ASSAM UNIVERSITY, SILCHAR

Department of Mathematics

Four Year Undergraduate Programme

Implemented under NEP 2020
Effective from the Academic Year 2023-24

Syllabus of MATHEMATICS

Approved in the ____th meeting of the Academic Council on _____vide Resolution No. _____

Programme Specific Outcome

Bachelor in MATHEMATICS with Honours/Honours and Research

Programme Specific Outcomes:

1. This program fosters critical thinking and scientific temper among the students.
2. It enables the students to appreciate mathematical logic and ideas and to write mathematical statements correctly with quantifiers.
3. This program provides a curriculum that trains the students to ask more questions.
4. It enriches the knowledge base and provides a strong foundation for higher studies.
5. It makes the students employable in academia and industry sectors.
6. It motivates the students towards research.
7. This program helps the students to model the real-life problems and to go for solving them with the help of various mathematical tools.

Table 1: Semester-wise list of Mathematics DSC(Discipline Specific Core) Courses

Semester	Course Code	Title of Courses	Credits
I	**MATDSC101**	Higher Algebra and Trigonometry	3
	MATDSC102	Differential Calculus	3
II	**MATDSC151**	Analytical Geometry	3
	MATDSC152	Integral Calculus and Vectors	3
III	**MATDSC201**	Real Analysis – I	4
	MATDSC202	Ordinary Differential Equations	4
IV	**MATDSC251**	Abstract Algebra – I	4
	MATDSC252	Mechanics – I	4
	MATDSC253	Linear Algebra	4
V	**MATDSC301**	Partial Differential Equations	4
	MATDSC302	Topology	4
	MATDSC303	Real Analysis – II	4
VI	**MATDSC351**	Complex Analysis	4
	MATDSC352	Hydrodynamics	4
	MATDSC353	Multivariate Calculus	4
	MATDSC354	Linear Programming	4
VII	**MATDSC401 (any one)**	Abstract Algebra – II	4
		Probability and Statistics	
	MATDSC402 (any one)	Mechanics – II	4
		Advanced Analysis	
	MATDSC403 (any one)	Number Theory and Combinatorics	4
		Integral Equations and Calculus of Variations	
	MATDSC404 (any one)	Optimization Techniques	4
		Advanced Numerical Methods	
VIII	**FOR HONOURS DEGREE WITH RESEARCH**		
	MATDSC451	Research Methodology	4
	MATDSC452	Research Project/Dissertation	12
	FOR HONOURS DEGREE		
	MATDSC451	Special Functions	4
	MATDSC452	Graph Theory	4
	MATDSC453 (any one)	Advanced Topology and Functional Analysis	4
		Advanced Differential Equations	
	MATDSC454 (any one)	Mathematical Modelling	4
		Discrete Mathematics	

Table 2: Semester-wise list of Mathematics DSM (Discipline Specific Minor) Courses

Semester	DSM1/DSM2	Course Code	Title of Courses	Credits
I	**DSM1**	**MATDSM101**	Calculus	3
II	**DSM2**	**MATDSM151**	Calculus	3
III	**DSM1**	**MATDSM201**	Classical Algebra and Trigonometry	4
IV	**DSM1**	**MATDSM251**	Differential Equations	3
	DSM2	**MATDSM252**	Differential Equations	3
V	**DSM1**	**MATDSM301**	Geometry and Vectors	3
	DSM2	**MATDSM302**	Geometry and Vectors	3
VI	**DSM2**	**MATDSM351**	Classical Algebra and Trigonometry	4
VII	**DSM1**	**MATDSM401**	Linear Programming	4
VIII	**DSM2**	**MATDSM451**	Linear Programming	4

Table 3: Semester-wise list of Mathematics SEC (Skill Enhancement Course) Courses

Semester	Course Code	Title of Courses	Credits
I	**MATSEC101**	Mathematical Skill Development with Software (Theory with Practical)	3
II	**MATSEC151**	Mathematical Programming in C (Theory with Practical)	3
III	**MATSEC201**	Numerical Methods (Theory with Practical)	3

