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UNIVERSITY OF CALCUTTA · CCF (NEP 2020) UG SYLLABUS

# Mathematics MDC (Pass) Syllabus

Complete syllabus · 3-Year Multidisciplinary Course · CC papers

## What this file contains

- Credit distribution and course structure
- CC-1 to CC-8 detailed syllabus
- Minor and SEC papers taken by MDC students
- Question patterns

### Source and note

The pages that follow are taken unchanged from the official University of Calcutta syllabus for Mathematics under the Curriculum and Credit Framework for Undergraduate Programmes (CCF, NEP 2020). PALMATHS has only selected the pages for this programme and semester and added this cover so students can find them quickly. Always check the University of Calcutta website (caluniv.ac.in) for later notifications, corrections or changes in paper options. PALMATHS is an independent coaching centre and is not part of, or endorsed by, the University of Calcutta.


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# University of Calcutta




## Syllabus for four-year (Eight Semester) B. Sc. Honours and Honours with Research Course with Mathematics Major

## &

## Mathematics as a Minor subject

## and

## Syllabus for three-year (Six Semester) Multidisciplinary Course with Mathematics

**Under**

## Curriculum and Credit Framework (CCF)

**Odd Semester : July to December**

**Even Semester : January to June**

The syllabus for the 4 Year B.A./B.Sc. Honours and Honours with Research Course with Mathematics Major is effective from the academic year **2023-24**.

The syllabus for the 3 Year Multidisciplinary Course with Mathematics is effective from the academic year **2023-24**.

# Distribution of Credits and Marks for 3-year Multi-Disciplinary Course

| | cc1 | cc2 | Minor | IDC | AEC | SEC | CVAC | Summer Internship | Total Credit |
|---|---|---|---|---|---|---|---|---|---|
| **Sem.** | $8 \times 4 = 32$ | $8 \times 4 = 32$ | $6 \times 4 = 24$ | $3 \times 3 = 9$ | $4 \times 2 = 8$ | $3 \times 4 = 12$ | $4 \times 2 = 8$ | $1 \times 3 = 3$ | **128** |
| **I** | $1 \times 4 = 4$ 3Th + 1P/TU | $1 \times 4 = 4$ 3Th + 1P/TU | | $1 \times 3 = 3$ 2Th + 1P/TU | $1 \times 2 = 2$ 2Th + 0P/TU | $1 \times 4 = 4$ | $2 \times 2 = 4$ | | **21** |
| **II** | $1 \times 4 = 4$ 3Th + 1P/TU | $1 \times 4 = 4$ 3Th + 1P/TU | | $1 \times 3 = 3$ 2Th + 1P/TU | $1 \times 2 = 2$ 2Th + 0P/TU | $1 \times 4 = 4$ | $2 \times 2 = 4$ | | **21** |
| **III** | $1 \times 4 = 4$ 3Th + 1P/TU | $1 \times 4 = 4$ 3Th + 1P/TU | $1 \times 4 = 4$ 3Th + 1P/TU | $1 \times 3 = 3$ 2Th + 1P/TU | $1 \times 2 = 2$ 2Th + 0P/TU | $1 \times 4 = 4$ | | | **21** |
| **IV** | $2 \times 4 = 8$ 2×(3Th + 1P/TU) | $2 \times 4 = 8$ 2×(3Th + 1P/TU) | $1 \times 4 = 4$ 3Th + 1P/TU | | $1 \times 2 = 2$ 2Th + 0P/TU | | | | **22** |
| **V** | $2 \times 4 = 8$ 2×(3Th + 1P/TU) | $1 \times 4 = 4$ 3Th + 1P/TU | $2 \times 4 = 8$ 2×(3Th + 1P/TU) | | | | | | **20** |
| **VI** | $1 \times 4 = 4$ 2×(3Th + 1P/TU) | $2 \times 4 = 8$ 3Th + 1P/TU | $2 \times 4 = 8$ 2×(3Th + 1P/TU) | | | | | | **20** |
| **Credits** | $8 \times 4 = 32$ | $8 \times 4 = 32$ | $6 \times 4 = 24$ | $3 \times 3 = 9$ | $4 \times 2 = 8$ | $3 \times 4 = 12$ | $4 \times 2 = 8$ | $1 \times 3 = 3$ | 128 |
| **Marks** | $8 \times 100 = 800$ | $8 \times 100 = 800$ | $6 \times 100 = 600$ | $3 \times 75 = 225$ | $4 \times 50 = 200$ | $3 \times 100 = 300$ | $4 \times 50 = 200$ | $3 \times 25 = 75$ | **=3200** |

**cc1 -** Core Course 1; **cc2 -** Core Course 2; **IDC -** Inter Disciplinary Course; **AEC -** Ability Enhancement Course; **SEC -** Skill Enhancement Course; **CVAC -** Common Value Added Course.
Th - Theory, P- Practical, TU - Tutorial.

4-yr Credit Distribution | MDC Credit Distribution | Course Overview
Major | Minor | MDC | Question Pattern

