

NEP 2020

Syllabus of

Four-Year Undergraduate Programme

in Mathematics



Bodoland University

Kokrajhar-783370, Assam, India

STRUCTURE OF THE SYLLABUS
FOUR-YEAR UNDERGRADUATE COURSE IN MATHEMATICS
BODOLAND UNIVERSITY
(UP TO 3RD YEAR)

	Class	Paper	Topics	Credit	Marks
1 ST YEAR	SEMESTER-I	MATMAJ101-4	Foundation of Mathematics	4	Internal: 30 Theory: 50 Practical:20
		MATMIN101-4	Foundation of Mathematics	4	Internal: 30 Theory:70
		MATIDC101-3	Commercial Arithmetic-I	3	Internal: 15 Theory: 35
		MATSEC101-3	HTML and Web Designing	3	Internal: 15 Theory: 15 Practical:20
	SEMESTER -II	MATMAJ102-4	Calculus	4	Internal: 30 Theory: 50 Practical:20
		MATMIN102-4	Integral Calculus and Differential Equations	4	Internal: 30 Theory:70
		MATIDC102-3	Commercial Arithmetic-II	3	Internal:15 Theory: 35
		MATSEC102-3	Programming in C	3	Internal: 15 Theory: 15 Practical:20
2 ND YEAR	SEMESTER -III	MATMAJ201-4	Elements of Real Analysis	4	Internal: 30 Theory:70
		MATMAJ202-4	Differential Equations (ODE)	4	Internal: 30 Theory: 50 Practical:20
		MATMIN201-4	Analytical Geometry	4	Internal: 30 Theory:70
		MATIDC201-3	Logic and Graphical Representation of Data	3	Internal: 15 Theory: 35
		MATSEC201-3	SciLab	3	Internal: 15 Theory: 15 Practical:20
	SEMESTER - IV	MATMAJ203-4	Group Theory	4	Internal: 30 Theory: 70
		MATMAJ204-4	Numerical Methods	4	Internal: 30 Theory: 50 Practical:20
		MATMAJ205-4	Analytical Geometry (2D)	4	Internal: 30

			and Vector Algebra		Theory: 70
		MATMIN202-4	Vector Calculus	4	Internal: 30 Theory: 70

Detailed Syllabus

SEMESTER-I

Paper Code	Paper Title	Paper Type	Credit Distribution of the Course			Contact Hour Per Week
			Theory	Practical	Tutorial	
MATMAJ101-4	Foundation of Mathematics	Major	3	1	0	4

Course Learning Objectives:

The primary objective of this course is to introduce:

- The types of functions and relations
- The basic tools of the theory of equations, Complex numbers
- The basic number theory
- The system of Linear Equations and their applications
- To apply Mathematica Software in matrix algebra

Course Learning Outcomes:

This course will enable the students to

- Identify different types of functions and relations with their applications
- Determine the number of positive/negative real roots of a real polynomial
- To learn the modular arithmetic and their applications
- To learn the systems of linear equations and their applications.
- To learn the use of Mathematica Software in solving system of linear equations

Syllabus of the Course

Theory:

Unit-1: Basics of Relations and Functions

Relations, Types of relations, Equivalence relations, Equivalence Classes and partitions of a set, Functions, Types of functions, Composition of functions, Inverse of a function, Image and inverse image of subsets under functions.

Contact Hour-11; Marks:12

Unit-2: Theory of Equations and Complex Numbers

General properties of polynomials and equations, Fundamental theorem of algebra, Relations between the roots and the coefficients, Upper bounds for the real roots; Theorems on imaginary, integral and rational roots; Newton's method for integral roots, De-Moivre's theorem for integer and rational indices and their applications, The nth roots of unity, Cardan's solution of the cubic equations.

Contact Hour-11; Marks: 13

Unit-3: Basic Number Theory

Division algorithm in \mathbb{Z} , Divisibility and the Euclidean algorithm, Fundamental theorem of arithmetic, Modular arithmetic and basic properties of congruences.

Contact Hour-11; Marks: 12

Unit-4: Basics of Linear Algebra:

Systems of linear equations, Row reduction and echelon forms, vector equations, the matrix equation $Ax=b$, Solution sets of linear systems, Applications of linear systems, the Inverse of a matrix, Algorithm to find the inverse of a matrix, Characterizations of invertible matrices.

Contact Hour-12; Marks: 13

Practical:**Software to be used Wolfram Mathematica:**

Construction of matrices, Algebraic operations of Matrices, Elementary operations of matrices, Partitions of matrices, Determinant of a matrix, Rank of a Matrix, Adjoint of a matrix, Inverse of a matrix, and Solutions of a system of linear equations.

Contact Hour- 15; Marks-20

Prescribed Textbooks:

- [1] A Foundation Course in Mathematics, A. Kumar, S. Kumaresan, B. K. Sarma, Alpha Science International Ltd. Oxford, U.K. **(For Unit-1)**
- [2] Dickson, Leonard Eugene (2009). First Course in the Theory of Equations. John Wiley & Sons, Inc. **(For Unit-2)**
- [3] Goodaire, Edgar G., & Parmenter, Michael M. (2006). Discrete Mathematics with Graph Theory (3rd ed.). Pearson Education Pvt. Ltd. Indian Reprint 2018. **(For Unit-3)**
- [4] David C. Lay, *Linear Algebra and its Applications*, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007. **(For Unit-4)**

Reference Books:

- [1] Titu Andreescu and Dorin Andrica, *Complex Numbers from A to Z*, Birkhauser, 2006.
- [2] Burnside, W.S., & Panton, A.W. (1979), *The Theory of Equations*, Vol. 1. Eleventh Edition, (Fourth Indian Reprint. S. Chand & Co. New Delhi), Dover Publications, Inc.
- [3] Burton, David M. (2011). *Elementary Number Theory* (7th ed.). McGraw-Hill Education Pvt. Ltd. Indian Reprint. Joseph A. Gallian, *Contemporary Abstract Algebra* (Fourth Edition), Narosa, 1999.

SEMESTER-I

Paper Code	Paper Title	Paper Type	Credit Distribution of the Course			Contact Hour Per Week
			Theory	Practical	Tutorial	
MATMIN101-4	Foundation of Mathematics	Minor	3	0	1	4

Course Learning Objectives:

The primary objective of this course is to introduce:

- The basic knowledge and background to understand other courses in either mathematics or physics.
- The basic concepts of matrix and compute the eigenvalues and eigenvectors.