Table 4: Semester-wise list of IDC Courses

Semester	Course Code	Title of Courses	Credits
I	**MATIDC101**	Foundation Course in Mathematics	3
II	**MATIDC151**	Geometry	3
III	**MATIDC201**	Basic Calculus	3

Syllabi of Mathematics DSC Courses

Semester*	**: I**
Course Type	**:** DSC
Course Code**	**:** MATDSC101
Name of the Course	**:** Higher Algebra and Trigonometry
Learning level***	**:** 150
Credits	**:** 3
Contact Hours	**:** 50
Total Marks	**:** 100
End Semester Marks	**:** 70
Internal Marks	**:** 30

Course Objective

The main objective of this course is to provide a comprehensive understanding of trigonometry, formal logic, polynomial equations, inequalities, and systems of linear equations. This will enable the learners to gain the necessary skills and knowledge to apply mathematical concepts in a variety of real-world contexts.

Unit – I

Polar representation of complex numbers. De Moivre's theorem for rational indices and related problems. Expansions of $\sin n\theta$, $\cos n\theta$, $\sin\theta$, $\cos\theta$. Expansions for $\sin^n\theta$, $\cos^n\theta$ for even and odd n.

Unit – II

Exponential and logarithmic functions of complex arguments, Gregory's series, hyperbolic functions, summation of trigonometric series.

Unit – III

Relations: Reflexive, symmetric, transitive, and equivalence. Equivalence classes and partitions. Introduction to Logic: propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions. Converse, contra positive and inverse propositions and precedence of logical operators. Quantifiers: Universal and Existential quantifiers.

Unit – IV

Relation between roots and coefficients of a polynomial equations of n^{th} degree, symmetric functions of roots. Transformation of equations, reciprocal and binomial equations. Cardan's method of solution of cubic equations. Descartes' rule of signs. Inequalities involving arithmetic and geometric means, Cauchy-Schwarz's inequality, Minkowski inequality.

Unit – V

Elementary transformation of matrices, echelon and canonical forms, rank of a matrix, linear dependence and independence of n-tuples; Inverse of a matrix by elementary operations. Systems of linear equations and their solutions by Gaussian elimination method.

Textbooks:

1. B.C. Das and B.N. Mukherjee, Higher Trigonometry, 34th ed., U.N. Dhur and Sons, 1933 **(Unit-I, II)**
2. A. Kumar, S. Kumaresan, and B.K. Sarma, A Foundation Course in Mathematics, 1st ed., Narosa Publishing House, 2018 **(Unit-III)**
3. J.G. Chakraborty and P.R. Ghosh, Higher Algebra: Classical and Modern, 23rd ed., U.N. Dhur and Sons, 1972 **(Unit-IV)**
4. S. Lipschutz and M. Lipson, Schaum's Outlines: Linear Algebra, 3rd ed., McGraw Hill Education, 2017 **(Unit-V)**

Reference books:

1. S.K. Mapa, Higher Algebra: Classical, 9th ed., Sarat Book House, 2021.
2. D.C. Lay, Linear Algebra and its Applications, 3rd ed., Pearson Education India, 2002.

Course Learning Outcome

After completion of the course, learners will be able to

1. Demonstrate understanding of complex numbers in polar form and apply De Moivre's theorem effectively.
2. Analyse and solve problems involving exponential and logarithmic functions with complex arguments and series expansions.
3. Apply formal logic principles to construct logical statements and understand the relationship between roots and coefficients of polynomial equations.
4. Solve polynomial equations and inequalities involving means using appropriate techniques.
5. Solve systems of linear equations using Gaussian elimination and understand concepts related to matrices, rank, and linear dependence/independence.