# Semesterwise Courses at a glance

| Semester | Course | Paper Code | Name of Paper | Credit | Page |
|---|---|---|---|---|---|
| ONE (I) | MAJOR | MTHM-DSCC 1 | Calculus, Geometry & Vector Analysis | 3TH+1TU = 4 | 10 |
| | MAJOR | MTHM-SEC 1 | C language with Mathematical Applications | 3TH+1TU = 4 | 73 |
| | MINOR | MMTH-MN1 | Calculus, Geometry & Vector Analysis | 3TH+1TU = 4 | 10 |
| | MDC | MMTH-MDC-CC1 | Calculus, Geometry & Vector Analysis | 3TH+1TU = 4 | 10 |
| | MDC | MMTH-SEC | C language with Mathematical Applications | 3TH+1TU = 4 | 73 |
| | IDC | MTHD-IDC | Mathematics in Daily Life | 2TH+1TU = 3 | 92 |
| TWO (II) | MAJOR | MTHM-DSCC 2 | Basic Algebra | 3TH+1TU=4 | 12 |
| | MAJOR | MTHM-SEC 2.1 or MTHM-SEC 2.2 | Python Programming and Introduction to Latex or Artificial Intelligence | 3TH+1TU=4 | 75 |
| | MINOR | MMTH-MN2 | Basic Algebra | 3TH+1TU=4 | 12 |
| | MDC | MMTH-MDC-CC2 | Basic Algebra | 3TH+1TU=4 | 12 |
| | MDC | MMTH-SEC | C language with Mathematical Applications | 3TH+1TU=4 | 73 |
| | IDC | MTHD-IDC | Mathematics in Daily Life | 2TH+1TU=3 | 92 |
| THREE (III) | MAJOR | MTHM-DSCC 3 | Real Analysis | 3TH+1TU=4 | 14 |
| | MAJOR | MTHM-DSCC 4 | Ordinary Differential equations - I & Group Theory - I | 3TH+1TU=4 | 16 |
| | MAJOR | MTHM-SEC 3 | Linear Programming & Rectangular Games | 3TH+1TU=4 | 78 |
| | MINOR | MMTH-MN1 | Calculus, Geometry & Vector Analysis | 3TH+1TU=4 | 10 |
| | MDC | MMTH-MDC-CC3 | Ordinary Differential equations & Group Theory | 3TH+1TU=4 | 80 |
| | MDC | MMTH-SEC | C language with Mathematical Applications | 3TH+1TU=4 | 73 |
| | MDC | MMTH-MDC-mn1 | Calculus, Geometry & Vector Analysis | 3TH+1TU=4 | 10 |
| | IDC | MTHD-IDC | Mathematics in Daily Life | 2TH+1TU=3 | 92 |
| FOUR (IV) | MAJOR | MTHM-DSCC 5 | Theory of Real Functions | 3TH+1TU=4 | 18 |
| | MAJOR | MTHM-DSCC 6 | Mechanics - I | 3TH+1TU=4 | 20 |
| | MAJOR | MTHM-DSCC 7 | Multivariate Calculus - I & Partial Differential Equation - I | 3TH+1TU=4 | 22 |
| | MAJOR | MTHM-DSCC 8 | Group Theory - II & Ring Theory - I | 3TH+1TU=4 | 25 |
| | MINOR | MMTH-MN2 | Basic Algebra | 3TH+1TU=4 | 12 |
| | MDC | MMTH-MDC-CC4 | Mechanics | 3TH+1TU=4 | 82 |
| | MDC | MMTH-MDC-CC5 | Advanced Calculus | 3TH+1TU=4 | 84 |
| | MDC | MMTH-MDC-mn2 | Basic Algebra | 3TH+1TU=4 | 12 |
| FIVE (V) | MAJOR | MTHM-DSCC 9 | Probability & Statistics | 3TH+1TU=4 | 27 |
| | MAJOR | MTHM-DSCC 10 | Ring Theory - II & Linear Algebra - I | 3TH+1TU=4 | 29 |
| | MAJOR | MTHM-DSCC 11 | Riemann Integration & Series of Functions | 3TH+1TU=4 | 31 |
| | MAJOR | MTHM-DSCC 12 | Mechanics - II | 3TH+1TU=4 | 33 |
| | MINOR | MMTH-MN3 | Ordinary Differential equations & Group Theory | 3TH+1TU=4 | 80 |
| | MINOR | MMTH-MN4 | Mechanics | 3TH+1TU=4 | 82 |
| | MDC | MMTH-MDC-CC6 | Statistics & Numerical Analysis | 3TH+1TU=4 | 86 |
| | MDC | MMTH-MDC-CC7 | Mathematical Methods | 3TH+1TU=4 | 88 |
| | MDC | MMTH-MDC-mn3 | Ordinary Differential equations & Group Theory | 3TH+1TU=4 | 80 |
| | MDC | MMTH-MDC-mn4 | Mechanics | 3TH+1TU=4 | 82 |
| SIX (VI) | MAJOR | MTHM-DSCC 13 | Metric Space & Complex Analysis - I | 3TH+1TU=4 | 35 |
| | MAJOR | MTHM-DSCC 14 | Multivariate Calculus - II & Applications of Calculus | 3TH+1TU=4 | 37 |
| | MAJOR | MTHM-DSCC 15 | Numerical Analysis | 3TH+1P=4 | 39 |
| | MINOR | MMTH-MN3 | Ordinary Differential equations & Group Theory | 3TH+1TU=4 | 80 |
| | MINOR | MMTH-MN4 | Mechanics | 3TH+1TU=4 | 20 |
| | MDC | MMTH-MDC-CC7 | Mathematical Methods | 3TH+1TU=4 | 88 |
| | MDC | MMTH-MDC-CC8 | Discrete Mathematics | 3TH+1TU=4 | 90 |
| | MDC | MMTH-MDC-mn5 | Advanced Calculus | 3TH+1TU=4 | 84 |
| | MDC | MMTH-MDC-mn6 | Statistics & Numerical Analysis | 3TH+1TU=4 | 86 |

# Course Structure for
# 3-year Multi-Disciplinary Course with Mathematics as a Core/Minor Subject

## 1. Mathematics opted as First Core Subject (i.e. Core Course 1)

| Semester | Paper Code | Name of Paper | Credit | Page No. |
|---|---|---|---|---|
| I | MMTH-MDC-CC1 | Calculus, Geometry & Vector Analysis | 3TH+1TU = 4 | 10 |
| II | MMTH-MDC-CC2 | Basic Algebra | 3TH+1TU = 4 | 12 |
| III | MMTH-MDC-CC3 | Ordinary Differential equations & Group Theory | 3TH+1TU = 4 | 80 |
| IV | MMTH-MDC-CC4 | Mechanics | 3TH+1TU = 4 | 82 |
| | MMTH-MDC-CC5 | Advanced Calculus | 3TH+1TU = 4 | 84 |
| V | MMTH-MDC-CC6 | Statistics & Numerical Analysis | 3TH+1TU = 4 | 86 |
| | MMTH-MDC-CC7 | Mathematical Methods | 3TH+1TU = 4 | 88 |
| VI | MMTH-MDC-CC8 | Discrete Mathematics | 3TH+1TU = 4 | 90 |

## 2. Mathematics opted as Second Core Subject (i.e. Core Course 2)

| Semester | Paper Code | Name of Paper | Credit | Page No. |
|---|---|---|---|---|
| I | MMTH-MDC-CC1 | Calculus, Geometry & Vector Analysis | 3TH+1TU = 4 | 10 |
| II | MMTH-MDC-CC2 | Basic Algebra | 3TH+1TU = 4 | 12 |
| III | MMTH-MDC-CC3 | Ordinary Differential equations & Group Theory | 3TH+1TU = 4 | 80 |
| IV | MMTH-MDC-CC4 | Mechanics | 3TH+1TU = 4 | 82 |
| | MMTH-MDC-CC5 | Advanced Calculus | 3TH+1TU = 4 | 84 |
| V | MMTH-MDC-CC6 | Statistics & Numerical Analysis | 3TH+1TU = 4 | 86 |
| VI | MMTH-MDC-CC7 | Mathematical Methods | 3TH+1TU = 4 | 88 |
| | MMTH-MDC-CC8 | Discrete Mathematics | 3TH+1TU = 4 | 90 |

## 3. Mathematics opted as a Minor Subject

| Semester | Paper Code | Name of Paper | Credit | Page No. |
|---|---|---|---|---|
| III | MMTH-MDC-mn1 | Calculus, Geometry & Vector Analysis | 3TH+1TU = 4 | 10 |
| IV | MMTH-MDC-mn2 | Basic Algebra | 3TH+1TU = 4 | 12 |
| V | MMTH-MDC-mn3 | Ordinary Differential equations & Group Theory | 3TH+1TU = 4 | 80 |
| | MMTH-MDC-mn4 | Mechanics | 3TH+1TU = 4 | 82 |
| VI | MMTH-MDC-mn5 | Advanced Calculus | 3TH+1TU = 4 | 84 |
| | MMTH-MDC-mn6 | Statistics & Numerical Analysis | 3TH+1TU = 4 | 86 |

**Note :** Skill Enhancement Course (SEC) on C Language with Mathematical Applications shall be studied either in Semester One or in Semester Two or in Semester Three.

