SYLLABUS

FOR

FOUR YEAR UNDER GRADUATE COURSE IN MATHEMATICS

A EIGHT SEMESTERS COURSE

(Effective from the academic session 2023 – 2024 and onwards)

COOCH BEHAR PANCHANAN BARMA UNIVERSITY
COOCH BEHAR, WEST BENGAL

AIMS AND OBJECTIVES OF THE NEW SYLLABUS IN MATHEMATICS AS A MAJOR SUBJECT

Aims

- To initiate students to use meaningful thought to solve different kinds of mathematical problems and to understand the basic structure of mathematics.
- To orient students towards various applications of Mathematics.
- To improve the point of view of the students on mathematics as per modern age requirement.
- To improve retention of mathematical concepts in the student.
- To enable the teachers to demonstrate, explain and reinforce abstract mathematical ideas by using models, charts, graphs, pictures, posters and with the help of different software through computer.
- To make a student-friendly approach in the learning process of Mathematics.
- To propagate free and open source software tools amongst the students and the teachers.
- To set up a mathematics laboratory in every college in order to help students to explore the mathematical concepts through activities and experimentation.
- To develop a spirit of inquisition in the student.

Objectives

- To provide a vibrant and more alive learning process of Mathematics, so that math-phobia can be gradually reduced amongst students.
- To improve the scope for individual participation in the process of learning of Mathematics.
- To include authentic learning, based on hands-on experience with computers with different software for better understanding of Mathematics.
- To promote experimental, problem-oriented and discovery learning of mathematics.
- To help the student to build interest and confidence in learning the subject.
- To explore the scope for greater involvement of both the mind and the hand which facilitates cognition.
- To engage the students in the activity-centered mathematics laboratory, so that problem solving approach develop amongst the students through self understanding.

1.1 Scheme and distribution of credits for Four Year Under Graduate Programme in Mathematics based on National Education Policy – 2020

Semester	Course Code	Course Detail	Contact Hours			Credits
			L	T	P	
First Year						
I	Major – 1	Classical Algebra and Linear Algebra -1	5	1	0	**6**
	Minor – 1	Differential Calculus and Integral Calculus	5	1	0	**6**
	MDC - 1	Business Mathematics	2	1	0	**3**
	SEC - 1	Decided by the respective College				**3**
	AEC - 1	Decided by the respective College				**4**
	Total Credit of First Semester					**22**
II	Major – 2	Real Analysis – 1 and Ordinary Differential Equation - 1	5	1	0	**6**
	Minor – 2	Ordinary Differential Equation and Partial Differential Equation	5	1	0	**6**
	VAC - 1	Decided by the respective College				**3**
	SEC - 2	Decided by the respective College				**3**
	INTERN	Decided by the respective College				**4**
	Total Credit of Second Semester					**22**
Total Credit after First Year = 22 + 22 = 44 **Exit Option with Certificate in Mathematics**						

1.2 Scheme and distribution of marks for Four Year Under Graduate Programme in Mathematics based on National Education Policy – 2020

PAPER WISE DISTRIBUTION OF MARKS

Year	Semester	Paper	Semester End Examination		Internal Assessment			Total
			Theory	Practical	CE	Project	A	
First	I	Major – 1	Classical Algebra (40) + Linear Algebra (35)	X	10	10	05	100
		Minor – 1	Differential Calculus (40) + Integral Calculus (35)	X	10	10	05	100
		MDC - 1	Business Mathematics (75)	X	10	10	05	100
		SEC - 1	Decided by the respective College					
		AEC – 1	Decided by the respective College					
	II	Major – 2	Real Analysis – 1 (40) + Ordinary Differential Equation – 1 (35)	X	10	10	05	100
		Minor – 2	Ordinary Differential Equation (40) + Partial Differential Equation (35)	X	10	10	05	100
		VAC - 1	Decided by the respective College					
		SEC - 2	Decided by the respective College					
		INTERN	Decided by the respective College					

2. Semester wise Syllabus of various papers in First Year

First Semester:

2.1 Major – 1 : Classical Algebra and Linear Algebra -1

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

Total Credit: 6, Total Hours: 90

Program Objectives: Students will learn complex algebra, theory of equations, and inequality in this course. Additionally, this course will enable the students to indeterminate roots of different polynomial functions. Students will learn how to use algebraic theory in various mathematical problems as part of this course. An extensive discussion will be carried out over vector spaces and matrices. Finding solutions for systems of linear equations will be greatly aided by the explanations in the following section.

