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UNIVERSITY OF CALCUTTA · CCF (NEP 2020) UG SYLLABUS

Mathematics Minor · Semester 5

Semester-wise syllabus · Minor stream · MMTH-MN papers

What this file contains

- MMTH-MN-3: Ordinary Differential Equations and Group Theory
- MMTH-MN-4: Mechanics
- (MN-3 and MN-4 are taken in Semester 5 or 6)
- 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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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**.

Course Structure for

4-year B.A./B.Sc. Honours & Honours with Research, with Mathematics as a Minor Subject

Semester	Paper Code	Name of Paper	Credit	Page No.
I	MMTH-MN1	Calculus, Geometry & Vector Analysis	3TH+1TU = 4	10
II	MMTH-MN2	Basic Algebra	3TH+1TU = 4	12
III	MMTH-MN1	Calculus, Geometry & Vector Analysis	3TH+1TU = 4	10
IV	MMTH-MN2	Basic Algebra	3TH+1TU = 4	12
V	MMTH-MN3	Ordinary Differential equations & Group Theory	3TH+1TU = 4	80
	MMTH-MN4	Mechanics	3TH+1TU = 4	82
VI	MMTH-MN3	Ordinary Differential equations & Group Theory	3TH+1TU = 4	80
	MMTH-MN4	Mechanics	3TH+1TU = 4	82

Note :

1. MMTH-MN1 and MMTH-MN2 shall be studied in either Semester One and Two respectively or in Semester Three and Four respectively.
2. MMTH-MN3 and MMTH-MN4 (both) shall be studied in either Semester Five or in Semester Six.

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.

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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]

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

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

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

Major | Minor | MDC | Question Pattern

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