4-yr Credit Distribution | MDC Credit Distribution | Course Overview
Major | Minor | MDC | Question Pattern

# Calculus, Geometry & Vector Analysis

| | |
|---|---|
| Semester : I | Paper Code : MTHM-DSCC 1-TH<br>MMTH-MN1-TH<br>MMTH-MDC-CC1-TH |
| Semester : III | Paper Code : MMTH-MN1-TH<br>MMTH-MDC-mn1-TH |
| Credit : 4 | Full Marks : 100 (Theory : 75 & Tutorial : 25) |
| *Minimum number of classes required* : 60 | |

4-yr Credit Distribution | MDC Credit Distribution | Course Overview

Major | Minor | MDC | Question Pattern

**Course Outcome**

CO1 : To understand and compute higher-order derivatives, apply Leibniz's rule and its applications, and use L'Hospital's rule to evaluate limits.

CO2 : To develop proficiency in solving problems involving higher-order derivatives, Leibniz's rule, and L'Hospital's rule.

CO3 : To learn reduction formulae and apply them to determine the arc length of a curve, the area under a curve, and the area and volume of surfaces of revolution.

CO4 : To study the classification of conic sections, reduce them to canonical form, and determine equations of tangents, normals, and polars.

CO5 : To acquire detail knowledge of spheres, cylindrical surfaces, central conicoids, different quadric surfaces.

CO6 : To apply vector equations to problems in geometry and mechanics, and to perform differentiation and integration of vector functions.

## Group A : Calculus [Marks : 20] [16 classes]

- Differentiability of a function at a point and in an interval. Meaning of sign of derivative. Differentiating Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to functions of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n\sin x$, $(ax+b)^n\cos x$. Indeterminate forms. L'Hospital's rule (statement and example).
- Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin^n x dx$, $\int \cos^n x dx$, $\int \tan^n x dx$, $\int \sec^n x dx$, $\int (\log x)^n dx$, $\int \sin^n x \sin mx\, dx$, $\int \sin^n x \cos^m x\, dx$. Parametric equations, parametrizing a curve, arc length of a curve, arc length of parametric curves, area under a curve, area and volume of surface of revolution.

## Group B : Geometry [Marks : 35] [28 classes]

- Rotation of axes and second degree equations, classification of conics using the discriminant, reduction to canonical form, tangent and normal, polar equations of conics.
- Spheres, Cylindrical surfaces. Central conicoids, paraboloids, plane sections of conicoids, generating lines, identification of quadric surfaces like cone, cylinder, ellipsoid, hyperboloid, classification of quadrics.

**Group C : Vector Analysis** [Marks : 20] [16 classes]

- Triple product, vector equations, applications to geometry and mechanics — concurrent forces in a plane, theory of couples, system of parallel forces. Introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions of one variable.

## References


[1] H. Anton, I. Bivens and S. Davis, Calculus, 10th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2015.

[2] T. Apostol, Calculus, Volumes I and II, Wiley and Sons, 1969.

[3] R. Courant and F. John, Introduction to Calculus and Analysis (Volumes I & II), Springer-Verlag, New York, Inc., 1989.

[4] R. R. Goldberg, Methods of Real analysis, Oxford and IBH Publishing, 2020.

[5] M. J. Strauss, G. L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2022.

[6] G. B. Thomas and R. L. Finney, Calculus, 14th Ed., Pearson Education, Delhi, 2018.

[7] Robert J. T. Bell, Co-ordinate Geometry of Three Dimensions, Macmillan and Co. Ltd., London, 2018.

[8] S. L. Loney, Co-ordinate Geometry, 6th Ed., Arihant Publications, 2016.

[9] J. Marsden and Tromba, Vector Calculus, W. H. Freeman and Co., 6th Ed., 2011.

[10] M. R. Speigel, Schaum's outline of Vector Analysis, Tata McGraw Hill, 2011.



4-yr Credit Distribution | MDC Credit Distribution | Course Overview

Major | Minor | MDC | Question Pattern

# Basic Algebra

| | |
|---|---|
| Semester : II | Paper Code : MTHM-DSCC 2-TH<br>MMTH-MN2-TH<br>MMTH-MDC-CC2-TH |
| Semester : IV | Paper Code : MMTH-MN2-TH<br>MMTH-MDC-mn2-TH |
| Credit : 4 | Full Marks : 100 (Theory : 75 & Tutorial : 25) |
| *Minimum number of classes required* : 60 | |

4-yr Credit Distribution | MDC Credit Distribution | Course Overview

Major | Minor | MDC | Question Pattern

**Course Outcome**

CO1 : To study exponential, logarithmic, trigonometric, and hyperbolic functions of a complex variable.

CO2 : To develop the ability to solve cubic and biquadratic equations.

CO3 : To acquire knowledge of equivalence relations, partial order relations, linear order relations, and composition of mappings.

CO4 : To understand the well-ordering property of positive integers, the division algorithm, and congruence relations among integers.

CO5 : To learn about the existence and uniqueness of solutions to systems of linear equations, including row reduction and echelon forms.

CO6 : To study the algebraic and geometric properties of vectors in n-dimensional space, including linear independence and its algebraic and geometric characterizations.

## Group A [Marks : 25] [20 classes]

- Polar representation of complex numbers, $n$-th roots of unity, De Moivre's theorem for rational indices and its applications. Exponential, logarithmic, trigonometric and hyperbolic functions of complex variable.
- Theory of equations : Relation between roots and coefficients, transformation of equation, Descartes rule of signs, application of Sturm's theorem, cubic equation (solution by Cardan's method) and biquadratic equation (solution by Ferrari's method).
- Inequalities : The inequality involving $AM \geq GM \geq HM$, Cauchy-Schwartz inequality.

## Group B [Marks : 25] [20 classes]

- Relation : equivalence relation, equivalence classes & partition, partial order relation, poset, linear order relation.
- Mapping : composition of mappings, relation between composition of mappings and various set theoretic operations. Meaning and properties of $f^{-1}(B)$, for any mapping $f : X \to Y$ and $B \subseteq Y$.
- Well-ordering property of positive integers, Principles of Mathematical induction, equivalence of Well-ordering property and Principles of Mathematical induction (statement only), division algorithm, divisibility and Euclidean algorithm. Prime numbers and their properties, Euclid's theorem. Congruence relation between integers. Fundamental Theorem of Arithmetic. Chinese remainder theorem. Arithmetic functions, some arithmetic functions such as $\varphi, \tau, \sigma$ and their properties.

**Group C** [Marks : 25] [20 classes]

- Systems of linear equations, homogeneous and non-homogeneous systems. Existence and uniqueness of solution. The matrix equation $Ax = b$, row reduction and echelon forms, uniqueness of reduced echelon form. Rank of a matrix and characterization of invertible matrices, Pivot positions, basic and free variables, parametric description of the solution set. Existence and uniqueness theorem.
- Vectors in $\mathbb{R}^n$, algebraic and geometric properties of the vectors. Vector form of a linear system and the column picture. Existence of solutions and linear combination of vectors. Geometry of linear combination and subsets spanned by some vectors. Uniqueness of solution and Linear independence of vectors. Algebraic and geometric characterizations of linearly independent subsets.