Program Outcomes: This course will enable student to

a) describe the graphical representation of a polynomial, maximum and minimum values of a polynomial,
b) acquires the concept of symmetric functions,
c) use Newton's theorem to find the sums of power of roots, homogeneous products, limits of the roots of equation,
d) derive Sturm's theorem and its application.
e) Learn about the concept of linear independence of vectors over a field, and the dimension of a vector space.
f) Basic concepts of linear transformations, dimension theorem, matrix representation of a linear transformation, and the change of coordinate matrix.
g) Compute the characteristic polynomial, eigen values, eigenvectors, and eigen spaces, as well as the geometric and the algebraic multiplicities of an eigen value and apply the basic diagonalization result.
h) Compute inner products and determine orthogonality on vector spaces, including Gram–Schmidt orthogonalization to obtain orthonormal basis.

Group – A: Classical Algebra (45 Hours, 40 Marks)

Unit 1: Complex Number

Geometric representation of complex numbers, Polar representation of complex numbers, nth roots of unity, De Moivre's theorem for rational indices and its applications, trigonometric,

logarithmic and exponential functions of complex variable, definition of $a^z (a \neq 0)$, Gregory's series, inverse circular function and hyperbolic function.

(15 Hours)

Unit 2: Theory of equations

Polynomial equations with real coefficients, transformation of equation, Fundamental theorem of Classical Algebra (statement only), nature of roots of an equation, statement of Rolle's theorem, Descartes' rule of signs, Strum's theorem, application of Strum's theorem, relation between roots and coefficients of equations, equation with binomial coefficients, symmetric functions of roots, Newton's theorem on the sums of powers of roots, limits of the roots of equations, reciprocal equations, binomial equations, special roots, cubic and bi-quadratic equation (Euler and Ferraris method). **(20 Hours)**

Unit 3: Inequality

Arithmetic, Geometric and Harmonic means, The inequality involving $A.M. \geq G.M. \geq H.M.$, theorem of weighted means and m-th power theorem (statement only), Weierstrass inequalities, Tchebychev's inequality, Cauchy-Schwartz inequality, application to the problems of maxima and minima. **(10 Hours)**

Group – B: Linear Algebra – 1 (45 Hours, 35 Marks)

Unit 1: Matrix and Systems of linear equations

Basic properties and operations of different types of matrices, Inverse of a matrix, characterizations of invertible matrices, elementary operations and elementary matrices, echelon matrix, row reduced echelon matrix, rank of a matrix, normal forms, equivalency and congruency of matrices.

Consistency of Systems of linear equations, the matrix equation $AX = B$ of a system of linear equations, solution sets of linear systems, solution of linear systems using row reduced form.

(15 Hours)

Unit 2: **Vector spaces**

Subspaces, algebra of subspaces, linear combination of vectors, linear span, linear independence and dependence, deletion theorem, basis and dimension, existence; extension and replacement theorems for basis of a finite dimensional vector space, complement of a subspace, quotient spaces. **(15 Hours)**

Unit 3: Rank of Matrix and Eigen values

Row space and column space of a matrix, row rank and column rank, statements of relevant theorems, characteristic equation of a matrix, Eigen values and eigenvectors of a square matrix, Cayley-Hamilton theorem and its use in finding the inverse of a matrix, diagonalisation of matrices. **(15 Hours)**

Reference Books:

1. Titu Andreescu and Dorin Andrica, Complex Numbers from A to Z, Birkhauser, 2006.
2. W. S. Burnside and A. W. Panton, The Theory of Equations, Dublin University Press, 1954.
3. C. C. MacDuffee, Theory of Equations, John Wiley & Sons Inc., 1954.
4. S. H. Friedberg, A. J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., Prentice-Hall of India Pvt. Ltd., New Delhi, 2004.
5. S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005
6. G. Strang, Linear Algebra and its Applications, Thomson, 2007.
7. S. Kumaresan, Linear Algebra- A Geometric Approach, Prentice Hall of India, 1999.
8. K. Hoffman, R. Kunze, Linear Algebra, Prentice-Hall of India Pvt. Ltd., 1971.
9. D. C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.
10. K. B. Dutta, Matrix and linear algebra.
11. Higher Algebra (Classical, Abstract& Linear) — S. K. Mapa
12. Higher Algebra: R K Ghosh & K C Maity, New Central Book Agency
13. University Algebra: Gopala Krishnan, N.S, New Age International
15. Linear Algebra-a Geometric Approach-S. Kumaresan