Semester*	**: I**
Course Type	**:** DSC
Course Code**	**:** MATDSC102
Name of the Course	**:** Differential Calculus
Learning level***	**:** 150
Credits	**:** 3
Contact Hours	**:** 50
Total Marks	**:** 100
End Semester Marks	**:** 70
Internal Marks	**:** 30

Course Objective

The main objective of this course is to provide the learners with a detailed understanding of differential calculus and its applications.

Unit – I

Limit of a function, Fundamental theorems on limits, Some important limits, Cauchy's criterion, Problems on limits. Continuity of a function, Different classes of discontinuity, Properties of continuous functions, related problems. Differentiability of a function, Fundamental theorems on differentiation, problems involving derivatives of a function of a function, inverse circular functions, hyperbolic functions, logarithmic differentiation, implicit functions and parametric equations.

Unit – II

Significance of derivative and its sign, geometrical interpretation, derivative as a rate measurer and related problems. Successive Differentiation, nth derivatives of some special functions, nth derivatives of rational algebraic functions, related problems. Leibnitz's theorem and related problems. Indeterminate forms, L'Hospital's theorem, and related problems.

Unit – III

Rolle's theorem, Lagrange's Mean Value Theorem, Geometrical interpretation and related problems. Generalized mean value theorem (Taylor's series in finite form), Lagrange's form of remainder, Cauchy's form of remainder, Expansion of functions in infinite power series - Taylor's series and Maclaurin's series. Increasing and decreasing functions, Maxima and minima for functions of single variable and related problems.

Unit – IV

Tangents and normals - equation of tangent, tangent at the origin, equation of normal, angle of intersection of curves, related problems. Cartesian subtangent and subnormal, derivative of arc-length (cartesian form), angle between radius vector and tangent, derivative of arc-length (polar form), polar subtangent and subnormal. Radius of curvature of cartesian and polar curves.

Unit – V

Partial derivatives, related problems, homogeneous functions, Euler's theorem on homogeneous functions. Asymptotes, Concavity, Points of inflection, Tracing graphs of polynomial and rational functions.

Textbooks:

1. B.C. Das and B.N. Mukherjee, Differential Calculus, 55th ed., U.N. Dhur and Sons, 1949.
   [Unit – I to Unit – V (up to Euler's theorem)]
2. H. Anton, I. Bivens and S. Davis, Calculus, 10th ed., John Wiley & Sons, 2015.
   [Unit-V (Asymptotes, concavity, tracing of graphs)]

Reference books:

1. G.B. Thomas and R.L. Finney, Calculus and Analytical Geometry, 9th ed., Pearson Education India, 2010
2. Shanti Narayan and P.K. Mittal, Differential Calculus, 15th ed., S. Chand, 1942

Course Learning Outcome

After completion of this course, the learners should be able to understand limits, continuity and differentiability and apply these to solve real life problems. The learners should also be able to grasp the concepts of tangents, normals, subtangents, subnormals and solve related problems. This course will also provide an overview of partial derivatives which will be helpful in further courses of study.

Semester*	**: II**
Course Type	**:** DSC
Course Code**	**:** MATDSC151
Name of the Course	**:** Analytical Geometry
Learning level***	**:** 199
Credits	**:** 3
Contact Hours	**:** 50
Total Marks	**:** 100
End Semester Marks	**:** 70
Internal Marks	**:** 30

Course Objective

The main objective of this course is to introduce orthogonal transformation, pair of straight lines, some basic idea of circles, parabola, hyperbola, ellipse, determination of pole and polar *w.r.t.* to them. This course further explains the shortest distance and its equation, definition of sphere, great circle and related problems. It also describes cone and cylinder under various conditions.

Unit – I

Change of origin, invariants in orthogonal transformation, pair of straight lines, bisector of angles between pair of straight lines.

Unit – II

Orthogonal circles, radial axis, radical centre of three circles, circles through intersection of two circles, circles through intersection of a circle and a straight line, condition of tangency of a straight line to a circle, parabola, ellipse and hyperbola.