Course Learning Outcomes:

This course will enable the students to

- Get the basic idea of Complex Numbers, Matrices and Theory of Equations.
- Utilize the knowledge of Complex Numbers, Matrix and Theory of Equations to understand.
- Learn to solve Complex Numbers, matrices and the Theory of Equations.

Syllabus of the Course:**Theory:****Unit-1: Complex Numbers**

Complex numbers as ordered pairs of real numbers, geometrical representation and polar form of complex numbers, modulus, argument and their properties, complex equations of straight line and circle. De Moivre's theorem, expansion of $\cos x$ and $\sin x$ in positive integral powers of x , the

logarithm of a complex number, exponential and trigonometric functions of a complex variable, Euler's expansion of cosine and sine, hyperbolic functions, inverse functions, Gregory's series.

Contact Hour- 25; Marks-32

Unit-2: Matrices

Basic concepts of matrices, Types of matrices, Transpose, trace and determinant of a matrix, Elementary operations, Row Reduced echelon form, Rank and inverse of a matrix, Normal form of a matrix, Solutions of a system of linear equations, Symmetric, skew-symmetric and orthogonal matrices, Eigenvalues, eigenvectors, Diagonalization of matrices, Cayley-Hamilton theorem.

Contact Hour- 12; Marks-22

Unit-3: Theory of Equations

Relation between the roots and coefficients of a general polynomial equation in one variable, transformation of equations, Descartes' rule of signs, Solutions of reciprocal and binomial equations, and solution of cubic equation by Cardon's method.

Contact Hour- 8; Marks-16

Prescribed Textbooks:

- [1] Higher Trigonometry - Das and Mukherjee: Dhur and Sons (**For Unit-1**)
- [2] Seymour Lipschutz; Marc Lipson: Schaum's Outline of Linear Algebra, McGraw-Hill Education, Schaum's Outlines, 4, 2008. (**For Unit-2**)
- [3] Higher Algebra (Classical) - S.K. Mappa, Asoke Prakasan. (**For Unit-3**)

Reference Books:

- [1] Titu Andreescu and Dorin Andrica, *Complex Numbers from A to Z*, Birkhauser, 2006.
- [2] Herstein I. N. & Winter D. J. - Matrix theory and linear algebra Macmillan Pub Co, 1988
- [3] Burnside, W.S., & Panton, A.W. (1979), *The Theory of Equations*, Vol. 1. Eleventh Edition, (Fourth Indian Reprint. S. Chand & Co. New Delhi), Dover Publications, Inc.
- [4] Dickson, Leonard Eugene (2009). First Course in the Theory of Equations. John Wiley & Sons, Inc.

SEMESTER-I

Paper Code	Paper Title	Paper Type	Credit Distribution of the Course			Contact Hour Per Week
			Theory	Practical	Tutorial	
MATIDC101-3	Commercial Arithmetic-I	IDC	2	0	1	3

Course Learning Objectives:

The primary objective of this course is to introduce:

- The concept of interest levied on borrowed capital from financial institutions or banks

Course Learning Outcomes:

This course will enable the students to

- Evaluate the legal, social and economic environment of business
- Apply decision support tools to business decision making
- Will be able to apply knowledge of business concepts and functions in an integrated manner

Syllabus of the Course:

Theory:

Unit-1: Commercial Arithmetic

Interest: Concept of Present value and Future value, Simple interest, Compound interest, Nominal and Effective rate of interest, Examples and Problems of Annuity: Ordinary Annuity, Sinking Fund, Annuity due, Present value and Future value of Annuity, Equated Monthly Instalments (EMI) by Interest of Reducing Balance and Flat Interest methods, Examples and Problems.

Contact Hours- 15; Marks-17

Unt-2: Measures of Central Tendency and Dispersion

Frequency distribution: Raw data, attributes and variables, Classification of data, frequency distribution, cumulative frequency distribution, Histogram and give curves. Requisites of ideal measures of central tendency, Arithmetic Mean, Median and Mode for ungrouped and grouped data. Combined mean, Merits and demerits of measures of central tendency, Geometric mean: Definition, merits and demerits, Harmonic mean: Definition, merits and demerits, Choice of A.M., G.M. and H.M. Concept of dispersion, Measures of dispersion: Range, Variance, Standard deviation (SD) for grouped and ungrouped data, Combined SD, Measures of relative dispersion: Coefficient of range, Coefficient of variation, Examples and problems.

Contact Hours- 15; Marks-18

Reference Books:

- [1] M. K. Bhowal, Fundamentals of Business Mathematics, Asian Books Pvt. Ltd., New Delhi, 2007
- [2] M. G. Das and J. K. Das, Business Mathematics and Statistics, McGraw Hill, New Delhi, 2017
- [3] K. Selvakumar, Mathematics for Commerce, Motion Press, Chennai, 2014.

SEMESTER-I

Paper Code	Paper Title	Paper Type	Credit Distribution of the Course			Contact Hour Per Week
			Theory	Practical	Tutorial	
MATSEC101-3	HTML and Web Designing	SEC	2	1	0	3

Course Learning Objectives:

The primary objective of this course is to introduce:

- To provide an understanding of the basic structure and syntax of HTML.
- To develop skills in creating and formatting basic web pages using HTML.
- To equip students with the ability to design and develop a simple website.
- To develop skills in creating visually appealing and effective presentations using PowerPoint and deliver a professional-level presentation.

Course Learning Outcomes:

This course will enable the students to

- Able to create and publish a basic website using HTML.
- Able to use common web design principles and techniques.
- Differentiate between effective and ineffective visual communication.
- Create visually appealing and effective presentations using PowerPoint.

Syllabus of the Course:

Theory + Practical:**Unit-1**

Definition of HTML, Overview of markup languages, HTML structure, Syntax of HTML, Basic HTML tags, Advanced HTML tags, Formatting and Styling with CSS, Building a Simple Website.

Contact Hours-20; Marks-17

Unit-2

Introduction to Web Designing, Design Tools, Web Design Principles, Responsive Design, Web hosting and domain registration, uploading web files to the server, Testing and maintaining the website. Introduction to PowerPoint, Features of PowerPoint, creating a new presentation, understanding effective visual communication, Visual hierarchy and alignment, Planning and designing a presentation.