2.2 Minor – 1 : Differential Calculus and Integral Calculus

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

Total Credit: 6, Total Hours: 90

Program Objectives:

Through this course, students will understand limit, continuity, differentiability, and partial differentiation. Additionally, they will study Rolle's Theorem, Mean Value Theorems, maxima and minima, indeterminate forms, and many calculus applications. As 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:
a) To introduce fundamentals of the calculus in order to enhance application skill of students

and prepare them to pursue higher analytical mathematics.
b) By the completion of the course the students will be able to analysis the relationships between quantities such as rates of changes, area, volume, properties of curves) and their mathematical equivalents.
c) The course will be able to equip the students with the tools of calculus to measure various quantities such as curvature, torsion, point motion in space etc.
d) One of the main objective of the course is to further deepen the fundamentals of analytical mathematics

Group - A : Differential Calculus (50 Hours, 40 marks)

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 it's applications, Partial differentiation, Euler's theorem on homogeneous functions.
(17 Hours)

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 $sinx, cosx, e^x, \log(1+x), (1+x)^m$, Maxima and Minima, Indeterminate forms.
(16 Hours)

Group - B : Integral Calculus (40 Hours, 35 marks)

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

2.3 MDC – 1 : Business Mathematics

Full Marks: 50 (35 = Written, 10 = Internal, 5 = Attendance)

Total Credit: 3, Total Hours: 40

Program Objectives:

The objective of this course is to familiarize the students with the basic mathematical tools, with an emphasis on applications to business and economic situations. This course will enable the students to translate the real word problems through appropriate mathematical modeling; explain the concepts and use equations, formulae and mathematical expression and relationship in a variety of context; finding the extreme values of functions; analyze and demonstrate the mathematical skill require in mathematically intensive areas in economics and business.

Program Outcomes: This course will enable the students to:

a) Explain the concepts and use equations, formulae and mathematical expression and relationship in a variety of context.

b) Finding the extreme values of functions.

c) Analyze and demonstrate the mathematical skill require in mathematically intensive areas in economic and business.

Unit 1: Matrices and Determinants

Definition of a matrix, Types of matrices, Algebra of matrices, Properties of determinants, Calculations of values of determinants up to third order, Inverse of a matrix, Elementary row and column operations, Solution of system of linear equations having unique solution and involving not more than three variables (using Matrix Inversion Method and Cremer's Rule), Examples on commercial mathematics.

(8 Hours)

Unit 2: Calculus

Concepts of limit and continuity of a function, Concept, rules and methods of differentiation and its calculation up to second order derivatives, Maxima and Minima of a function and its application, Partial Differentiation: Partial derivatives up to second order, Homogeneity of functions and Euler's theorem, Total differentials, Differentiation of implicit functions with the help of total differentials. Integration: Standard forms, Methods of Integration- by substitutions, by pats and by use of partial fractions, definite integration, finding areas in simple cases.

(8 Hours)

Unit 3: Percentage, Ratios and Proportions

Percentages: Definition, Calculation of percentage, Ratios: Types of Ratios, Duplicate Triplicate and Sub-Duplicate of ratio, Proportions: Definitions and properties- cross product property and reciprocal property, continued proportions, Compound proportions, Examples on commercial mathematics.

(12 Hours)

Unit 4: Mathematics of Finance:

Rates of Interest: nominal, effective; and their inter-relationships in different compounding situations, Compounding and discounting of a sum using different types of rates, Types of annuities, like ordinary, due, deferred, continuous, perpetual, and their future and present values using different types of rates of interest, Depreciation of Assets (General annuities to be excluded).

(12 Hours)

Reference Books:

1. Basic Mathematics, R.G.D. Allen, Macmillan, New Delhi, 1962
2. Mathematical Analysis for Economists, R.G.D. Allen, Macmillan
3. Quantitative Techniques in Management, N.D. Vohra, Tata McGraw Hill, New Delhi, 2006
4. Business Mathematics with Applications in Business and Economics, R.S. Soni, Pitambar Publishing House, Delhi, 1996
5. Introduction to Mathematical Economics, E.T. Dowling, Schaum's Series, McGraw Hill.