Unit – III

Definition, equation of polar of a point with respect to a circle, parabola, ellipse and hyperbola, determination of the pole of a straight line with respect to a circle, parabola, ellipse and hyperbola, polar equation of a conic in the form $\frac{1}{r} = 1 + e\cos\theta$, equation of chord and tangent, related problems.

Unit – IV

Shortest distance and equation of shortest distance line, general equation of a sphere, sphere through origin and having intercepts on the axes, section of a sphere by a plane, great circle, sphere through a given circle, the curve of intersection of two spheres, tangent plane to a sphere at a given point on it, condition of tangency of a given plane to be a tangent plane to a sphere.

Unit – V

Cone with vertex at a given point and a given curve as base, equation of a right circular cone with vertex is at a point other than origin, cylinder, equation of a cylinder, equation of a right circular cylinder, related examples.

Textbook:

1. J.G. Chakraborty and P.R. Ghosh, Advanced Analytical Geometry, 14th ed., U.N. Dhur and sons, 1987.

Reference books:

1. S.L. Loney, The Elements of Coordinate Geometry, 17th ed., Arihant Publication (India), 2023.
2. B. Das, Analytical Geometry with Vector Analysis, 1st rev. ed., Orient Book Company, 2018.

Course Learning Outcome

After completion of the course, learners will be able to

1. Know about transformation of co-ordinate axes, pair of straight lines, angle between pair of straight lines, orthogonal circles, radical axis, parabola, hyperbola and ellipse.
2. Know about how to determinate the pole and polar *w.r.t.* circle, parabola, hyperbola, ellipse and polar form of conics.
3. Know about spheres, formula to find shortest distance and great circles, etc.
4. Know about definition of cone, right circular cone, cylinder, right circular cylinder and its related problems.

Semester*	**: II**
Course Type	**:** DSC
Course Code**	**:** MATDSC152
Name of the Course	**:** Integral Calculus and Vectors
Learning level***	**:** 199
Credits	**:** 3
Contact Hours	**:** 50
Total Marks	**:** 100
End Semester Marks	**:** 70
Internal Marks	**:** 30

Course Objective

The aim of this course is to introduce integral calculus and vectors to study indefinite, definite integrals and the properties of definite integrals, reduction formulae, rectification of plane curves, areas of surfaces of revolution and volumes of solids of revolution. This course further explores the scalar and vector triple products, vector equations, vector functions, etc.

Unit – I

Integration of rational functions, definite integral as the limit of a sum. Definite integrals and their properties.

Unit – II

Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin^n x\,dx$, $\int \cos^n x\,dx$, $\int \tan^n x\,dx$, $\int \sec^n x\,dx$, $\int (\log x)^n\,dx$, $\int \sin^m x \cos^n x\,dx$, $\int \sin^m x \cos nx\,dx$.

Unit-III

Cartesian and parametric equations of plane curves, rectification of plane curves, areas of surfaces of revolution and volumes of solids of revolution.

Unit – IV

Scalar and vector triple products, related problems. Vector equations of lines, planes and spheres.

Unit – V

Vector functions, limit, continuity and differentiation of vector functions, and related problems, gradient, divergence and curl, their identities and related problems.

Textbooks:

1. B.C. Das and B.N. Mukherjee, Integral Calculus with Differential Equations, 57th ed., U.N. Dhur and Sons, 1938 **(Unit-I-III)**
2. M.R. Spiegel, Schaum's Outlines: Vector Analysis, 2nd ed., McGraw Hill Education, 2017 **(Unit-IV, V)**

Reference Books:

1. G.B. Thomas and R.L. Finney, Calculus and Analytical Geometry, 9th ed., Pearson Education India, 2010.
2. Shanti Narayan and P.K. Mittal, Integral Calculus, 35th ed., S. Chand, 2005.
3. Shanti Narayan and P.K. Mittal, A Textbook of Vector Analysis, S. Chand, 2020.

Course Learning Outcome

After completion of the course, learners will be able to

1. Solve problems of definite and indefinite Integrations and learn properties of definite integrals.
2. Prove reduction formulae and solved some problems by using these formulae.
3. Explain the importance of integrations and its techniques to solve real life problems.
4. Understand vector calculus and related problems.