Contact Hours-25; Marks-18

Prescribed Textbooks:

- [1] *HTML and CSS: Design and Build Websites*, Jon Duckett, John Wiley & Sons, 2011. **(For Unit-1)**
 [2] *Web Design with HTML, CSS, JavaScript and jQuery Set*, Jon Duckett, Wiley, 2014. **(For Unit-2)**

Reference Books:

- [1] Elizabeth Castro and Bruce Hyslop, *HTML and CSS: Visual QuickStart Guide*, Peachpit Press, 2013.
 [2] Jennifer Niederst Robbins, *Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics*, O'Reilly Media, 2018.
 [3] Jason Beaird, *The Principles of Beautiful Web Design*, SitePoint, 2010.
 [4] Garr Reynolds, *Presentation Zen: Simple Ideas on Presentation Design and Delivery*, New Riders, 2008.
 [5] Nancy Duarte, *Slide:ology: The Art and Science of Creating Great Presentations*, O'Reilly Media, 2008

SEMESTER-II

Paper Code	Paper Title	Paper Type	Credit Distribution of the Course			Contact Hour Per Week
			Theory	Practical	Tutorial	
MATMAJ102-4	Calculus	Major	3	0	1	4

Course Learning Objectives:

The primary objective of this course is to introduce:

- Differential calculus and integral calculus to study the physical phenomena-the differential equation. To apply Mathematica Software in matrix algebra.

Course Learning Outcomes:

This course will enable the students to

- To learn the technique of finding nth derivative of some standard functions
- Identify and apply the intermediate value theorem.
- Learn the centre of curvature, asymptotes of the given curve.
- Learn to evaluate integrals, find arc -lengths, areas and volume.

Syllabus of the Course:

Theory:**Unit-1**

Limits, Continuity, Differentiability and properties. Properties of continuous functions. $n^{(th)}$ Derivatives of Standard functions e^{ax+b} , $(ax + b)^n$, $\log(ax + b)$, $\sin(ax+b)$, $\cos(ax+b)$, $e^{ax}\sin(bx+c)$, $e^{ax}\cos(bx+c)$, derivatives hyperbolic functions, Leibnitz theorem and its application.

Contact Hour-11; Marks-17

Unit-2

Intermediate value theorem, Rolle's Theorem, Lagrange's Mean Value theorem, Cauchy's Mean value theorem and examples. Taylor's theorem, Maclaurin's series, Indeterminate forms hyperbolic function and evaluation of limits using L'Hospital's rule.

Contact Hour-11; Marks-18

Unit-3

Polar coordinates, angle between the radius vector and tangent. Angle of intersection of two curves (polar forms), length of perpendicular from pole to the tangent, pedal equations. Derivative of an arc in Cartesian, parametric and polar forms, curvature of plane curve-radius of curvature formula in Cartesian, parametric and polar and pedal forms- center of curvature, asymptotes.

Contact Hour-13; Marks-20

Unit-4

Recapitulation of definite integrals and its properties. Reduction formulae- $\int \sin^n x dx$. $\int \cos^n x dx$ $\int \sin^n x \cos^n x dx$. $\int_0^{\pi/2} \sin^n x dx$. $\int_0^{\pi/2} \cos^n x dx$. $\int_0^{\pi/2} \sin^n x \cos^n x dx$. Problems, computation of length of an arc, Area of plane curves, surface area and volume of revolution in Cartesian and polar forms.

Contact Hour-10; Marks-15

Prescribed Textbook:

- [1] Shanti Narayan, Differential Calculus - S. Chand & Company, NewDelhi. (Unit-1 & 2)
- [2] B. C.Das and B.N Mukherjee, Calculus, U,N, DHUR & SONS PRIVATE LTD (Unit-1 & 2)
- [3] B. C.Das and B.N Mukherjee, Integral Calculus, U,N, DHUR & SONS PRIVATE LTD (Unit-3 & 4)
- [4] Shanti Narayan and PK Mittal, Integral Calculus, S. Chand and Co. Pvt. Ltd., (Unit-3 & 4)

Reference Books:

- [1] Debasish Sengupta, Applications of Calculus, Books and Allied (P) Ltd.,2019.
- [2] Lipman Bers, Calculus Holt, Rinehart & Winston.
- [3] S Narayanan & T. K. Manicavachogam Pillay, Calculus S. Viswanathan Pvt.Ltd., vol. I & II.
- [4] Schaum's Outline of Calculus - Frank Ayres and Elliott Mendelson, 5th ed.USA: Mc. Graw.
- [5] M. J. Strauss, G.L. Bradley and K. J. Smith, *Calculus*, 3rd Ed., Dorling Kindersley (India) P. L td. (Pearson Education), Delhi, 2007.
- [6] H. Anton, I. Bivens and S. Davis, *Calculus*, 7th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2002.

SEMESTER-II

Paper Code	Paper Title	Paper Type	Credit Distribution of the Course			Contact Hour Per Week
			Theory	Practical	Tutorial	
MATMIN102-4	Integral	Minor	3	0	1	4

	Calculus and Differential Equations					
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Course Learning Objectives:

The primary objective of this course is to introduce:

- Methods of integration and reduction formulae.
- Various methods to solve differential equations and introduce partial differential equations.

Course Learning Outcomes:

This course will enable the students to

- Get the basic idea of integration and reduction formulae.
- Utilize the knowledge of integration by parts for definite integral.
- Learn various methods for solving differential equations and partial differential equations.

Syllabus of the Course:

Unit-1: Integration and reduction formulae

A review of familiar integration formula, Integration by parts, Repeated integration by parts, Integration by parts for definite integrals, Integration by substitution, Reduction formulae to obtain the iterative formulae for the integrals of the form: $\int \sin^n x dx$, $\int \cos^n x dx$, $\int \tan^n x dx$, $\int \sec^n x dx$ and $\int \sin^n x \cos^m x dx$

Contact Hour-15; Marks-22

Unit-2 First-order differential equations

First-order exact differential equations. Integrating factors, Rules to find an integrating factor. First-order higher-degree equations solvable for x, y, p. Methods for solving higher-order differential equations. The basic theory of linear differential equations, Wronskian and its properties.

Contact Hour-12; Marks-18

Unit-3 Higher Order Linear Differential Equations and Formation of Partial Differential Equations

Linear homogeneous equations with constant coefficients, Linear non-homogeneous equations, The method of variation of parameters, and The Cauchy-Euler equation; Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations.

