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UNIVERSITY OF CALCUTTA · CCF (NEP 2020) UG SYLLABUS

Mathematics Major (Honours) · Semester 1

Semester-wise syllabus · 4-Year Major · DSCC and SEC papers

What this file contains

- DSCC-1: Calculus, Geometry and Vector Analysis
- MTHM-SEC-1: C Language with Mathematical Applications
- Course structure page and question pattern

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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More semester-wise syllabus files and question papers: palmaths.com/cu-pyqs/

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**.

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
4-year B.A./B.Sc. Honours & Honours with Research, with Mathematics Major

Semester	Paper Code	Name of Paper	Credit	Page No.
I	MTHM-DSCC 1	Calculus, Geometry & Vector Analysis	3TH+1TU = 4	10
	MTHM-SEC 1	C language with Mathematical Applications	3TH+1TU = 4	73
II	MTHM-DSCC 2	Basic Algebra	3TH+1TU=4	12
	MTHM-SEC 2.1 or MTHM-SEC 2.2	Python Programming & Introduction to Latex or *Artificial Intelligence	3TH+1TU=4	75
III	MTHM-DSCC 3	Real Analysis	3TH+1TU=4	14
	MTHM-DSCC 4	Ordinary Differential equations - I & Group Theory - I	3TH+1TU=4	16
	MTHM-SEC 3	Linear Programming & Rectangular Games	3TH+1TU=4	78
IV	MTHM-DSCC 5	Theory of Real Functions	3TH+1TU=4	18
	MTHM-DSCC 6	Mechanics - I	3TH+1TU=4	20
	MTHM-DSCC 7	Multivariate Calculus–I & Partial Differential Equation - I	3TH+1TU=4	22
	MTHM-DSCC 8	Group Theory - II & Ring Theory - I	3TH+1TU=4	25
V	MTHM-DSCC 9	Probability & Statistics	3TH+1TU=4	27
	MTHM-DSCC 10	Ring Theory - II & Linear Algebra - I	3TH+1TU=4	29
	MTHM-DSCC 11	Riemann Integration & Series of Functions	3TH+1TU=4	31
	MTHM-DSCC 12	Mechanics - II	3TH+1TU=4	33
VI	MTHM-DSCC 13	Metric Space & Complex Analysis-I	3TH+1TU=4	35
	MTHM-DSCC 14	Multivariate Calculus II & Applications of Calculus	3TH+1TU=4	37
	MTHM-DSCC 15	Numerical Analysis	3TH+1P=4	39
VII	MTHM-DSCC 16	Group Theory-III & Linear Algebra-II	3TH+1TU=4	41
	MTHM-DSCC 17	Complex Analysis - II & Measure Theory - I	3TH+1TU=4	43
	MTHM-DSCC 18	Generalised functions, Integral Transforms Integral Equations	3TH+1TU=4	45
	MTHM-DSCC 19	Topology - I	3TH+1TU=4	47
	MTHM-DSCC 20	Functional Analysis - I	3TH+1TU=4	49
VIII		**Honours**		
	MTHM-DSCC 21	Ordinary Differential Equation - II & Partial Differential Equation - II	3TH+1TU=4	51
	MTHM-DSCC 22	Graph Theory	3TH+1TU=4	53
	MTHM-DSCC 23.1 or MTHM-DSCC 23.2	Mechanics - III or Measure Theory - II	3TH+1TU=4 3TH+1TU=4	55 57
	MTHM-DSCC 24.1 or MTHM-DSCC 24.2	Operations Research & Stochastic Process or Differential Geometry	3TH+1TU=4 3TH+1TU=4	59 61
	MTHM-DSCC 25.1 or MTHM-DSCC 25.2	Fluid Mechanics & Computational Mathematics or Functional analysis - II & Topology - II	3TH+1P=4 3TH+1TU=4	63 66
		Honours with Research		
	MTHM-RM1	Research Methodology - I	3TH +1Viva =4	68
	MTHM-RM2	Research Methodology - II	3TH +1Viva =4	70
		Research Internship	4	107
		Dissertation/Project	8	108

***Refer to Notification No. CSR/36/2023 and Notification No. CSR/35/2024 for the Syllabus and Question Pattern for the paper "Artificial Intelligence".**

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 MMTH-MN1-TH MMTH-MDC-CC1-TH
Semester : III	Paper Code : MMTH-MN1-TH 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

C Language with Mathematical Applications

Semester : I	Paper Code : MTHM-SEC 1-TH 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

Question Pattern for
4-year B.A./B.Sc. Honours & Honours with Research, with Mathematics Major

MTHM-DSCC 1-TH	**Calculus, Geometry & Vector Analysis**
Group A : Calculus (Marks : 20)	(a) Short answer type questions: 2 questions are to be attempted out of 3 questions each carrying 2 marks. (b) Long answer type questions: 4 questions are to be attempted out of 6 questions each carrying 4 marks.
Group B : Geometry (Marks : 35)	(a) Short answer type questions: 2 questions are to be attempted out of 3 questions each carrying 2.5 marks. (b) Long answer type questions: 5 questions are to be attempted out of 8 questions each carrying 6 marks.
Group C : **Vector Analysis** (Marks : 20)	(a) Short answer type questions: 2 questions are to be attempted out of 3 questions each carrying 2 marks. (b) Long answer type questions: 4 questions are to be attempted out of 6 questions each carrying 4 marks.
MTHM-SEC 1-TH	**C Language with Mathematical Applications**
(Marks : 75)	(a) Short answer type questions: 5 questions are to be attempted out of 7 questions each carrying 3 marks (b) Long answer type questions: 5 questions are to be attempted out of 7 questions each carrying 8 marks (a) Longer answer type questions: 2 questions are to be attempted out of 3 questions each carrying 10 marks.
MTHM-DSCC 2-TH	**Basic Algebra**
Group A, B, C : (Each group carries 25 marks)	(a) Short answer type questions: 2 questions are to be attempted out of 3 questions each carrying 2.5 marks. (b) Long answer type questions: 4 questions are to be attempted out of 6 questions each carrying 5 marks.
MTHM-SEC 2.1-TH	**Python Programming & Introduction to Latex**
Group A : **Python programming** (Marks : 50)	(a) Short answer type questions: 5 questions are to be attempted out of 7 questions each carrying 3 marks. (b) Long answer type questions: 7 questions are to be attempted out of 10 questions each carrying 5 marks
Group B : **Introduction to Latex** (Marks : 25)	(a) Short answer type questions: 5 questions are to be attempted out of 7 questions each carrying 2 marks (b) Long answer type questions: 3 questions are to be attempted out of 5 questions each carrying 5 marks.