Syllabi of Mathematics DSM Courses

Semester* **: I**
Course Type **:** DSM
Course Code** **:** MATDSM101
Name of the Course **:** Calculus
Learning level*** **:** 100
Credits **:** 3
Contact Hours **:** 50
Total Marks **:** 100
End Semester Marks **:** 70
Internal Marks **:** 30

Course Objective

The main objective of this course is

1. To introduce the concept of limits, continuity, differentiability of functions and their various applications.
2. To learn the techniques of L'Hospital rule for evaluation of limit.
3. To explain the concept of definite integral and various types of reduction formula for integration of trigonometric function.
4. To explain the applications in finding the area and rectification of plane curves; the volume and surface area of revolution of curve.

Unit – I

Limit (ε - δ definition), Cauchy's criterion for existence of limit (without proof), problems on limits. Continuity (ε - δ definition), related theorems and problems, types of discontinuities. Differentiability of a function, problems on differentiability, relation between continuity and differentiability. Successive differentiation, Leibnitz's theorem and its application.

Unit –II

Rolle's theorems, Lagrange's mean value theorem, Cauchy's mean value theorem. Statement and applications of Taylor's and Maclaurin's theorems, Taylor's and Maclaurin's series, expansions of functions $\sin x$, $\cos x$, e^x, $(1+x)$ (assuming $R_n \to 0$ as $n \to \infty$). Maxima and minima for functions of one variable, necessary and sufficient condition for maxima and minima. Indeterminate forms: $\frac{0}{0}$, $\frac{\infty}{\infty}$, $0 \times \infty$, $\infty - \infty$, 0^0, 1^∞, ∞^0.

Unit –III

Partial differentiation. Euler's theorem on homogeneous functions (two variable). Tangents, normals: Equations and properties of tangents and normals, subtangents and subnormals of cartesian and polar curves.

Unit – IV

Definition and properties of definite integrals, Fundamental theorem (without proof), Reduction formulae of the type $\int sin^n x dx$, $\int cos^n x dx$, $\int tan^n x dx$, $\int sec^n x dx$, $\int (logx)^n dx$, $\int sin^m x cos^n x dx$, $\int sin^m x cosnx dx$.

Unit – V

Area bounded by plane curves (cartesian and polar), rectification of plane curves (cartesian and polar), volumes and surface of solid of revolution about axes: Cartesian curves.

Textbooks:

1. B.C. Das and B.N. Mukherjee, Differential Calculus, 55th ed., U.N. Dhur and Sons, 1949. [Unit – I to Unit – III]
2. B.C. Das and B.N. Mukherjee, Integral Calculus with Differential Equations, 57th ed., U.N. Dhur and Sons, 1938. [Unit – IV to Unit – V]

Reference books:

1. S.C. Malik and S. Arora, Mathematical Analysis, 4th ed., New Age International, 2010.
2. R.K. Ghosh and S.K. Maity, An Introduction to Analysis: Differential Calculus,13th ed., New Central Book Agency, 2011.
3. R.K. Ghosh and S.K. Maity, An Introduction to Analysis: Integral Calculus, 12th ed. New Central Book Agency, 2013.
4. Shanti Narayan and P.K. Mittal, Differential Calculus, 15th ed., S. Chand, 1942.
5. Shanti Narayan and P.K. Mittal, Integral Calculus,35th ed., S. Chand, 2005.

Course Learning Outcome

After completion of this course, the learners will be able to

1. Solve the problems of limits, continuity, derivative and integration.
2. Apply Calculus in real life problems.

Semester*	**: II**
Course Type	**:** DSM
Course Code**	**:** MATDSM151
Name of the Course	**:** Calculus
Learning level***	**:** 100
Credits	**:** 3
Contact Hours	**:** 50
Total Marks	**:** 100
End Semester Marks	**:** 70
Internal Marks	**:** 30

Course Objective

The main objective of this course is

1. To introduce the concept of limits, continuity, differentiability of functions and their various applications.
2. To learn the techniques of L'Hospital rule for evaluation of limit.
3. To explain the concept of definite integral and various types of reduction formula for integration of trigonometric function.
4. To explain the applications in finding the area and rectification of plane curves; the volume and surface area of revolution of curve.

