorialsPoint C Programming – https://www.tutorialspoint.com/cprogramming/
- W3Schools C Tutorial – https://www.w3schools.com/c/
- YouTube – C Programming Series by Neso Academy and Jenny's Lectures

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods: **Maximum marks:** 100 Marks **Continuous internal Assessment (CIA):** 15 Marks **End Semester Exam (ESE):** 50 Marks **Presentation & Viva Voce:** 35 Marks		
Continuous internal Assessment (CIA) (Conducted by Course Teacher)	Two Test/Quiz- 10 Marks Assignment/Seminar- 05 Marks	Best out of two test/quiz + obtained marks in Assignment/Seminar shall be considered against 15 marks
End Semester Exam (ESE)	**Two Section A & B** Section-A: Q1. Objective- 10 X 1 = 10 marks. Q2. Short answer type question 4 X 2 = 08 marks. Section B: Descriptive answer type question, 1 out of 2 from each unit- 08 X 4 = 32 Marks.	
Presentation & Viva Voce	Oral Presentation (clarity, confidence, visuals): 20 Marks Viva Voce (questions & answers): 15 Marks	

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POST GRADUATE PROGRAM (2025-2026)
DEPARTMENT OF MATHEMATICS
COURSE CURRICULUM

Part A: Introduction				
Program: Master in Science		**Semester-III**		**Session: 2025-26**
1.	Course Code	**MASE-17**		
2.	Course Title	**Statistical Methods and Inference**		
3.	Course Type	**Optional**		
4.	Pre-requisite (If any)	Basic knowledge of arithmetic operations		
5.	Course Learning Outcomes (CLO)	This Course will enable the students to: ➢ Understand and apply descriptive and inferential statistical methods. ➢ Use probability distributions for real-life modeling. ➢ Perform statistical estimation and hypothesis testing.		
6.	Credit Value	4C	1 Credit = 15 hours-Learning and observation	
7.	Total Marks	Maximum Marks: 100		Minimum Passing Marks: 40

Part B: Content of the course

Total no of teaching-learning period = 60 periods

Unit	Topic	No. of Periods
Unit I: Descriptive Statistics	Measures of Central Tendency: Mean, Median, Mode. Measures of Dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation. Skewness and Kurtosis. Moments and their significance	**15**
Unit II: Probability Distributions	Review of Probability. Random Variables (Discrete and Continuous). Discrete Distributions: Binomial, Poisson, Geometric. Continuous Distributions: Normal, Exponential, Uniform	**15**
Unit III: Sampling Theory	Concepts of Population and Sample. Sampling and Non-Sampling Errors. Methods of Sampling: Simple Random, Stratified, Systematic, Cluster Sampling. Sampling Distributions: Mean, Proportion, Difference of Means.	**15**
Unit IV: Statistical Inference	Estimation: Point and Interval Estimation. Properties of Estimators: Unbiasedness, Consistency, Efficiency, Sufficiency. Hypothesis Testing: Null and Alternative Hypothesis, Type I & II Errors, Level of Significance, p-value. Tests based on Normal, t, Chi-square, and F distributions	**15**