## References


[1] Titu Andreescu and Dorin Andrica, Complex Numbers from A to Z, 2nd Ed., Springer Nature, 2014.

[2] W. S. Burnside and A.W. Panton, Theory of equations, Dublin University Press Series, S. Chand & Co., Pvt. Ltd., 1986.

[3] Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, 3rd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2005.

[4] Anton Howard and Chris Rorres, Elementary Linear Algebra with Supplemental Applications, 11th Ed., Wiley, 2014.

[5] K. Hoffman, R. Kunze, Linear algebra, Prentice Hall India Learning Pvt. Ltd., 2015.

[6] David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.

[7] Gilbert Strang, Introduction to Linear Algebra, 5th Ed., Wellesley-Cambridge Press, 2019.



4-yr Credit Distribution | MDC Credit Distribution | Course Overview

Major | Minor | MDC | Question Pattern

# C Language with Mathematical Applications

| | |
|---|---|
| Semester : I | Paper Code : MTHM-SEC 1-TH<br>MMTH-SEC-TH |
| Semester : II or III | Paper Code : MMTH-SEC-TH |
| Credit : 4 | Full Marks : 100 (Theory : 75 & Tutorial : 25) |
| *Minimum number of classes required* : 60 | |

4-yr Credit Distribution | MDC Credit Distribution | Course Overview
Major | Minor | MDC | Question Pattern

**Course Outcome**

CO1 : To learn C language in detail.

CO2 : To learn how to use different types of control statements and arrays.

CO3 : To learn how to write different types of computer programs using C language.

- **Overview** of architecture of a computer, compiler, interpreter, assembler, machine language, high level language, procedural vs object oriented language.
- **Constants, Variables and Data types :** Character set, constants and variables, data types, C statements, declaration.
- **Operations and Expressions:** Arithmetic operators, relational operators, logical operators, assignment operator, expressions.
- **Decision Making and Branching:** decision making with if, if-else, Nested if, switch-case, break and continue statements.
- **Control Statements:** while, do-while and for statements.
- **Arrays and Strings:** One-dimensional, two-dimensional and multidimensional arrays, declaration of arrays, initialization of arrays, strings.
- **User-defined Functions:** Definition of functions, Scope of variables, return values and their types, function declaration, function call by value, Nesting of functions, passing of arrays to functions, Recursive function.
- **Introduction to Library functions:** stdio.h, math.h, string.h, stdlib.h, time.h etc.

**Sample problems:**

1. Display first 15 natural numbers.
2. Compute the sum of first 10 natural numbers.
3. Read 10 numbers from keyboard and find their average.
4. Find the sum of first 15 even natural numbers.
5. Write a program to find factorial of a number using recursion.
6. Write a program to make a pyramid pattern with numbers increased by 1.

7. From the terminal read three values, namely, length, width, height. Print a message whether the box is a cube or rectangle or semi-rectangle.
8. Find the AM, GM, HM of a given set of numbers.
9. Write a program to print multiplication table.
10. Find the maximum and minimum element of a given array.
11. Sort the elements of an array in ascending order.
12. Write a program to read in an array of names and to sort them in alphabetical order.
13. Write a program for addition of two matrices.
14. Find the transpose of a given matrix.
15. Find the product of two matrices.
16. Write a program to check whether two given strings are an anagram.
17. Write a program to check Armstrong and Perfect numbers.
18. Write a program to check whether a number is a prime number or not.
19. Prepare a code for summing a Series.
20. Compute approximate value of pi .
21. Compute the area under a given curve.
22. Solve a quadratic equation.
23. Write a program to solve a system of two linear equations in two unknowns.
24. Write a program to find the shortest distance between two straight lines (parallel or intersecting or skew) in space.
25. Prepare an investment report by calculating compound interest.

**Note: A practical notebook must be maintained for internal assignments and submitted for the partial fulfillment of the course.**

## References


[1] E. Balagurnsamy, Programming in ANSI C, Tata McGraw Hill, 2004.

[2] Y. Kanetkar, Let Us C, BPB Publication, 1999.

[3] B. W. Kernighan and D. M. Ritchi, The C-Programming Language, 2nd Edi. (ANSI Refresher), Prentice Hall, 1977.

[4] V. Rajaraman, Computer Oriented Numerical Methods, Prentice Hall of India, 1980.

[5] C. Xavier, C-Language and Numerical Methods, New Age International, 2007.



4-yr Credit Distribution | MDC Credit Distribution | Course Overview

Major | Minor | MDC | Question Pattern

# Ordinary Differential Equations & Group Theory

| | |
|---|---|
| Semester : III | Paper Code : MMTH-MDC-CC3-TH |
| Semester : V | Paper Code : MMTH-MDC-mn3-TH |
| Semester : V or VI | Paper Code : MMTH-MN3-TH |
| Credit : 4 | Full Marks : 100 (Theory : 75 & Tutorial : 25) |
| *Minimum number of classes required* : 60 | |

4-yr Credit Distribution | MDC Credit Distribution | Course Overview

Major | Minor | MDC | Question Pattern

**Course Outcome**

CO1 : To understand the formation of differential equations and the methods for solving them.

CO2 : To learn techniques for solving first-order, first-degree, and higher-degree differential equations.

CO3 : To study methods for solving higher-order linear and nonlinear differential equations.

CO4 : To study the algebraic structure of groups, including elementary properties, subgroups, order of a group, cyclic groups, alternating groups, and related concepts.

## Group A : Ordinary Differential Equations [Marks : 45] [36 classes]

- Formation of differential equations, order and degree of a differential equation. First order and first degree differential equations. Homogeneous and exact differential equations, conditions for an equation of the first order to be exact. Integrating factors. Rules for finding integrating factors. Linear equations and Bernoulli equations.
- First order higher degree differential equations solvable for $x$, $y$ and $p$. Clairaut's forms. Singular solutions. Equations of tac-locus, nodal locus and cuspidal locus.
- Higher order linear and non-linear equations. Concept of Wronskian and its properties. Complementary functions, particular integrals. Linear homogeneous and non-homogeneous equations with constant coefficient. Method of undetermined coefficients. Method of variation of parameters. Simultaneous linear differential equations.
- Higher order linear equations with variable coefficients reducible to linear equations with constant coefficients (Euler's equation). Condition for exactness of higher order linear equations. Integrating factors. Equations of the form $\frac{d^n y}{dx^n} = f(y)$ $(n \geq 2)$.

## Group B : Group Theory [Marks : 30] [24 classes]

- Definition of a group, examples of groups including permutation groups, dihedral groups and quaternion groups (through matrices), elementary properties of groups, examples of commutative and non-commutative groups. Subgroups and examples of subgroups, necessary and sufficient condition for a nonempty subset of a group to be a subgroup. Normalizer, centralizer, center of a group, product of subgroups.
- Order of an element of a group, order of a group. Cyclic groups. Properties of cyclic groups, classification of subgroups of cyclic groups. Permutation, cycle notation for permutations, properties of permutation, even and odd permutations. Alternating group. Properties of cosets. Lagrange's theorem and consequences including Fermat's Little theorem.