Second Semester:

2.4 Major – 2 : Real Analysis – 1 and Ordinary Differential Equation - 1

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

Total Credit: 6, Total Hours: 90

Program Objectives:

The objective of this course is to learn the axiomatic definition of real number system, in particular, with completeness, bounded monotone sequence of real numbers and their convergence. They will also learn the Cauchy's Limit Theorems, topology of real number system, concept of sub sequential convergence, limit superior, limit inferior, different forms of completeness of real number system and their equivalence, Cauchy's general principle of convergence, absolute and conditional convergence of series of real numbers and related tests. Students familiarize with the various methods of solving second and higher order linear.

differential equation . They will also learn hoe to form mathematical model to solve the real world problem.

Program Outcomes: This course will enable the students to:

a) Understand many properties of the real line $\mathbb{R}$, including completeness and Archimedean properties.
b) Learn to define sequences in terms of functions from $\mathbb{N}$ to a subset of $\mathbb{R}$.
c) Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and to calculate their limit superior, limit inferior, and the limit of a bounded sequence.
d) Apply the ratio, root, alternating series and limit comparison tests for convergence and absolute convergence of an infinite series of real numbers.
e) Learn basics of differential equations and mathematical modeling.
f) Formulate differential equations for various mathematical models.
g) Solve first order non-linear differential equations and linear differential equations of higher order using various techniques.
h) Apply these techniques to solve and analyze various mathematical models.

Group – A: Real Analysis-I (50 Hours, 40 marks)

Unit-1: Review of Algebraic and Order Properties of R, δ-neighborhood of a point set in R. Idea of countable sets, uncountable sets and uncountability of R. Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets, Suprema and Infima, The Completeness Property of R. The Archimedean Property,Arithmetic continuum, Linear continuum. Density of Rational (and Irrational) numbers in R with special reference to well-ordering property. Limit points of set, isolated points, open sets,closed sets, Derived set,Union,Intersection,Complement of open and closed set in R. Closure of a set and interior of a set.The basic properties of closure of a set and interior of a set. Proof of Bolzano-Weierstrass theorem for sets. **(25 Hours)**

Unit-2: Sequences, Bounded sequence, Limit of a sequence, Convergent sequence.Proof of Sandwich theorem and application. Monotone Sequences, Monotone Convergence Theorem, Nested interval theorem. Subsequences, Divergence criteria, Monotone Subsequence Theorem,Proof of Bolzano Weierstrass Theorem for Sequences. Subsequential limit. Limsup and liminf of a sequence.A sequence is convergent iff its upper and lower limits be equal.Cauchy sequence, Cauchy's Convergence Criterion. . Cauchy's first and second Limit Theorems with application. **(15 Hours)**

Unit-3: Convergence and divergence of infinite series, Cauchy's criterion of convergence; Test for convergence of positive term series:- comparison test, limit comparison test, D'Alembert's ratio test, Cauchy's nth root test, Raabe's test, Logarithmic test. Alternating series, absolute and conditional convergence, Leibnitz test, Abel's and Dirichlet's test (Statement and application). Rearrangement of series through examples. **(10 Hours)**

References:

(1) Introduction to Real Analysis—Bartle, Sherbert (Wiley)
(2) Calculus (Vol. I)—T.M.Apostol (Wiley India Pvt. Ltd)
(3) Undergraduate Analysis—S. Lang (pringer-Verlag New York Inc.; 2nd ed. 1997.)
(4) Mathematical Analysis— S. C. Malik and Arora (New Age International.)
(5) Advanced Calculus(An Introduction to Classical Analysis) – Louis Brand (Dover)
(6) A First Course in Real Analysis—S. K. Berberian (**Springer)**
(7) Advanced Calculus—D. Widder (Dover Books on Mathematics)
(8) Mathematical Analysis—Elias Zakon.(Trillia Group, 2004.)
(9) Real Analysis— S.K. Mapa(LEVANT BOOKS INDIA)
(10) Principles of Mathematical Analysis—Walter Rudin(McGraw Hill)
(11) Mathematical Analysis—Shanti Narayan(S. Chand & Co.)
(12) Method of Real Analysis—R.R. Goldberg.(Oxford & IBH Pub., 1970)