Unit – I

Limit (ε - δ definition), Cauchy's criterion for existence of limit (without proof), problems on limits. Continuity (ε - δ definition), related theorems and problems, types of discontinuities. Differentiability of a function, problems on differentiability, relation between continuity and differentiability. Successive differentiation, Leibnitz's theorem and its application.

Unit –II

Rolle's theorems, Lagrange's mean value theorem, Cauchy's mean value theorem. Statement and applications of Taylor's and Maclaurin's theorems, Taylor's and Maclaurin's series, expansions of functions $\sin x$, $\cos x$, e^x, $(1+x)$ (assuming$R_n \to 0$ as $n \to \infty$). Maxima and minima for functions of one variable, necessary and sufficient condition for maxima and minima. Indeterminate forms:$\frac{0}{0}$, $\frac{\infty}{\infty}$, $0 \times \infty$, $\infty - \infty$, 0^0, 1^∞, ∞^0.

Unit –III

Partial differentiation. Euler's theorem on homogeneous functions (two variable). Tangents, normals: Equations and properties of tangents and normals, subtangents and subnormals of cartesian and polar curves.

Unit – IV

Definition and properties of definite integrals, Fundamental theorem (without proof), Reduction formulae of the type $\int sin^n xdx$, $\int cos^n xdx$, $\int tan^n xdx$, $\int sec^n xdx$, $\int (logx)^n dx$, $\int sin^m xcos^n xdx$, $\int sin^m xcosnxdx$.

Unit – V

Area bounded by plane curves (cartesian and polar), rectification of plane curves (cartesian and polar), volumes and surface of solid of revolution about axes: Cartesian curves.

Textbooks:

1. B.C. Das and B.N. Mukherjee, Differential Calculus, 55th ed., U.N. Dhur and Sons, 1949.
   [Unit – I to Unit – III]
2. B.C. Das and B.N. Mukherjee, Integral Calculus with Differential Equations, 57th ed., U.N. Dhur and Sons, 1938.
   [Unit – IV to Unit – V]

Reference books:

1. S.C. Malik and S. Arora, Mathematical Analysis, 4th ed., New Age International, 2010.
2. R.K. Ghosh and S.K. Maity, An Introduction to Analysis: Differential Calculus,13th ed., New Central Book Agency, 2011.
3. R.K. Ghosh and S.K. Maity, An Introduction to Analysis: Integral Calculus, 12th ed. New Central Book Agency, 2013.
4. Shanti Narayan and P.K. Mittal, Differential Calculus, 15th ed., S. Chand, 1942.
5. Shanti Narayan and P.K. Mittal, Integral Calculus,35th ed., S. Chand, 2005.

Course Learning Outcome

After completion of this course, the learners will be able to

1. Solve the problems of limits, continuity, derivative and integration.
2. Apply Calculus in real life problems.

Syllabi of Mathematics SEC Courses

Semester* **: I**
Course Type **:** SEC
Course Code** **:** MATDSEC101
Name of the Course **:** Mathematical Skill Development with Software (Theory with Practical)
Learning level*** **:** 100
Credits **:** 3
Contact Hours **:** 50
Total Marks **:** 100
End Semester Marks **:** 80 (Theory: 50, Practical: 30)
Internal Marks **:** 20

Course Objective

The main objective of this course is

1. To enhance and strengthen one's understanding and proficiency in various mathematical concepts and techniques.
2. To plot the graphs of various functions and analyse them.
3. To enhance learners problem-solving skills by applying mathematical principles in a visual and intuitive manner using software applications.