## References


[1] S. Ahmed and A. Ambrosetti, A Textbook on Ordinary Differential Equations, Springer-Verlag, 2015.

[2] W. E. Boyce and R.C. DiPrima, Elementary Differential Equations and Boundary Value Problems, John Wiley & Sons, 2009.

[3] J. M. Cushing, Analysis of Ordinary Differential Equations, University of Arizona, 2018.

[4] E. A. Coddington, An Introduction to Ordinary Differential Equations, Dover Publications, 1989.

[5] D. A. Murray, Introductory course in Differential Equations, Orient and Longman, 1967.

[6] G. Nagy, Ordinary Differential Equations, Michigan State University, 2015.

[7] H. T. H. Piaggio, An Elementary Treatise on Differential Equations and Their Applications, C. B. S. Publishers & Distributors, Delhi, 1985.

[8] S. L. Ross, Differential Equations, 3rd Ed., John Wiley & Sons, India, 2004.

[9] G. F. Simmons, Differential Equations with Applications and Historical Notes, Tata McGraw Hill, 1972.

[10] W. F. Trench, Elementary Differential Equations, S. Chand & Co., Ltd., 1999

[11] M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.

[12] D. S. Dummit and R. M. Foote, Abstract Algebra, 3rd Ed., John Wiley & Sons, India, 2011.

[13] J. B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.

[14] J. A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, New Delhi, 1999.

[15] I. N. Herstein, Topics in Algebra, Wiley Eastern Ltd., India, 1975.

[16] D. S. Malik, J. M. Mordeson and M. K. Sen, Fundamentals of abstract algebra, McGraw Hill, 1997.

[17] J. J. Rotman, An Introduction to the Theory of Groups, 4th Ed., Springer Verlag, 1995.



4-yr Credit Distribution | MDC Credit Distribution | Course Overview

Major | Minor | MDC | Question Pattern

# Mechanics

| | |
|---|---|
| Semester : IV | Paper Code : MMTH-MDC-CC4-TH |
| Semester : V | Paper Code : MMTH-MDC-mn4-TH |
| Semester : V or VI | Paper Code : MMTH-MN4-TH |
| Credit : 4 | Full Marks : 100 (Theory : 75 & Tutorial : 25) |
| *Minimum number of classes required* : 60 | |

4-yr Credit Distribution | MDC Credit Distribution | Course Overview
Major | Minor | MDC | Question Pattern

**Course Outcome**

CO1 : To understand the principles of forces, including resultant forces, resultant couples, and coplanar force systems.

CO2 : To study rectilinear motion and simple harmonic motion.

CO3 : To develop the ability to solve problems related to work, power, and energy.

CO4 : To study impulsive forces and the collision of elastic bodies.

CO5 : To develop the ability to solve problems involving the motion of a particle in two dimensions.

## Statics - I

- Idea about Physical Independence Principle of Forces, Principle of transmissibility of a force, Principle of action and reaction and Principle of parallelogram law of forces, Composition and resolution of forces, Concurrent Forces in a plane, Composition and resolution of forces, Equilibrium of three forces acting at a point, Lami's theorem, Moment of a force about a point and an axis, Varignon's theorem, Resultant forces and resultant couple, Coplanar forces: Its reduction and conditions of equilibrium. [8 classes]

## Particle Dynamics - I

- Law of gravitation, Concept of inertial frame, Newton's laws of motion, Concept of equation of motion of a particle, Rectilinear motion in a given force field, Simple harmonic motion, damped and forced oscillations, Concept of resonance, motion of elastic strings, Rectilinear motion under uniform gravity, Rectilinear motion in a resisting medium where resistance is proportional to velocity. [18 classes]
- Work, power, energy, Conservative forces, Potential energy, Existence of potential energy function, Conservative field and Principle of conservation of energy.
. [6 classes]
- Impulse of a force, Impulsive force, Principle of conservation of linear momentum, Collision of elastic bodies: Coefficient of restitution, Newton's law of collision, Direct and oblique impact of a smooth sphere with a fixed plane, Direct and oblique impact of two smooth spheres. [8 classes]
- Motion of a particle in a plane (2D Cartesian): Angular velocity and angular acceleration, Expressions for components of velocity and acceleration, Tangential and normal components of velocity and acceleration, Motion of a projectile in a resisting medium under gravity. Motion of a particle in a plane (2D Polar): Expressions for components of velocity and acceleration, Central forces and central orbits, Motion under inverse square law, Times of describing the arcs of central orbits for a particle moving under inverse square

law, Kepler's laws on planetary motion, Motion of artificial satellites, Tangential and normal components of velocity and acceleration, Constrained motion of a particle on smooth curve. [20 classes]

## References


[1] D. Chernilevski, E. Lavrova and V. Romanov, Mechanics for Engineers, MIR Publishers, 1984.

[2] F. Chorlton, Textbook of Dynamics, CBS Publishers, 2nd Ed., 2002.

[3] R. Douglas Gregory, Classical mechanics, Cambridge University Press, 2006.

[4] D. T. Greenwood, Principle of Dynamics, Prentice-Hall, 2nd Ed, 1988.

[5] D. Kleppner and R. Kolenkow, An Introduction to Mechanics, Cambridge University Press, 2010.

[6] S. L. Loney, An Elementary Treatise on the Dynamics of particle and of Rigid Bodies, Cambridge University Press, 1913.

[7] S. L. Loney, An Elementary Treatise on Statics, Cambridge University Press, 2nd Ed., 1917.

[8] A. S. Ramsey, Dynamics(Part I & Part II), CBS Publishers, 2nd Edition, 2002.

[9] J. L. Synge and B.A. Griffith, Principles of Mechanics, McGraw-Hill, 3rd Ed., 1959.

[10] S. Timoshenko and D. H. Young, Engineering Mechanics, McGraw-Hill, 5th Ed., 2017.



4-yr Credit Distribution | MDC Credit Distribution | Course Overview

Major | Minor | MDC | Question Pattern

# Advanced Calculus

| | |
|---|---|
| Semester : IV | Paper Code : MMTH-MDC-CC5-TH |
| Semester : VI | Paper Code : MMTH-MDC-mn5-TH |
| Credit : 4 | Full Marks : 100 (Theory : 75 & Tutorial : 25) |
| *Minimum number of classes required* : 60 | |

4-yr Credit Distribution | MDC Credit Distribution | Course Overview

Major | Minor | MDC | Question Pattern

**Course Outcome**

CO1 : To learn sequence of real numbers and infinite series of constant terms.

CO2 : To understand limit, continuity of real valued functions and properties of continuous functions.

CO3 : To learn Rolle's theorem, mean value theorems, Taylor's and Maclaurin's infinite series.

CO4 : To learn limit, continuity, differentiability, partial derivatives of real valued functions of two or three variables, chain rule of partial derivatives, Euler's theorem on homogeneous functions.