Group - B: Ordinary Differential Equation - I (40 Hours, 35 marks)

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: Geometric applications**,** Orthogonal trajectories. **(15 Hours)**

Unit-2: Higher order linear equation with constant coefficients: Complementary Function, Particular Integral. Method of undetermined co-efficients, Wronskian (Its properties and application), Method of variation of parameters.Cauchy-Euler's homogeneous equation and Reduction to an equation with constant co-efficients.simple Eigen value problem. **(15 Hours)**

Unit - 3: Second order linear equations with variable co-efficients: 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. **(10 Hours)**

References:

(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 Inc)
(5) Difference equations: An Introduction with Applications-- Walter Kelley & Allan Peterson.(Academic Press Inc; 2nd edition (16 June 2000))
(6) Fundamentals of Differential Equations--R. Kent Nagle, Edward B. Saff, Arthur David Snider (Pearson College Div · Publication)
(7) Differential Equations – D.A.Murray [Orient Longmann] (**Andesite Press**)
(8) An Introduction to Differential Equations—R.K . Ghosh and K.C. Maity(New Central Book Agency (P) Ltd.)
(9) Ordinary and Partial differential Equation—Dr. M.D. Raisinghania(S. Chand Publishing)
(10) Differential Equation —J.G. Chakravorty and P.R. Ghosh (U.N. Dhar and Sons)
(11) Differential Equation—G.F.Simmons (Tata McGraw Hills)
(12) Introductory Course in Differential Equation—B.A. Murray (Orient Longman Limited, 1967)

2.5 Minor – 2 : Ordinary Differential Equation and Partial Differential Equation

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

Total Credit: 6, Total Hours: 90

Program Objectives: To familiarize with the various methods of solving second order, higher order linear ODE. To form mathematical model to solve the real problem. To formation of PDE and the study the various method of solving PDE: Lagrange method, Charpit's method. To study the classification of second order PDE and their simple solution.

Program Outcomes: This course will enable student to:

a) Learn basics of differential equations and mathematical modeling.
b) Formulate differential equations for various mathematical models.
c) Solve first order non-linear differential equations and linear differential equations of higher order using various techniques.
d) Apply these techniques to solve and analyze various mathematical models.
e) Formulate, classify and transform first order PDEs into canonical form.
f) Learn about method of characteristics and separation of variables to solve first order PDE's.
g) Classify and solve second order linear PDEs.

h) Learn about Cauchy problem for second order PDE and homogeneous and nonhomogeneous wave equations.
i) Apply the method of separation of variables for solving many well-known second order PDEs

Group - A: Ordinary Differential Equation (50 Hours, 40 marks)

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.
Application: Geometrical applications**,** Orthogonal trajectories.

(20 Hours)

Unit - 2: Higher order linear equation with constant coefficients: Complementary Function, Particular Integral. Method of undetermined co-efficients,Wronskian (Its properties and application) Method of variation of parameters.Cauchy-Euler's homogeneous equation and Reduction to an equation with constant co-efficients.simple Eigen value problem.

(15 Hours)

Unit – 3: Second order linear equations with variable co-efficients: 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 ode equation in two variables.

(15 Hours)

Group – B: Partial Differential Equation (40 Hours, 35 marks)

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)**

References:

(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 Inc)
(5) Difference equations: An Introduction with Applications-- Walter Kelley & Allan Peterson.(Academic Press Inc; 2nd edition (16 June 2000))
(6) Fundamentals of Differential Equations--R. Kent Nagle, Edward B. Saff, Arthur David Snider (Pearson College Div · Publication)
(7) Differential Equations – D.A.Murray [Orient Longmann] (**Andesite Press**)
(8) An Introduction to Differential Equations—R.K . Ghosh and K.C. Maity(New Central Book Agency (P) Ltd.)
(9) Ordinary and Partial differential Equation—Dr. M.D. Raisinghania(S. Chand Publishing)
(10) Differential Equation —J.G. Chakravorty and P.R. Ghosh (U.N. Dhar and Sons)
(11) Differential Equation—G.F.Simmons (Tata McGraw Hills)
(12) Introductory Course in Differential Equation—B.A. Murray(Orient Longman Limited, 1967)