Contact Hour-18; Marks-30

Prescribed Textbook:

- [1] Anton, Howard, Bivens, Irl, & Davis, Stephen (2013), Calculus (10th ed.), John Wiley & Sons, Singapore Pvt. Ltd., Indian Reprint (2016) by Wiley India Pvt. Ltd. Delhi. (Unit-1)
- [2] Ross, Shepley L (1984), Differential Equations (3rd ed.), John Wiley & Sons, Inc. (Unit-2 & Unit-3)
- [3] I, Sneddon, Elements of Partial Differential Equations, McGraw-Hill, International Edition, 1967. (Unit-3)

Reference Books:

- [1] M. J. Strauss, G. L. Bradley and K. J. Smith, Calculus (3rd ed.), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.
- [2] Prasad, Gorakh (2016), Differential Calculus (19th ed.), Pothishala Pvt. Ltd., Allahabad.
- [3] Kreyszig, Erwin (2011), Advanced Engineering Mathematics (10th ed.), John Wiley & Sons, Inc. Wiley India Edition 2015.
- [4] Ordinary differential equations by M. D. Raisinghania.

SEMESTER-II

Paper Code	Paper Title	Paper Type	Credit Distribution of the Course			Contact Hour Per Week
			Theory	Practical	Tutorial	
MATIDC102-3	Commercial Arithmetic-II	IDC	2	0	1	3

Course Learning Objectives:

The primary objective of this course is to introduce:

- To understand ratio and proportion, profit and loss, and cost & expenditures.
- To understand the key concept of still water, upstream, downstream and stream in real-time under different circumstances.

Course Learning Outcomes:

This course will enable the students to

- Integrate the concept of basic mathematics for business.
- To learn different techniques of simplification of the real number system.
- To enable students to answer competitive examinations.
- To apply knowledge of business concepts and functions in an integrated manner.

Syllabus of the Course:

Unit-1

Techniques of solving problems involving numbers system and decimal fraction to calculate the share of profit, simplification of an equation involving cost and expenditure, Average, Profit and loss.

Contact Hours- 15; Marks-17

Unit-2

Percentage, Ratio and proportion, Partnership, Time and Work, Situation in Boats and Stream, Simple problems on the train and other moving objects, different types of problems the in Calendar, number of days and dates to calculate the period of payments and share and problem related to clock.

Contact Hours- 15; Marks-18

Reference Books:

- [1] R.S Agarwal, Quantitative, S Chand & Company Pvt, Ltd,2014
- [2] K Selvakumar, Mathematics for Commerce, Notion Press Chinnai,2014
- [3] M.K. Bhowal, Fundamental of Mathematics, Asian Books Pvt.Ltd New Delhi, 2009
- [4] Martin Anthony and Norman Biggs, Mathematics for Economics and Finance: Methods and Modelling, Cambridge University, Cambridge,1996

SEMESTER-II

Paper Code	Paper Title	Paper Type	Credit Distribution of the Course			Contact Hour Per Week
			Theory	Practical	Tutorial	

MATSEC102-3	Programming in C	SEC	2	1	0	3
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Course Learning Objectives:

The primary objective of this course is to introduce:

- C programming in the context of mathematics.
- Transmit a starting orientation using available mathematical libraries, and their applications

Course Learning Outcomes:

This course will enable the students to

- Understand and learn data-types, Library functions of C
- Used the programming concepts of C to mathematical investigation and problem solving.
- Learn about applications in factorization of an integer, Cartesian geometry and uses understanding in various applications in algebra
- In practical students learn about the roots of a quadratic equation, solution of $\sin(x)$, $\cos(x)$ with the help of functions

Syllabus of the Course:

Theory:

Unit-1

Algorithm and Flowchart, Variables, constants, Keywords, variable declaration, basic data types, operators and expression (arithmetic, relational, logical, assignment, conditional, increment and decrement), hierarchy of operations(s), library functions, structure of a C program, input/output functions and statements.

Contact Hours-15; Marks-7

Unit-2

Control Statements: if-else statement (including nested if-else statement), switch statement. Loop control Structures (for and nested for and while). Break, continue, exit function. Arrays and subscripted variables: One and Two-dimensional array declaration, accessing values in an array, initializing values in an array, sorting of numbers in an array, addition and multiplication of matrices with the help of array, Functions: function declaration, actual and formal arguments, function prototype, calling a function by value, recursive function.

Contact Hours-15; Marks-8

Programs for practical

To find sum, average, greatest or smallest of the digits of any given positive integers, factorial of a given positive integer, Fibonacci numbers, square root of a number, cube root of a number, sum of different algebraic and trigonometric series, root of quadratic equation, a given number to be prime or not, reversing digits of an integer. Sorting of numbers in an array, to find addition, subtraction and multiplication of matrices. To find $\sin(x)$, $\cos(x)$ with the help of functions.

Contact Hours-15; Marks-20

Prescribed Textbooks:

- [1] T. Jeyapoovan, A First Course in Programming with C T. Jeyapoovan, Vikash Publishing House Pvt. Ltd

Reference Books:

- [1] E. Balaguruswamy, Programming with C, Schaum Series.
 [2] Y. Kanetkar, *Let us C*, B.P. Publication Elizabeth Castro and Bruce Hyslop, *HTML and CSS: Visual QuickStart Guide*, Peachpit Press, 2013.

SEMESTER-III

Paper Code	Paper Title	Paper Type	Credit Distribution of the Course			Contact Hour Per Week
			Theory	Practical	Tutorial	
MATMAJ201-4	Elements of Real Analysis	Major	3	0	1	4

Course Learning Objectives:

The primary objective of this course is to introduce:

- The Algebraic and Order Properties of Real Numbers
- The boundedness of the Real numbers
- Sequences and their convergences
- Series and their convergences

Course Learning Outcomes:

This course will enable the students to

- To learn in-depth about the suprema and infima of real numbers and their applications
- To learn about the convergence and the divergence of real sequences and their series.

Syllabus of the Course:

Unit-1 Basics of Real Analysis

The Algebraic and Order Properties of \mathbb{R} , Inequalities including Bernoulli's Inequality, Absolute value and the real line, Neighbourhood of a point, bounded above and bounded below sets, Suprema and infima, The completeness property of \mathbb{R} and \mathbb{Q} , Applications of the supremum property, Archimedean Property of \mathbb{R} , Density of rational numbers in \mathbb{R} , Intervals, (up to Nested Interval Property), Countable and uncountable sets, Countability of \mathbb{Z} , \mathbb{R} , $\mathbb{N} \times \mathbb{N}$, \mathbb{Q} , $[0, 1]$ and related theorems.