## Group A : [Marks : 20] [16 classes]

- **Sequence of real numbers :** Definition of bounds of a sequence and monotone sequence. Limit and convergence of a sequence. Statements of limit theorems. Convergence and divergence of monotone sequences and applications. Convergence of $r^n$, $r^{\frac{1}{n}}$ and $n^{\frac{1}{n}}$ in particular. Statement of Cauchy's general principle of convergence and its applications.
- **Infinite series of constant terms :** Convergence and Divergence (definitions and examples). Cauchy's principle as applied to infinite series (applications only). Series of positive terms: Statements of Comparison test, Limit form of Comparison Test, D. Alembert's Ratio test. Cauchy's root test and Rabbe's test : Applications. Alternating series: Statement of Leibnitz's test and its applications.

## Group B : [Marks : 25] [20 classes]

- **Real-valued functions defined on an interval :** Limits of functions ($\epsilon$-$\delta$ approach), Cauchy's criterion of existence of limit (statement only). Algebra of limits (statements only), Continuity of a function at a point and on an interval, Properties of continuous functions on closed and bounded intervals without proof (Boundedness and Intermediate value property ) Statement of existence of inverse function of a strictly monotone function and its continuity.
- **Derivative :** Statement of Rolle's theorem and its geometrical interpretation. Mean Value Theorems of Lagrange and Cauchy as a consequence of Rolle's theorem. Geometrical interpretation of Lagrange's Mean value Theorem, Statements of Taylor's and Maclaurin's Theorems with Lagrange's and Cauchy's form of remainders, Taylor's and Maclaurin's Infinite series, Expansion of the functions $e^x$, $\sin x$, $\cos x$, $(1+x)^n$ and $\log(1+x)$ [with restrictions wherever necessary and assuming $R_n \to 0$].

## Group C : [Marks : 30] [24 classes]

- **Multivariate Calculus :** Real-valued Functions of two and three real variables: Their geometrical representations. Limit and Continuity (definitions only) for functions of two variables, Partial derivatives,

Differentiability, sufficient condition for differentiability (statement only), Chain rule for two independent variables, Higher order partial derivatives up to second order, Statement of Schwarz's Theorem for equality of mixed partial derivatives, Euler's theorem on homogeneous functions of two variables. Derivative of Implicit functions of two variables (existence assumed).

## References


[1] T. Apostol, Calculus, Volumes I and II, John Wileyand Sons, 1969.

[2] R. Courant and F. John, Introduction to Calculus and Analysis (Vol. I & II), Springer-Verlag, New York, Inc., 1998.

[3] S. Lang, A First course in Calculus, Springer, 1986.

[4] S. C. Malik and S. Arora, Mathematical Analysis, New Age International Publishers, 4e, 2014.

[5] G. B. Thomas and R. L. Finney, Calculus, 14th Ed., Pearson Education, Delhi, 2018.



4-yr Credit Distribution | MDC Credit Distribution | Course Overview

Major | Minor | MDC | Question Pattern

# Statistics & Numerical Analysis

| | |
|---|---|
| Semester : V | Paper Code : MMTH-MDC-CC6-TH |
| Semester : VI | Paper Code : MMTH-MDC-mn6-TH |
| Credit : 4 | Full Marks : 100 (Theory : 75 & Tutorial : 25) |
| *Minimum number of classes required* : 60 | |

4-yr Credit Distribution | MDC Credit Distribution | Course Overview

Major | Minor | MDC | Question Pattern

**Course Outcome**

CO1 : To learn probability theory, discrete and continuous distribution, mathematical expectations.

CO2 : To learn measures of central tendency, measures of dispersion, correlation and regression.

CO3 : To learn sampling theory, basic idea of some distributions used in sampling theory.

CO4 : To learn estimation of parameters, point estimation, interval estimation, testing of hypothesis, type I and type II error.

CO5 : To learn interpolation and numerical integration.

CO6 : To learn methods for solving transcendental equations and Gauss elimination method for solving system of linear equations.

## Group A : Statistics [Marks : 50] [40 classes]

- **Probability Theory:** Theorems on Total Probability, Conditional probability and Multiplication theorem, Bayes' Theorem (application only). Independence of events, Related Problems.
  Compound experiment, Independent trials, Bernoulli's trials, Binomial law.
- **Probability Distribution:** Random Variables, Probability Distribution function, Properties of probability distribution function, Discrete and continuous distribution, Probability mass and probability density function, Some important probability distributions and their properties – Binomial, Poisson, Uniform and Normal distributions, Related problems.
  Two-dimensional random variables and bivariate distribution (discrete and continuous), Marginal distribution, Bivariate Uniform and Normal distributions. Related problems.
- **Mathematical Expectation:** Definition of mathematical expectation, Mean, Variance, Standard Deviation, Moments, Theorems on mathematical expectation (statement only), Standardized random variate, Mean, Variance and standard deviation of Binomial, Poisson and Normal distributions.
  Mathematical Expectation in bivariate distribution, Moments, Covariance, Correlation coefficient, $E(X+Y) = E(X) + E(Y)$, $E(XY) = E(X).E(Y)$ for independent variates.
- **Elements of Statistical Methods:** Measure of Central tendency: Arithmetic Mean, Geometric Mean, Harmonic Mean, Median and Mode (their advantages and disadvantages), Relation between Mean, Median and Mode, Measures of Dispersion: Range, Quartile Deviation, Mean Deviation, Variance / Standard Deviation, Moments, Raw moments and Central moments and relation between them, Effect of change of origin and change of scale on moments.
  Correlation and Regression: Bivariate data, Scatter Diagram, Correlation coefficient-its determination and properties. Regression lines of $y$ on $x$ and $x$ on $y$ – their deductions and properties.

- **Sampling Theory:** Meaning and objects of sampling, Parameter and Statistic, Sampling distribution of a statistic, Methods of drawing random sample, Mean and Variance of sample mean, Basic idea of some distributions used in Sampling Theory - (i) Standard Normal distribution, (ii) Chi-square distribution (iii) Student's t-distribution (iv) Snedecor's F-distribution, Related problems.
- **Statistical Inference:** Estimation of Parameters, Unbiased estimator, Consistent estimator, Sample mean is an unbiased estimate of population mean, Sample variance is a biased estimator of population variance, Point estimation, Interval estimation, Method for finding Confidence Intervals, Confidence intervals for $m$ of Normal $(m, \sigma)$ population when $\sigma$ is known and when $\sigma$ is unknown.
  Statistical Hypothesis – Null Hypothesis and Alternative Hypothesis, Critical Region, Type I and II error, Level of significance, Related simple problems.
  (Note: Emphasis should be given on definitions and problem solving)

**Group B : Numerical Analysis** [Marks : 25] [20 classes]

- **Approximate numbers:** Significant figures, Rounding off of numbers. Errors – Absolute, Relative and Percentage.
- **Operators** - $\Delta$, $\nabla$ and $E$ (Definitions and some relations among them).
- **Interpolation:** Problem of interpolation, Equi-spaced arguments, Difference Table, Deduction of Newton's Forward Interpolation Formula, remainder term (expression only). Newton's Backward interpolation Formula (Statement only) with remainder term. Unequally-space arguments, Lagrange's Interpolation Formula (Statement only), Related problems.
- **Numerical Integration:** Trapezoidal rule and Simpson's $\frac{1}{3}$ rule with geometrical interpretation, Related problems.
- **Numerical solution of nonlinear equations:** To find a real root of an algebraic or transcendental equation. Location of root (tabular method), Bisection method, Newton-Raphson method with geometrical interpretation, Related problems.
- **Numerical solution of system of linear equations:** Gauss elimination method using partial pivoting for solution of system of three linear equations in three unknowns.
  (Note : Emphasis should be given on problems)

## References


[1] W. Feller, An introduction to Probability Theory and its Applications, Vol. 1, 3e, Wiley, 1968.