Part C-Learning resources

Text books, Reference Books and other resources

Text Book recommended

<table>
<tr><td colspan="3">1. Goon, Gupta, and Dasgupta – Fundamentals of Statistics, Vol I & II
2. S.C. Gupta – Fundamentals of Mathematical Statistics.
3. S.P. Gupta – Statistical Methods
4. Hogg, McKean, and Craig – Introduction to Mathematical Statistics
Reference Books
9. Rohatgi and Saleh – An Introduction to Probability and Statistics.
10. Mood, Graybill, and Boes – Introduction to the Theory of Statistics.
11. R.A. Johnson – Miller & Freund's Probability and Statistics for Engineers.
12. Montgomery – Design and Analysis of Experiments</td></tr>
<tr><td colspan="3">E-resources
• https://swayam.gov.in
• https://www.khanacademy.org/math/statistics-probability
• StatQuest with Josh Starmer (YouTube)
• Courses from Stanford, Duke, MIT on statistics and data science
• https://www.isical.ac.in (Check academics/resources section)</td></tr>
<tr><td colspan="3">Part D: Assessment and Evaluation</td></tr>
<tr><td colspan="3">Suggested Continuous Evaluation Methods:
Maximum marks: 100 Marks
Continuous internal Assessment (CIA): 30 Marks
End Semester Exam (ESE): 70 Marks</td></tr>
<tr><td>Continuous internal Assessment (CIA)
(Conducted by Course Teacher)</td><td>Two Test/Quiz- 20 Marks
Assignment/Seminar- 10 Marks</td><td>Best out of two test/quiz + obtained marks in Assignment/Seminar shall be considered against 30 marks</td></tr>
<tr><td>End Semester Exam (ESE)</td><td colspan="2">Two Section A & B
Section-A: Q1. Objective- 10 X 1 = 10 marks. Q2. Short answer type question 5 X 4 = 20 marks.
Section B: Descriptive answer type question, 1 out of 2 from each unit- 10 X 4 = 40 Marks.</td></tr>
</table>

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DEPARTMENT OF MATHEMATICS
COURSE CURRICULUM

Part A: Introduction			
Program: Master in Science		**Semester-IV**	**Session: 2025-26**
1.	Course Code	**MASC-11**	
2.	Course Title	**Dissertation / Project**	
3.	Course Type	**Compulsory**	
4.	Pre-requisite (If any)	Basic research methodology knowledge	
5.	Course Learning Outcomes (CLO)	This Course will enable the students to: ➢ Select a relevant research topic in mathematics and design a research plan independently. ➢ Apply appropriate mathematical theories, techniques, and tools to investigate the problem. ➢ Conduct systematic literature review and critical analysis of related work. ➢ Compile results, interpret findings, and draft a well-organized dissertation following academic writing standards. ➢ Defend their work through presentation and viva voce demonstrating clarity, depth, and originality.	
6.	Credit Value	12C	1 Credit = 15 hours-Learning and observation
7.	Total Marks	Maximum Marks: 100	Minimum Passing Marks: 40

Part B: Content of the course

Total no. of teaching-learning/research guidance hours: 60 hours

Stage	Topic	No. of required hours
Stage I	Selection of topic, formulation of objectives, and research methodology design	**10**
Stage II	Literature review, resource collection, and preliminary analysis	**10**
Stage III	Core investigation: mathematical modelling, theoretical or computational	**25**
Stage IV	Drafting of dissertation, revision, formatting, and final submission	**15**

Part C-Learning resources

Text books, Reference Books and other resources

Text Book recommended

1. G. Lakshmi Narayan, Research Methodology in Mathematics, Universities Press.
2. C.R. Kothari, Research Methodology: Methods and Techniques, New Age International.
3. J. D. Murray, Mathematical Biology (for biological modeling-based projects).
4. J. B. Conway, A Course in Functional Analysis, Springer (for analysis-based projects).
5. N.J. Higham, Handbook of Writing for the Mathematical Sciences, SIAM.

E-resources • NPTEL Online Certification – Research Methodology • Coursera/edX – Scientific Writing & Research Skills • arXiv.org – For reviewing recent mathematical research papers • Overleaf.com – For writing dissertations using LaTeX • Zotero, Mendeley – For reference management	
Part D: Assessment and Evaluation	
Suggested Continuous Evaluation Methods: **Maximum marks:** **300 Marks** **Dissertation/Project Report:** **200 Marks** **Presentation & Viva Voce:** **100 Marks**	
Dissertation/Project Report	**Dissertation quality (structure, originality, depth):** 100 Marks **Methodology & research content:** 100 Marks
Presentation & Viva Voce	**Oral Presentation (clarity, confidence, visuals):** 50 Marks **Viva Voce (questions & answers):**50 Marks

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POST GRADUATE PROGRAM (2025-2026)
DEPARTMENT OF MATHEMATICS
COURSE CURRICULUM