Contact Hour-20; Marks-22

Unit-2 Sequences of Real Numbers

Sequences, The limit of a sequence with examples and related theorems, Bounded sequence, Limit Theorems, Squeeze theorem, Monotone Sequences, and Monotone Convergence Theorem; Euler's Number, Subsequences, Divergence Criteria, Bolzano Weierstrass Theorem for Sequences, Monotone Subsequence Theorem, Cauchy sequence, and Cauchy's Convergence Criterion with applications.

Contact Hour-20; Marks-25

Unit-3 Infinite Series of Real Numbers

Basic concepts and examples, General Term Test, Grouping, Cauchy Criterion for convergence of series, Linearity of sums of series, Nonnegative series, The Integral Test, p-series, Comparison Test, Limit Comparison Test, Ratio Test, Root Test, Alternating series Test, Absolute and Conditional convergence.

Contact Hour-20; Marks-23

Prescribed Textbooks:

- [1] Bartle, Robert G., & Sherbert, Donald R. (2015). *Introduction to Real Analysis* (4th ed.). Wiley India Edition. New Delhi (**For Units-1 & 2**).
- [2] Denlinger, Charles G. (2011). *Elements of Real Analysis*. Jones & Bartlett India Pvt. Ltd. Student Edition. Reprinted 2015 (**For Units 3**).

Reference Books:

- [1] Ross, Kenneth A. (2013). *Elementary Analysis: The Theory of Calculus* (2nd ed.). Undergraduate Texts in Mathematics, Springer. Indian Reprint.

[2] Thomson, Brian S., Bruckner, Andrew. M., & Bruckner, Judith B. (2001). *Elementary Real Analysis*. Prentice Hall.

SEMESTER-III

Paper Code	Paper Title	Paper Type	Credit Distribution of the Course			Contact Hour Per Week
			Theory	Practical	Tutorial	
MATMAJ202-4	Differential Equations (ODE)	Major	3	1	0	4

Course Learning Objectives:

The primary objective of this course is to introduce:

- The primary objective of this course is to introduce the students to the exciting world of ordinary differential equations, mathematical modeling and their applications.

Course Learning Outcomes:

This course will enable the students to

- Learn basics of differential equations and mathematical modeling.
- Formulate differential equations for various mathematical models.
- Solve first order linear and non-linear differential equations and linear differential equations of higher order using various techniques.
- Apply these techniques to solve and analyze various mathematical models.

Syllabus of the Course:

Theory:

Unit-1 First-Order Differential Equations

Basic concepts and origin of ordinary differential equations, explicit, implicit, singular, general and particular solutions of a differential equation; initial value problems, and existence of solutions; Exact differential equations and integrating factors, separable equations and equations reducible to this form, linear equation and Bernoulli equations, special integrating factors and transformations.

Contact Hour-12; Marks-14

Unit-2 Formulation and Analysis of Mathematical Models

Introduction to compartmental model, exponential decay model, lake pollution model (case study of Lake Burley Griffin), drug assimilation into the blood (case of a single cold pill, case of a course of cold pills), exponential growth of population, density- dependent growth model, limited growth with harvesting, predatory-prey model and its analysis, epidemic model of influenza and its analysis, battle model and its analysis, Equilibrium points, Interpretation of phase plane.

Contact Hour-15; Marks-16

Unit-3 Second and Higher-Order Differential Equations

General solution of homogeneous equation of second order, principle of super position for a homogeneous equation, Wronskian: its properties and applications, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, method of undetermined coefficients, method of variation of parameters, Cauchy-Euler equation.

Contact Hour-18; Marks-20

Practical:

Practical (30 Hours): Practical / Lab work to be performed in a computer Lab.

List of Practicals using Mathematica/MATLAB/Scilab/Python etc.

1. Solutions of following differential equations.
 - a) $\frac{dy}{dx} + 2\left(\frac{y}{x}\right) = \sin x$
 - b) $\frac{dy}{dx} = y \tan x - 2\sin x$
 - c) $x^2 \frac{d^2y}{dx^2} + 2x \frac{dy}{dx} = \log x$
 - d) $\frac{d^2y}{dx^2} + 3\frac{dy}{dx} + 2y = x + \cos x$
 - e) $x^3 \frac{d^3y}{dx^3} + 3x^2 \frac{d^2y}{dx^2} + x \frac{dy}{dx} + 8y = 0$
 - f) $x^3 \frac{d^3y}{dx^3} - x^2 \frac{d^2y}{dx^2} + 2x \frac{dy}{dx} - 2y = x^3 + 3x$
2. Plotting of family of solutions of following differential equations.
 - a) $\frac{dy}{dx} = 0.2, y(0) = 1$
 - b) $2\frac{d^2y}{dx^2} - 5\frac{dy}{dx} + 2y = 0, y(0) = 0, y'(0) = 1,$
 - c) $\frac{d^3y}{dx^3} - e^x = 0; y(0) = 3, y'(0) = 1, y''(0) = 5$
3. Growth and decay model (exponential case only).
4. Lake pollution model (with constant/seasonal flow and pollution concentration).
5. Density-dependent growth model.
6. Limited growth of population (with and without harvesting).
7. Predatory-prey model (basic volterra model, with density dependence, effect of DDT, two prey one predator).
8. Epidemic model of influenza (basic epidemic model, contagious for life, disease with carriers).
9. Battle model (basic battle model, jungle warfare, long range weapons).

Prescribed Textbooks:

- [1] Barnes, Belinda & Fulford, Glenn R. (2015). Mathematical Modelling with Case Studies, Using Maple and MATLAB (3rd ed.). CRC Press, Taylor & Francis Group. **(Unit-2)**
- [2] Edwards, C. Henry, Penney, David E., & Calvis, David T. (2015). Differential Equation and Boundary Value Problems: Computing and Modeling (5thed.). Pearson Education. **(Unit-3)**
- [3] Ross, Shepley L. (2004). Differential Equations (3rded.). John Wiley & Sons. India **(Units-1 & 3)**

Reference Books:

- [1] Martha L Abell, James P Braselton, Differential Equations with MATHEMATICA, 3rd Ed., Elsevier Academic Press, 2004.
- [2] M. D. Raisinghania, Ordinary and Partial Differential Equations, S Chand, 2018

SEMESTER-III

Paper Code	Paper Title	Paper Type	Credit Distribution of the Course			Contact Hour Per Week
			Theory	Practical	Tutorial	
MATMIN201-4	Analytical Geometry	Minor	3	0	1	4

Course Learning Objectives:

The primary objective of this course is to introduce:

- The systems of polar co-ordinate systems, transformation of coordinate axes, pair of straight lines.
- The basic concepts of parabola, ellipse and hyperbola
- Concepts of tangents and normals, condition of tangency, pole and polar of the conic section.
- Rectangular coordinates in 3-dimensional space, Planes in 3-dimensional space.
- Equation of a sphere, plane section of sphere, tangents and tangent plane to a sphere

Course Learning Outcomes:

This course will enable the students to

- Learn concepts in two-dimensional geometry.
- Identify and sketch conics namely, ellipse, parabola and hyperbola.
- Learn about three-dimensional objects such as straight lines and planes using vectors, spheres, cones and cylinders

Syllabus of the Course:

Unit-1 Transformation of coordinates

Polarcoordinatesystem,transformation of Cartesian coordinates to polar coordinates, transformation of coordinate axes, pair of straight lines.

