



COOCH BEHAR PANCHANAN BARMA UNIVERSITY

PANCHANAN NAGAR, VIVEKANANDA STREET, COOCH BEHAR – 736101

Semester wise Syllabus of Minor Courses in Mathematics:

**Course: First Year, Minor – 1, Semester – 1
for Chemistry (Major), Physics (Major), & Computer Science (Major)**

**Second Year, Minor – 3, Semester – 3
for Geography (Major) & Economics (Major)**

Paper Name: Differential Calculus and Integral Calculus

Paper Code: MATMIN - 1

Full Marks: 100 (75 = Written, 10 = Project, 10 = Internal, 5 = Attendance)

Total Credit: 6, Total Hours: 90

Program Objectives:

Through this course, the students will understand the various aspects of limit, continuity, differentiability and partial differentiation. Additionally, they will study Rolle's Theorem, Mean Value Theorems, maxima and minima, indeterminate forms and many other applications of calculus. As a part of this course, students will learn how to integrate a solid, calculate the volume and surface area of various solids in the form of revolutions, and calculate the surface area of a solid as a function of integration.

Program Outcomes:

This course will enable the students to:

- learn the fundamentals of the calculus,
- enhance the application skills of the students and prepare them to pursue higher analytical mathematics,
- analyze the relationships between quantities such as rates of changes, area, volume, properties of curves and their mathematical equivalents,
- equip with the tools of calculus to measure various quantities such as curvature, torsion, point motion in space etc.

Differential Calculus (50 Hours)

Unit-1: Limit and Continuity

Limit and Continuity (ϵ and δ definition), Types of discontinuities, Differentiability of functions, Successive differentiation, Leibnitz's theorem, L'Hospital's rule and its applications, Partial differentiation, Euler's theorem on homogeneous functions.

(17 Hours)



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Unit-2: Tangents and Normal

Tangents and normals, Pedal equation, Curvature, Asymptotes, Envelope, Singular points, Tracing of curves, Parametric representation of curves and tracing of parametric curves, Polar coordinates and tracing of curves in polar coordinates.

(17 Hours)

Unit-3: Mean Value theorems

Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series of $\sin x$, $\cos x$, e^x , $\log(1+x)$, $(1+x)^m$, Maxima and Minima, Indeterminate forms.

(16 Hours)

Integral Calculus (40 Hours)

Unit-1: Integration

Integration by Partial fractions, integration of rational and irrational functions, Properties of definite integrals, Reduction formulae for integrals of rational, trigonometric, exponential and Logarithmic functions, and their combinations, Working knowledge of Beta and Gamma functions (convergence to be assumed) and their interrelation (without proof).

(22 Hours)

Unit-2: Applications of Integration theory

Arc length of a curve, arc length of parametric curves, area enclosed by a curve, area between two curves, volume and surface areas of solids of revolution, Double and Triple integrals.

(18 Hours)

Reference Books:

1. H. Anton, I. Bivens and S. Davis, Calculus, 7th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2002.
2. G. B. Thomas and R. L. Finney, Calculus, 9th Ed., Pearson education, Delhi, 2005.
3. M. J. Strauss, G. L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007.
4. T. Apostol, Calculus, Volumes I and II.
5. S. Goldberg, Calculus and mathematical analysis.
6. Shanti Narayan: Integral Calculus
7. B.C. Das & B.N. Mukherjee (U.N. Dhur & Sons): Integral Calculus
8. Shanti Narayan: Differential Calculus
9. B.C. Das & B.N. Mukherjee (U.N. Dhur & Sons): Differential Calculus



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**Course: First Year, Minor – 2, Semester – 2
for Chemistry (Major), Physics (Major), & Computer Science (Major)**

**Second Year, Minor – 4, Semester – 4
for Geography (Major) & Economics (Major)**

Paper Name: Ordinary Differential Equation and Partial Differential Equation

Paper Code: MATMIN - 2

Full Marks: 100 (75 = Written, 10 = Project, 10 = Internal, 5 = Attendance)

Total Credit: 6, Total Hours: 90

Program Objectives:

- To familiarize the students with the various methods for solving second and higher order linear ODEs,
- To form mathematical model for various real world problems with their solution.
- To form the PDEs in different manners,
- To study the various methods for solving PDEs like Lagrange method, Charpit's method etc. ,
- To study the classification of second order PDE and their simple solutions.

Program Outcomes:

This course will enable student to:

- learn the basics of differential equations and mathematical modeling,
- formulate the ordinary differential equations for various mathematical models,
- solve first order non-linear differential equations and linear differential equations of higher order using various techniques,
- formulate, classify and transform first order PDEs into canonical form,
- learn about method of characteristics and separation of variables to solve first order PDEs,
- classify and solve the second order linear PDEs,
- learn about Cauchy problem for second order PDE and homogeneous & non-homogeneous wave equations,
- apply the method of separation of variables for solving many well known second order PDEs.



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Ordinary Differential Equation (50 Hours)

Unit-1: Equation of first order and first degree: Picard's Existence theorem (statement only). Lipschitz condition. Separable, Homogeneous and Exact equations, Condition of exactness, Integrating factor, Rules of finding integrating factor, Equation reducible to linear equation (Bernouli's equation).

Equation of first order but not of first degree: Clairaut's equation, Singular solution.

Applications: Geometrical applications, Orthogonal trajectories.

(20 Hours)

Unit-2: Higher order linear equation with constant coefficients: Complementary Function, Particular Integral. Method of undetermined coefficients, Wronskian - Its properties and applications, Method of variation of parameters. Cauchy-Euler's homogeneous equation and reduction to an equation with constant coefficients.

Simple eigen value problem.