Part A: Introduction			
Program: Master in Science		**Semester-IV**	**Session: 2025-26**
1.	Course Code	**MASE-18**	
2.	Course Title	Scientific Computing using MATLAB	
3.	Course Type	**Optional**	
4.	Pre-requisite (If any)	Basic knowledge in computer	
5.	Course Learning Outcomes (CLO)	This Course will enable the students to: ➢ Use MATLAB for matrix operations and programming tasks. ➢ Implement statistical and mathematical models in MATLAB. ➢ Visualize and analyze data effectively using built-in tools. ➢ Perform hypothesis testing, regression, and data interpretation.	
6.	Credit Value	4C	1 Credit = 15 hours-Learning and observation
7.	Total Marks	Maximum Marks: 100	Minimum Passing Marks: 40

Part B: Content of the course

Total no of teaching-learning period = 60 periods

Unit	Topic	No. of Periods
Unit I	MATLAB environment and interface. Variables, operators, data types. Scripts and functions. Input/output commands. Vectors, matrices, and matrix operations	**8T + 16P**
Unit II	Control flow: if, for, while, switch. User-defined functions and sub functions. Error handling and debugging. File handling: reading and writing data	**8T + 16P**
Unit III	2D and 3D plotting (plot, bar, surf, etc.). Formatting plots: titles, labels, legends. Subplots and saving plots. Visualizing statistical data (histogram, boxplot, scatter)	**8T + 16P**
Unit IV	Descriptive statistics: mean, median, mode, SD. Probability distributions and their plots. Random number generation. Linear regression, correlation. ANOVA and hypothesis testing using MATLAB	**6T + 12P**
List of Practical's: 1. MATLAB environment overview and basic arithmetic 2. Create and manipulate matrices 3. Use of logical indexing and matrix operations 4. Create 2D plots (plot, line, scatter, etc.) 5. Create 3D plots (mesh, surf, contour)		

6. Symbolic math operations: differentiation, integration 7. Solve algebraic and differential equations symbolically 8. Read and write .csv and .xls data 9. Statistical analysis: mean, median, std dev, histogram 10. Fit polynomial curve using polyfit and polyval 11. Create and use MATLAB functions (.m files) 12. Create Live Script (.mlx) with text, code, and graphics 13. Use loops and conditional statements (for, while, if) 14. Use MATLAB to model population growth (Logistic, Malthusian) 15. Use fsolve, fminsearch for optimization problems 16. Plot phase portraits for differential equations 17. Create GUI using MATLAB App Designer 18. Generate and export plots in different formats 19. Simulate signal or image processing data (optional) 20. Combine LaTeX and MATLAB for report generation	

Part C-Learning resources

Text books, Reference Books and other resources

Text Book recommended

1. Amos Gilat – MATLAB: An Introduction with Applications
2. Rudra Pratap – Getting Started with MATLAB
3. Stormy Attaway – MATLAB: A Practical Introduction to Programming and Problem Solving

Reference Books

1. Brian R. Hunt et al. – A Guide to MATLAB
2. Palaniappan – MATLAB for Engineers

E-resources

- MathWorks Tutorials: https://www.mathworks.com/learn/tutorials/matlab-onramp.html
- Coursera MATLAB Courses (Free audit option)
- YouTube Channels: MATLAB & Simulink (official), MATLAB Helper
- NPTEL MATLAB Course

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum marks:	**100 Marks**
Continuous internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**50 Marks**
Presentation & Viva Voce:	**35 Marks**

Continuous internal Assessment (CIA) (Conducted by Course Teacher)	Two Test/Quiz- 10 Marks Assignment/Seminar- 05 Marks	Best out of two test/quiz + obtained marks in Assignment/Seminar shall be considered against 15 marks
End Semester Exam (ESE)	**Two Section A & B** Section-A: Q1. Objective- 10 X 1 = 10 marks. Q2. Short answer type question 4 X 2 = 08 marks. Section B: Descriptive answer type question, 1 out of 2 from each unit- 08 X 4 = 32 Marks.	
Presentation & Viva Voce	Oral Presentation (clarity, confidence, visuals): Viva Voce (questions & answers):	20 Marks 15 Marks