Contact Hour-12; Marks-12

Unit-2General second degree equations

Classification of quadratic equation representing lines, parabola, ellipse and hyperbola, tangents and normals to the conics, parametric forms of tangents and normal, condition of tangency, pole and polar, centre of a conic, equation of pair of tangents, reduction to standard forms, central conics, equation of the axes, and length of the axes.

Contact Hour-15; Marks-18

Unit-3Curve Tracing

Techniques for sketching parabola, ellipse and hyperbola; Reflection properties of parabola, ellipse, hyperbola, and their applications to signals.

Contact Hour-8; Marks-10

Unit-4Plane, straight lines and shortest distance

Rectangular coordinates in 3-dimensional space, Planes in 3-dimensional space, coplanarity of two lines, angle between two planes, distance of a point from a plane, angle between a line and a plane, distance between parallel planes; Shortest distance between two skew lines.

Contact Hour-10; Marks-13

Unit-5 Sphere, Cone and Cylinder

Equation of a sphere, plane section of sphere, tangents and tangent plane to a sphere; Equation of a cone, enveloping cone of a sphere, Reciprocal cones and right circular cone; Equation of a cylinder, enveloping cylinder and right circular cylinder.

Contact Hours-15 Marks- 17

Prescribed Textbook:

- [1] P.R.Vittal:*AnalyticalGeometry-2D&3D*,PearsonEducation,2013. **(For Units-1 & 2)**
- [2] Anton, Howard, Bivens, Irl, & Davis, Stephen (2013). *Calculus* (10th ed.). John Wiley & Sons Singapore Pte. Ltd. Indian reprint (2016) by Wiley India Pvt. Ltd. Delhi. **(For Unit-3)**
- [3] J.G.ChakravortyandP.R.Ghosh:*AnalyticalGeometryandVectorAnalysis*,U.N.Dhur& Sons Pvt. Ltd, 1973. **(For Units-4 & 5)**

Reference Books:

- [1] S.L.Loney:*TheElementsofCoordinateGeometry*,McMillanandCompany,London,2018.
- [2] ShantiNarayanandP.K.Mittal:*AnalyticalSolidGeometry*,S.Chand&Company,2007.

- [3] JyotiDas:*AnalyticalGeometry*,AcademicPublisher,2011.
 [4] HenryB.FineandH.D.Thompson:*CoordinateGeometry*,theMacmillanCompany,1909.
 [5] GeorgeB.ThomasandRossL.Finney:*CalculusandAnalyticGeometry*,Pearson Education, 2010.
 [6] RobertJ.T.Bell:*AnElementaryTreatiseonCoordinateGeometryofthreedimensions*,
 MacmillanIndiaLtd.,1923.
 [7] P.K.Jain:*ATextbookofAnalyticalGeometry*,NewAgePublication, 2014.

SEMESTER-III

Paper Code	Paper Title	Paper Type	Credit Distribution of the Course			Contact Hour Per Week
			Theory	Practical	Tutorial	
MATIDC201-3	Logic and Graphical Representation of Data	IDC	2	0	1	3

Course Learning Objectives:

The primary objective of this course is to introduce:

- Logical calculus
- Graphical representation of data

Course Learning Outcomes:

This course will enable the students to:

- Understand about logics in mathematics
- Understand to analyze data graphically

Syllabus of the Course:

Unit-1 Logic

Propositions, truth values and truth tables, negation, conjunction and disjunction, implications, bi-conditional propositions, converse, contrapositive and inverse propositions, propositional equivalence: logical equivalences, predicates and quantifiers, tautology and contradiction, Analysis of arguments. Examples and exercises on these topics.

Contact Hours- 15; Marks-17

Unt-2 Graphical Representation of Data

Bar charts with spreadsheets, histograms and pie charts with spreadsheets, line plots, line plots and graphs in spreadsheets, identifying trends from graphs, linear interpolation and line of the best fit, scatter plots in spreadsheets, locating the center, mode, median and mean and their calculations with spreadsheets, percentiles, percentiles in spreadsheets, percent rank, variance and standard deviation.

Contact Hours- 15; Marks-18

Prescribed Textbooks:

- [1] Steve Warner, *Pure Mathematics of Beginners*, Get 800 LLC, 2018. **(For Unit-1)**
 [2] Shobha Bagai, Amber Habib and Geetha Venkataraman, *A Bridge to Mathematics*, Saga Publications India Pvt Ltd. 2017. **(For Unit-2)**

Reference Books:

- [1] David M. Burton, *Elementary Number Theory*, McGraw Hill Education, 2017.

- [2] Ajit Kumar, S. Kumaresen and Bhaba Kumar Sarma, *A Foundation Course in Mathematics*, Narosa Publications, 2018.
- [3] Paul R. Halmos, *Naïve Set Theory*, Springer, 1998.

SEMESTER-III

Paper Code	Paper Title	Paper Type	Credit Distribution of the Course			Contact Hour Per Week
			Theory	Practical	Tutorial	
MATSEC201-3	SciLab	SEC	2	1	0	3

Course Learning Objectives:

The primary objective of this course is to introduce:

- To give working knowledge of Scilab typesetting language.
- To create or import graphics into Scilab.

Course Learning Outcomes:

This course will enable the students to

- Get the basic idea of Scilab and how to install it.
- Learn to write equations, matrix and tables.
- Implement simple mathematical equations in numerical computing environment.
- Draw 2D and 3D graphs and export it.

Syllabus of the Course:

Theory+Practical

Unit-1 Overview of Scilab

Introduction to Scilab and its features, Installing Scilab on different platforms, Different data types in Scilab, Basic arithmetic and logical operators in Scilab, Expressions and their evaluation in Scilab, Variables and arrays, Initialising variables in Scilab, Multidimensional arrays.