[2] A. Gupta, Groundwork of Mathematical Probability and Statistics, Academic Publishers, 1983.

[3] A. M. Goon, M. K. Gupta and B. Dasgupta, Fundamental of Statistics, World Press, Vol 1, 2013 & Vol 2, 2016.

[4] R. V. Hogg, J. W. McKean and A. T. Craig, Introduction to Mathematical Statistics, Pearson Education, Asia, 2007.

[5] S. Ross, Introduction to Probability Models, 9th Ed., Academic Press, Indian Reprint, 2007.

[6] B. Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007.

[7] C. F. Gerald and P. O. Wheatley, Applied Numerical Analysis, Pearson Education, India, 2008.

[8] M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publishers, 4e, 2005.



4-yr Credit Distribution | MDC Credit Distribution | Course Overview

Major | Minor | MDC | Question Pattern

# Mathematical Methods

| Semester : V or VI | Paper Code : MMTH-MDC-CC7-TH |
|---|---|
| Credit : 4 | Full Marks : 100 (Theory : 75 & Tutorial : 25) |
| *Minimum number of classes required* : 60 | |

4-yr Credit Distribution | MDC Credit Distribution | Course Overview

Major | Minor | MDC | Question Pattern

**Course Outcome**

CO1 : To learn sequence and series of functions in detail.

CO2 : To learn application of differential calculus and maxima and minima of functions.

CO3 : To learn Fourier series of periodic functions.

CO4 : To learn Laplace transform and its application to the solution of ordinary differential of second order with constant coefficients.

## Group A [Marks : 25] [20 classes]

- **Sequence and Series of functions:** Concept of Point-wise and Uniform convergence of sequence of functions and series of functions defined on intervals with special reference of Power Series, Statement of Weierstrass' M-Test for Uniform convergence of sequence of functions and of series of functions, Simple applications. Statements of important properties like boundedness, continuity, differentiability of the limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions, Convergence of Power Series, Radius of convergence, Statement of Abel's Theorem on Power Series and region of convergence of Power Series, Simple problems.

## Group B [Marks : 35] [28 classes]

- **Application of differential calculus:** Tangents and Normals, Pedal equations, Curvature, radius of curvature of plane curves, Rectilinear asymptotes (Cartesian only), Envelopes (Cartesian only), Concavity, Convexity, Point of inflection (Cartesian only), Definition and examples of singular points (viz. Node, Cusp, Isolated point) (Cartesian only).
- **Maxima and minima of functions:** Maxima and Minima of functions involving one and two variables, Lagrange's Method of undetermined multipliers of functions involving two variables ( Problems only).

## Group C [Marks : 15] [12 classes]

- **Fourier series on $[-\pi, \pi]$:** Periodic function, Determination of Fourier coefficients, Statement of Dirichlet's conditions (improperness excluded) for convergence and statement of the theorem on convergence and sum of Fourier series, Sine and Cosine series.
- **Laplace Transform and its application to ordinary differential equation:** Laplace Transform and Inverse Laplace Transform, Statement of Existence theorem, Statements of elementary properties of Laplace Transform and its Inverse, Application to the solution of ordinary differential equation of second order with constant coefficients.

## References

[1] H. Anton, I. Bivens and S. Davis, Calculus, 7th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2002.

[2] T. Apostol, Calculus, Volumes I and II, Wiley Student Edition, 1967.

[3] R. Courant and F. John, Introduction to Calculus and Analysis (Vol. I &II), Springer- Verlag, New York, Inc., 1989.

[4] J. Edwards, An Elementary Treatise on Differential Calculus, Radha Publishers, 1992.

[5] J. M. H. Olmstead, Advanced Calculus, Prentice Hall, 1961.

[6] M. J. Strauss, G. L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007.

[7] A. E. Taylor and W. Robert Mann, Advanced Calculus (3rd Edition), John Wiley & Sons, Inc., 1983.

[8] G. B. Thomas and R. L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.

[9] D. Widder, Advanced Calculus, Prentice Hall, 1947.

[10] R. C. Wrede and M. Spiegel, Advanced Calculus, Schaum's Outline Series, McGraw-Hill, 2020.

4-yr Credit Distribution | MDC Credit Distribution | Course Overview

Major | Minor | MDC | Question Pattern

# Discrete Mathematics

| Semester : VI | Paper Code : MMTH-MDC-CC8-TH |
|---|---|
| Credit : 4 | Full Marks : 100 (Theory : 75 & Tutorial : 25) |
| *Minimum number of classes required* : 60 | |

4-yr Credit Distribution | MDC Credit Distribution | Course Overview

Major | Minor | MDC | Question Pattern

**Course Outcome**

CO1 : To learn Graph theory in detail.

CO2 : To learn application of congruences.

CO3 : To learn combinatorics, recurrence relations, generating functions.

CO4 : To learn Boolean functions, Boolean polynomials, Minimal forms of Boolean polynomials, switching circuits, Logic gates.

## Group A [Marks : 30] [24 classes]

- **Graph Theory :** Definition and examples of graphs, Walks, Trails, Paths, Circuits and cycles, Eulerian circuits and paths. Eulerian graphs, example of Eulerian graphs. Hamiltonian cycles and Hamiltonian graphs. Definition of Trees and their elementary properties. Definition of Planar graphs, Kuratowski's graphs.

## Group B [Marks : 45] [36 classes]

- **Application of Congruences :** Congruence classes, addition and multiplication of congruence classes, Fermat's little theorem, Euler's Theorem, Wilson's theorem (statements only) and some applications. Divisibility tests by 2, 3, 4, 5, 7, 9, 11, 13 (Statements of relevant results, thrust will be on working out problems), Check Digits in ten digit International Standard Book Number (ISBN), Universal Product Code (UPC), VISA and MASTER card (Statements of relevant results and Problems only), Formation of Round Robin Tournament, Table using congruence of integers (Technique and Problems only).
- **Combinatorics, Recurrence Relations and Generating functions :** Statement of Fundamental counting principle, Recurrence Relations, Solution of recurrence relations by the method of Iteration (Consideration of problems of Rabbit on an island, The tower of Hanoi), Linear difference equations up to second order with constant coefficients.
- **Boolean Algebra :** Boolean Algebra (Definition, examples and basic properties), Boolean functions, Boolean polynomials, minimal forms of Boolean polynomials - CNF & DNF, Switching circuits and minimization of switching circuits using Boolean algebra, Logic Gates ( Definition and examples).