(15 Hours)

Unit -3: Second order linear equations with variable coefficients: Reduction of order when one solution is known. Complete solution. Reduction to Normal form. Change of independent variable.

Simultaneous linear differential equations of the form $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$.

Total differential equations. System of linear ordinary differential equation in two variables.

(15 Hours)

Partial Differential Equation (40 Hours)

Unit-1: Partial Differential Equations – Basic concepts and definitions, Formation of PDE, Order and Degree of PDE, Types of PDE (Linear, Semi-linear, Quasi-linear). Solution of linear PDE by Lagrange's Method. Cauchy's problem for first order partial differential equations.

(20 Hours)

Unit-2: Solution of Non-linear partial differential equation by Charpit's method. Classification of second order PDE equations as hyperbolic, parabolic and elliptic. Reduce the equation to its corresponding canonical form. Method of Separation of variables.

(20 Hours)



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References Books:

- (1) Differential Equations, S.L. Ross, John Wiley & Sons, New York, 1980.
- (2) Differential Equations with Historical Notes, G.F. Simmons, McGraw Hill Education.
- (3) Linear Partial Differential Equations for Scientists and Engineers, TynMyint-U and Lokenath Debnath, Birkhäuser, Boston.
- (4) Differential Equations with MATHEMATICA, Martha L Abell, James P Braselton, Elsevier.
- (5) Difference equations: An Introduction with Applications, Walter Kelley & Allan Peterson, Academic Press, 2000.
- (6) Fundamentals of Differential Equations, R. Kent Nagle, Edward B. Saff, Arthur David Snider, Pearson.
- (7) Differential Equations, D. A. Murray, Orient Longmann.
- (8) An Introduction to Differential Equations, R. K. Ghosh and K. C. Maity, New Central Book Agency.
- (9) Ordinary and Partial differential Equation - Dr. M.D. Raisinghania, S. Chand.
- (10) Differential Equation, J. G. Chakravorty and P. R. Ghosh, U.N. Dhar and Sons.
- (11) Differential Equation, G. F. Simmons, Tata McGraw Hill.

**Course: Fourth Year, Minor – 5, Semester – 7
for Chemistry (Major), Physics (Major), & Computer Science (Major)**
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**Fourth Year, Minor – 6, Semester – 8
for Geography (Major) & Economics (Major)**

Paper Name: Classical, Linear and Abstract Algebra

Paper Code: MATMIN - 3

Full Marks: 100 (75 = Written, 10 = Project, 10 = Internal, 5 = Attendance)

Total Credit: 6, Total Hours: 90

Program Objectives:

The objective of this course is to:

- Develop understanding of algebraic equations and inequalities.
- Introduce fundamental group theory concepts.
- Build foundation of vector spaces and matrices.
- Enhance computational and analytical skills.
- Prepare students for higher mathematical studies.



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Program Outcomes:

After completion, students will be able to:

- Solve polynomial equations and use complex numbers effectively.
- Apply inequalities in algebraic problems.
- Understand and work with basic group structures.
- Compute eigenvalues and analyze matrices.
- Apply Cayley–Hamilton theorem in matrix problems.

Classical Algebra (30 Hours)

Unit 1: Theory of Equations

Polynomials and roots, Relation between roots and coefficients, Symmetric functions of roots (elementary problem), Transformation of equations, Descarte's Rule of Signs, Multiple roots (concept and simple problem), Reciprocal equations, Cardon's method for solving cubic equation.

(15 Hours)

Unit 2: Inequalities

$AM \geq GM \geq HM$, Cauchy–Schwarz inequality (simple cases), application to the problems of maxima and minima.

(7 Hours)

Unit 3: Complex Numbers

Geometric and Polar representation of complex numbers, Modulus and argument, De Moivre's theorem and its applications, n-th roots of unity, Logarithmic and Exponent of a complex numbers, definition of a^z ($a \neq 0$).

(8 Hours)

Abstract Algebra (30 Hours)

Definition and examples of groups, Finite and infinite groups, Subgroups, Cyclic groups, Order of a group and elements, Lagrange's theorem (statement and applications), Co-sets, Normal subgroups (basic idea), Homomorphism (definition and examples), Kernel and image, Isomorphism (idea and examples).

(30 Hours)

Linear Algebra (30 Hours)

Unit 1: Matrix and System of linear equation:

Elementary row and column operations on a matrix, Rank of a matrix, Inverse of a matrix (using elementary operations), Consistency of linear systems, Matrix equation $AX=B$, Solution sets of linear systems.

(10 Hours)



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Unit 1: Vector Spaces :

Definition and examples, Subspaces, Linear dependence and independence, Basis and dimension Sum and direct sum (basic idea).

(10 Hours)

Unit 3: Eigen values and Eigen vectors:

Definition and computation, Characteristic equation, Properties of eigen values, Diagonalization (simple cases), Cayley–Hamilton Theorem (Statement only), Verification of its for small matrices, Applications of its (Finding inverse of a matrix, Computing powers of matrices).

(10 Hours)

Reference books:

1. S. K. Mapa , Higher Algebra-Abstract and Linear, Levant Books.
2. S. K. Mapa, Higher Algebra-Classical, Levant Books.
3. J. G. Chakraborty and P. R. Ghosh, Advanced Higher Algebra, U. N. DHUR AND SONS PRIVATE LIMITED.
4. P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, Basic Abstract Algebra, Cambridge University Press.
5. K. B. Datta, Matrix and Linear Algebra, Prentice Hall of India.
6. S. Kumaresan, Linear Algebra, Prentice Hall of India.
7. S. K. Pundir, Classical Algebra, CBS Publishers and Distributors Pvt. Ltd.
8. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.