Contact Hours-20; Marks-17

Unit-2 Applications of Scilab

Basic plot commands in Scilab, plotting 2D and 3D graphs in Scilab, Formatting and customizing plots, Saving and exporting graphs, Matrices and vectors in Scilab, Numerical integration and differentiation in Scilab

Contact Hours-25; Marks-18

Prescribed Textbooks:

- [1] Sandeep Nagar, *Introduction to Scilab: For Engineers and Scientists*, Apress (2017).

Reference Books:

- [1] Er. Hema Ramachandran, Dr. Achuthsankar S. Nair, *Computer SCILAB-A free software to MATLAB*, S Chand (2011).
- [2] Anil Kumar Verma, *SCILAB: A Beginner's Approach*, Cengage Learning India Pvt. Ltd (2018).

SEMESTER-IV

Paper Code	Paper Title	Paper Type	Credit Distribution of the Course			Contact Hour Per Week
			Theory	Practical	Tutorial	
MATMAJ203-4	Group Theory	Major	3	0	1	4

Course Learning Objectives:

The primary objective of this course is to introduce:

- Groups, Cyclic groups, permutation groups, normal subgroups, Lagrange's Theorem on the order of a finite group
- Homomorphism and isomorphism of groups

Course Learning Outcomes:

This course will enable the students to

- Understand groups and classify them as abelian, cyclic and permutation groups
- Explain the significance of the notion of cosets, normal subgroups and homomorphism of groups.

Syllabus of the Course:

Unit-1 Introduction to Groups

Definition and examples of groups, Elementary properties of groups, Order of a group and order of an element of a group; Subgroups and its examples, Subgroup tests; Center of a group and centralizer of an element of a group, Symmetries of a square and Dihedral groups.

Contact Hour-12; Marks-18

Unit-2 Cyclic Groups and Permutation Groups

Cyclic groups and their properties, Generators of a cyclic group; Classifications of subgroups of cyclic groups; Permutation groups, Cyclic decomposition of permutations and its properties, Even and odd permutations and the alternating group, Klein's group, Order of a permutation.

Contact Hour-11; Marks-17

Unit-3 Cosets, Lagrange's Theorem and Normal Subgroups

Cosets and their properties, Lagrange's theorem and consequences; Stabilizer and orbit of a point, Orbit-Stabilizer Theorem, Definition and examples of normal subgroups, Quotient groups, Cauchy's Theorem for Abelian group.

Contact Hour-11; Marks-18

Unit-4 Isomorphism and Homomorphism of Groups

Group homomorphism, Isomorphism, and their properties, First, Second and Third Theorems of Isomorphism, Cayley's Theorem and application, Automorphisms and Inner automorphisms.

Contact Hour-11; Marks-17

Prescribed Textbooks:

- [1] Gallian, Joseph. A. (2017). Contemporary Abstract Algebra (9th ed.). Cengage Learning India Private Limited, Delhi. Indian Reprint (2021).

Reference Books:

- [1] I.N. Herstein, *Topics in Algebra*, Wiley Eastern Limited, India, 1975.
[2] Dummit, David S. & Foote, Richard M. (2016). Abstract Algebra (3rd ed.). Student Edition. Wiley India.

SEMESTER-IV

Paper Code	Paper Title	Paper Type	Credit Distribution of the Course			Contact Hour Per Week
			Theory	Practical	Tutorial	
MATMAJ204-4	Numerical Methods	Major	3	1	0	4

Course Learning Objectives:

The primary objective of this course is to introduce:

- Various computational techniques to find approximate value for possible root(s) of algebraic and non-algebraic equations.
- Methods to solve system of linear equations and ordinary differential equations.
- The use of computer algebra system (CAS) by which the numerical problems can be solved both numerically and analytically, and to enhance the problem-solving skills.

Course Learning Outcomes:

This course will enable the students to

- Learn some numerical methods to find the zeroes of nonlinear functions of a single variable and solution of a system of linear equations, up to a certain given level of precision.
- Know about methods to solve system of linear equations, such as Gaussian Elimination and Gauss Jordan methods, LU decomposition method, Gauss Jacobi method, Gauss Seidel method.
- Compute the values for a tabulated function at points not in the table using interpolation techniques.
- Know about applications of numerical differentiation and integration to convert differential equations into difference equations for numerical solutions.

Syllabus of the Course:

Theory:

Unit- Methods for Solving Algebraic and Transcendental Equations

Rate and order of convergence; Bisection method, Method of false position, Secant method and Newton's method, Rate of convergence of these methods.

Contact Hour-12; Marks-12

Unit-2 Methods for solving systems of linear equations and interpolation

Gaussian Elimination and Gauss Jordan methods, LU decomposition method, Iterative methods: Gauss Jacobi method, Gauss Seidel method; Errors: Round off, Truncation, Absolute, Relative and Percentage, Lagrange and Newton interpolation: linear and higher order, Finite difference operators.

Contact Hour-15; Marks-18

Unit-3 Numerical Differentiation and Integration

First and higher order approximation for the first derivative, Approximation for the second derivative; Numerical integration by closed Newton-Cotes formulae: Trapezoidal rule, Simpson's rule, Euler's method to solve ODE's, Modified Euler method, Runge-Kutta Method (fourth-order).

Contact Hour-18; Marks-20

Practical:

Practical (30 hours): Practical / Lab work to be performed in a computer Lab.

Use of computer algebra system (CAS) software: Mathematica/MATLAB/Scilab/Python etc., for developing the following Numerical programs:

List of Practicals:

- (i) Bisection Method.

- (ii) Secant Method.
- (iii) Newton-Raphson Method.
- (iv) Gauss Elimination method.
- (v) L U decomposition Method.
- (vi) Gauss-Jacobi Method.
- (vii) Gauss–Seidel method.
- (viii) Lagrange interpolation.
- (ix) Newton interpolation.
- (x) Trapezoidal rule.
- (xi) Simpson's rule.
- (xii) Euler’s method.
- (xiii) Runge–Kutta Method (fourth-order).

Text Books:

- [1] Bradie, Brian. (2006). A Friendly Introduction to Numerical Analysis. Pearson Education India. Dorling Kindersley (India) Pvt. Ltd. Third impression 2011. **(For all Units)**
- [2] M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computation, New age International Publisher, India, 5th edition, 2007. **(Unit-2)**

Reference Books:

- [1] C.F. Gerald and P.O. Wheatley, Applied Numerical Analysis, Pearson Education, India, 2008.
- [2] B.S. Grewal, Numerical Methods in Engineering and Science.