## References

[1] J. Clark and D. Holton, A first look at Graph Theory, World Scientific Publishing Co. Pvt. Ltd.(Allied Publishers Ltd.) 1991.

[2] N. Deo, Graph Theory with applications to Engineering and Computer Science, Prentice-Hall of India, 2000.

[3] E. G. Goodaire and M. M. Parmenter, Discrete Mathematics with Graph Theory, 3rd Edition, Pearson India Education Services Pvt. Ltd., 2015.

[4] F. Harary, Graph Theory, Narosa Publishing House, New Delhi, 2001.

[5] K. H. Rosen, Discrete Mathematics and its applications with combinations and Graph Theory (7th Edition), Mc-Graw Hill Education (India) Pvt. Ltd., 2011.

[6] M. K. Sen and B. C. Chakraborty, Introduction to Discrete Mathematics, 4th Edition, Books & Allied Pvt. Ltd., 2019.

[7] R. J. Wilson, Introduction to Graph Theory, 4th edition, Pearson, 2007.

4-yr Credit Distribution | MDC Credit Distribution | Course Overview

Major | Minor | MDC | Question Pattern

## Question Pattern for

## 3-year Multidisciplinary Course with Mathematics and Mathematics as a Minor subject

| | |
|---|---|
| **MMTH-MN1-TH**<br>**MMTH-MDC-mn1-TH**<br>**MMTH-MDC-CC1-TH** | **Calculus, Geometry & Vector Analysis** |
| **Group A : Calculus**<br>(Marks : 20) | (a) Short answer type questions:<br>4 questions are to be attempted out of 7 questions each carrying 2 marks.<br>(b) Long answer type questions:<br>3 questions are to be attempted out of 6 questions each carrying 4 marks. |
| **Group B : Geometry**<br>(Marks : 35) | (a) Short answer type questions:<br>2 questions are to be attempted out of 4 questions each carrying 2.5 marks<br>(b) Long answer type questions:<br>5 questions are to be attempted out of 9 questions each carrying 6 marks |
| **Group C :**<br>**Vector Analysis**<br>(Marks : 20) | (a) Short answer type questions:<br>4 questions are to be attempted out of 7 questions each carrying 2 marks.<br>(b) Long answer type questions:<br>3 questions are to be attempted out of 6 questions each carrying 4 marks. |
| **MMTH-MN2-TH**<br>**MMTH-MDC-mn2-TH**<br>**MMTH-MDC-CC2-TH** | **Basic Algebra** |
| **Group A, B, C :**<br>(Each group carries 25 marks) | (a) Short answer type questions:<br>2 questions are to be attempted out of 4 questions each carrying 2.5 marks.<br>(b) Long answer type questions:<br>4 questions are to be attempted out of 7 questions each carrying 5 marks. |
| **MMTH-SEC-TH** | **C Language with Mathematical Applications** |
| (Marks : 75) | (a) Short answer type questions:<br>5 questions are to be attempted out of 8 questions each carrying 3 marks.<br>(b) Long answer type questions:<br>5 questions are to be attempted out of 8 questions each carrying 8 marks.<br>(a) Longer answer type questions:<br>2 questions are to be attempted out of 4 questions each carrying 10 marks. |

| | |
|---|---|
| **MMTH-MN3-TH**<br>**MMTH-MDC-mn3-TH**<br>**MMTH-MDC-CC3-TH** | **Ordinary Differential Equations & Group Theory** |
| **Group A: Ordinary Differential Equations**<br>(Marks : 45) | 9 questions are to be attempted out of 16 questions each carrying 5 marks. |
| **Group B : Group Theory**<br>(Marks : 30) | 6 questions are to be attempted out of 10 questions each carrying 5 marks. |
| **MMTH-MN4-TH**<br>**MMTH-MDC-mn4-TH**<br>**MMTH-MDC-CC4-TH** | **Mechanics** |
| (Marks : 75) | (a) Short answer type questions:<br>6 questions are to be attempted out of 10 questions each carrying 2 marks.<br>(b) Long answer type questions:<br>(i) 7 questions are to be attempted out of 11 questions each carrying 6 marks.<br>(2 questions from Statics, 4 questions from Law of gravitation portion, 3 questions from Work, Power, Energy portion and 2 questions from Impulse of a force portion are to be set.)<br>(ii) 3 questions are to be attempted out of 6 questions each carrying 7 marks.<br>(questions are to be set from Motion of a particle in a plane) |
| **MMTH-MDC-CC5-TH**<br>**MMTH-MDC-mn5-TH** | **Advanced Calculus** |
| **Group A:**<br>(Marks : 20) | 4 questions are to be attempted out of 7 questions each carrying 5 marks. |
| **Group B :**<br>(Marks : 25) | 5 questions are to be attempted out of 9 questions each carrying 5 marks. |
| **Group C :**<br>(Marks : 30) | 6 questions are to be attempted out of 10 questions each carrying 5 marks. |
| **MMTH-MDC-CC6-TH**<br>**MMTH-MDC-mn6-TH** | **Statistics & Numerical Analysis** |
| **Group A: Statistics**<br>(Marks : 50) | (i) 5 questions are to be attempted out of 9 questions each carrying 5 marks.<br>Each question may have further parts.<br>These 9 questions must be set from Probability Theory, Probability Distribution and Mathematical Expectation.<br>(ii) 5 questions are to be attempted out of 9 questions each carrying 5 marks.<br>Each question may have further parts.<br>These 9 questions must be set from Elements of Statistical Methods, Statistical Inference, Sampling Theory |
| **Group B : Numerical Analysis**<br>(Marks : 25) | 5 questions are to be attempted out of 9 questions each carrying 5 marks.<br>Each question may have further parts. |

| MMTH-MDC-CC7-TH | Mathematical Methods |
|---|---|
| **Group A:**<br>**Sequencs and series of functions**<br>(Marks : 25) | 5 questions are to be attempted out of 9 questions each carrying 5 marks.<br>Each question may have further parts. |
| **Group B :**<br>**Application of differential calculus**<br>(Marks : 35) | 7 questions are to be attempted out of 11 questions each carrying 5 marks.<br>Each question may have further parts. |
| **Group C :**<br>**Fourier series and Laplace Transform**<br>(Marks : 15) | 3 questions are to be attempted out of 7 questions each carrying 5 marks.<br>Each question may have further parts. |
| **MMTH-MDC-CC8-TH** | **Discrete Mathematics** |
| **Group A: Graph Theory**<br>(Marks : 30) | 6 questions are to be attempted out of 10 questions each carrying 5 marks.<br>Each question may have further parts. |
| **Group B :**<br>(Marks : 35) | (i) 6 questions are to be attempted out of 10 questions each carrying 5 marks.<br>These 11 questions will be set from Combinatorics, Recurrence Relations and Generating functions.<br>Each question may have further parts.<br>(ii) 3 questions are to be attempted out of 5 questions each carrying 5 marks.<br>These 5 questions will be set from Boolean Algebra.<br>Each question may have further parts. |

4-yr Credit Distribution | MDC Credit Distribution | Course Overview
Major | Minor | MDC | Question Pattern