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POST GRADUATE PROGRAM (2025-2026)
DEPARTMENT OF MATHEMATICS
COURSE CURRICULUM

Part A: Introduction			
Program: Master in Science		**Semester-IV**	**Session: 2025-26**
1.	Course Code	**MASE-19**	
2.	Course Title	**Programming in C++**	
3.	Course Type	**Optional**	
4.	Pre-requisite (If any)		
5.	Course Learning Outcomes (CLO)	This Course will enable the students to: ➢ Understand and implement core concepts of object-oriented programming using C++. ➢ Write modular and reusable code using classes, objects, and templates. ➢ Apply operator overloading and function overloading in practical scenarios. ➢ Demonstrate inheritance and polymorphism to enhance program extensibility. ➢ Utilize exception handling mechanisms for robust and error-resilient programs. ➢ Design and implement programs using advanced features like virtual functions and abstract classes.	
6.	Credit Value	4C	1 Credit = 15 hours-Learning and observation
7.	Total Marks	Maximum Marks: 100	Minimum Passing Marks: 40

Part B: Content of the course		
Total no of teaching-learning period = 60 periods		
Unit	**Topic**	**No. of Periods**
Unit I	Object oriented programming, introduction to C++, Tokens, Expressions and Control Structure, Function in C++, Classes and Objects	**8T + 16P**
Unit II	Constructors and Destructors, Operator Overloading and Type Conversion.	**8T + 16P**
Unit III	Inheritance, Virtual Functions and Polymorphism	**8T + 16P**
Unit IV	Working with Files, Templates, Manipulating Strings.	**6T + 12P**
List of Practicals: 1. Basic input/output program using cin and cout 2. Implement class with constructor and destructor 3. Default and parameterized constructors 4. Function overloading 5. Operator overloading: +, <<, [] 6. Inheritance: single, multiple, multilevel 7. Virtual functions and runtime polymorphism 8. Use of this pointer and friend functions 9. Static members of a class 10. Templates: function and class templates 11. Exception handling using try, catch, throw		

12. File handling: text and binary files 13. Create a mini project (e.g., inventory management system) 14. Use STL containers: vector, list, set, map 15. Sorting a list using STL sort() and custom comparator 16. Dynamic memory allocation using new and delete 17. Build a simple calculator using switch and class 18. Demonstrate copy constructor and assignment operator 19. Implementation of abstract class and interface using pure virtual functions 20. Create a real-world class hierarchy (e.g., Vehicle, Car, Bike)	

Part C-Learning resources

Text books, Reference Books and other resources

Text Book recommended

1. E. Balagurusamy, Object Oriented Programming with C++, McGraw-Hill Education.
2. Robert Lafore, Object-Oriented Programming in C++, Sams Publishing.
3. Bjarne Stroustrup, The C++ Programming Language, Pearson Education.
4. Herbert Schildt, C++: The Complete Reference, McGraw-Hill Education.
5. Sourav Sahay, Object Oriented Programming with C++, Oxford University Press.
6. Yashavant Kanetkar, Let Us C++, BPB Publications.

E-resources

- NPTEL Course: Object-Oriented Programming in C++. https://nptel.ac.in/courses/106105151
- GeeksforGeeks – C++ Programming Language. https://www.geeksforgeeks.org/c-plus-plus/
- W3Schools – C++ Tutorial. https://www.w3schools.com/cpp/
- cplusplus.com – C++ Language Reference. https://cplusplus.com/doc/tutorial/
- Programiz – C++ Programming. https://www.programiz.com/cpp-programming

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum marks:	**100 Marks**
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Presentation & Viva Voce	Oral Presentation (clarity, confidence, visuals): 20 Marks Viva Voce (questions & answers): 15 Marks	

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