SEMESTER-IV

Paper Code	Paper Title	Paper Type	Credit Distribution of the Course			Contact Hour Per Week
			Theory	Practical	Tutorial	
MATMAJ205-4	Analytical Geometry (2D) and Vector Algebra	Major	3	0	1	4

Course Learning Objectives:

The primary objective of this course is to introduce:

- 2D analytical geometry
- Vector algebra

Course Learning Outcomes:

This course will enable the students to

- This course will enhance the understanding of mathematical concepts with geometrical/graphical interpretations. After studying this course student will be able to visualize mathematical concepts geometrically. Further, the course will enable students to know about the practical applicability of the concept of vectors to explain and analyze physical situations. Students will acquire basic knowledge and background to understand other courses either in mathematics or physics from this course.

Syllabus of the Course:

Unit-1 Transformation of coordinates

Polar coordinates system, transformation of Cartesian coordinates to polar coordinates, transformation of coordinate axes, pair of straight lines.

Contact Hour-6; Marks-8

Unit-2 General second degree equations

Classification of quadratic equation representing lines, parabola, ellipse and hyperbola, tangents and normals to the conics, parametric forms of tangents and normal, condition of tangency, pole and polar, centre of a conic, equation of pair of tangents, reduction to standard forms, central conics, equation of the axes, and length of the axes.

Contact Hour-15; Marks-18

Unit-3 Curve Tracing

Techniques for sketching parabola, ellipse and hyperbola; Reflection properties of parabola, ellipse, hyperbola, and their applications to signals.

Contact Hour-12; Marks-13

Unit-4 Vector equations of line and plane

Dot product; Projections; Cross product, scalar triple product, vector triple product and their geometrical properties; Parametric equations of lines, direction cosines and direction ratios of a line, vector and symmetric equations of lines, angle between two lines; Planes in 3-dimensional space, coplanarity of two lines, angle between two planes, distance of a point from a plane, angle between a line and a plane, distance between parallel planes; Shortest distance between two skew lines.

Contact Hour-15; Marks-18

Unit-5

Application of vectors to Mechanics: Lami's Theorem, Work, Vector moment or Torque, Relative motion.

Contact Hour-12; Marks-13

Prescribed Textbooks:

- [1] J.G.Chakravorty and P.R.Ghosh: *Analytical Geometry and Vector Analysis*, U.N.Dhur & Sons Pvt. Ltd, 1973. (For Units-1 & 2)
- [2] Anton, Howard, Bivens, Irl, & Davis, Stephen (2013). *Calculus* (10th ed.). John Wiley & Sons Singapore Pte. Ltd. Indian reprint (2016) by Wiley India Pvt. Ltd. Delhi. (For Unit-3)
- [3] Spiegel, M. R., Schwam Series. (For Unit-4)
- [4] Richard E. Johnson, *Vector Algebra*, Krishna Prakashan Media (P) Ltd. (For Unit-5)

Reference Books:

- [1] S.L.Loney: *The Elements of Coordinate Geometry*, McMillan and Company, London, 2018.
- [2] Shanti Narayan and P.K.Mittal: *Analytical Solid Geometry*, S.Chand & company, 2007.
- [3] Jyoti Das: *Analytical Geometry*, Academic Publisher, 2011.
- [4] Henry B. Fine and H.D. Thompson: *Coordinate Geometry*, The Macmillan company, 1909.
- [5] George B. Thomas and Ross L. Finney: *Calculus and Analytic Geometry*, Pearson Education, 2010.
- [6] Robert J.T. Bell: *An Elementary Treatise on Coordinate Geometry of three dimensions*, Macmillan India Ltd., 1923.
- [7] P.K.Jain: *A Textbook of Analytical Geometry*, New Age Publication, 2014.
- [8] P.R.Vittal: *Analytical Geometry-2D & 3D*, Pearson Education, 2013.

SEMESTER-IV

Paper Code	Paper	Paper	Credit Distribution of the	Contact
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	Title	Type	Course			Hour Per Week
			Theory	Practical	Tutorial	
MATMIN202-4	Vector Calculus	Minor	3	0	1	4

Course Learning Objectives:

The primary objective of this course is to introduce:

- To have knowledge of different types of vector product.
- To have knowledge of Vector differentiation and about gradient. Divergent and curl

Course Learning Outcomes:

This course will enable the students to

- Understand the scalar and vector triple products.
- Understand the calculus of vector functions and their uses to develop the basic principles of planetary motion.

Syllabus of the Course:

Unit-1 Multiple product

Triple Product, Scalar Triple Product, Geometric Interpretation, Distributive Law for Vector Product, Properties of Scalar triple product, Scalar triple product in terms of three non-coplanar vectors. Vector Triple Product, Scalar product of Four vectors, Vector Product of Four vectors.

Contact Hour-15; Marks-16

Unit-2 Derivative of a vector

Vector function, Limit, continuity and derivative of a vector function, Derivative of higher order, Derivative of sum and products, Derivative of scalar and vector product of two vectors and related theorems. Derivative of scalar and vector product of three vectors.

Contact Hour-15; Marks-18

Unit-3 The ∇ operator

Scalar point functions, scalar fields, Vector point functions, Vector fields, Partial derivatives, Level surfaces, Directional Derivative, normal derivative, The del operator ∇ and ∇^2 , Gradient, Divergence and Curl and corresponding Vector Identities.

Contact Hour-15; Marks-18

Unit- Line Integrals

Line integrals, Applications of line integrals: Mass and Work, Fundamental theorem for line integrals, Conservative vector fields, Green's theorem, Area as a line integral. Definition of surface, Stokes' theorem and the divergence theorem.

Contact Hour-15; Marks-18

Prescribed Textbook:

- [1] A.R. Vasistha, Vector Algebra by Krishna Prakashan Media(P) Ltd. (For Unit-1, ch-3)
- [2] Ghose and Maity, Vector Analysis, New Central Book Agency. (For Unit-2 (ch-5), Unit-3 (Ch-8))
- [3] Strauss, Monty J., Bradley, Gerald L., & Smith, Karl J. (2007). Calculus (3rd ed.). (For Unit-4 (Ch-13))

Reference Books:

- [1] Shanti Narayan and J.N. Kapoor, Vector Calculus Shanti Narayan and J.N. Kapoor
- [2] Spiegel, Vector Calculus (Schaum's series)
- [3] H.K. Das, Mathematical Physics, S. Chand & Company Ltd.