THEORY

Unit – I

Introduction to problem solving with computer programming. Introduction to algorithms, flowcharts, symbols used in flowcharts. Algorithms and flowcharts for decision making - use of if-then, if-then-else, nested if-then-else. Algorithms and flowcharts for problems involving iterations and looping - use of repeat-while. Algorithms and flowcharts involving arrays. Common exercises involving each of the above from the textbook.

Unit – II

Relations, functions, types of functions: exponential, logarithm, trigonometric, polynomial, periodic, greatest integer, injective, surjective, bijective, even and odd. Operation of functions: addition, subtraction, multiplication, division and composition.

Unit– III

Well-ordering property of positive integers, Division algorithm, Divisibility of integers, Euclidean algorithm, Greatest Common Divisor (GCD), Prime number, Fundamental Theorem of Arithmetic, Congruence relation between integers, properties of congruences.

Unit– IV

Idempotent, nilpotent, involutory matrices, transpose of a matrix, conjugate of a matrix, symmetric, skew symmetric, Hermitian, skew Hermitian, orthogonal, unitary matrices, adjoint of a square matrix, Jacobi's theorem, inverse of a square matrix.

Unit– V

Introduction of differential equation, basic concepts, general and particular solutions of a differential equation, formation of a differential equation whose general solutions are given. Methods of solving differential equations: variable separable, homogeneous differential equation, linear differential equation.

Textbooks:

1. A.B. Chaudhuri, Flowchart and Algorithm Basics: The Art of Programming, 1st ed., Mercury Learning and Information, 2020. [Unit – I]
2. J.G. Chakraborty and P.R. Ghosh, Higher Algebra: Classical and Modern, 23rd ed., U.N. Dhur and Sons, 1972. [Unit – II to Unit – IV]
3. D.M. Burton, Elementary Number Theory, 7th ed., McGraw Hill Education, 2017. [Unit – III]
4. M.D. Raisinghania, Ordinary and Partial Differential Equations, 20th ed., S. Chand, 2020. [Unit – V]

Reference books:

1. S.K. Mapa, Higher Algebra: Classical, 9th ed., Sarat Book House, 2021.
2. S.B. Malik, Basic Number Theory, 2nd ed., Vikas Publishing House, 2018.
3. S.L. Ross, Differential Equations, 3rd ed., Wiley, 2007.
4. S. Lipschutz and M. Lipson, Schaum's Outlines: Linear Algebra, 3rd ed., McGraw Hill Education, 2017.

PRACTICAL

(*Using any software*)

1. Input the values of variables and display them, demonstrate use of if, if-else, nested if statements, demonstrate use of loops, demonstrate the use of arrays
2. Plotting of graphs of various functions
3. Check, obtain, list the prime numbers and check divisibility, obtain divisor, remainder and GCD of two numbers
4. Different operations of matrices (Like addition, multiplication, transpose, inverse, etc.)
5. Solving ordinary differential equation through software and plotting the solution of the family of differential equation

Course Learning Outcome

After completing the course, learners will

1. Build a solid understanding of the core principles that underpin various branches of mathematics, laying the groundwork for their application in science and technology fields.
2. Gain proficiency in utilising mathematical software to solve a wide range of mathematical problems.

Semester*	**: II**
Course Type	**:** SEC
Course Code**	**:** MATDSEC151
Name of the Course	**:** Mathematical Programming in C (*Theory with Practical*)
Learning level***	**:** 150
Credits	**:** 3
Contact Hours	**:** 50
Total Marks	**:** 100
End Semester Marks	**:** 80 (Theory: 50, Practical: 30)
Internal Marks	**:** 20

Course Objective

The main objective of this course is to introduce the fundamentals of the C programming language and its application in mathematical programming and to develop problem-solving skills by implementing mathematical algorithms.

THEORY

Unit – I

Introduction to C language, C characters, constants and variables. Arithmetic expression and statement. Input-output statements, assignment statement, `printf` and `scanf` statements, declaration statement.

Unit – II

Simple computer programs. Logical expression and statements, logical and relational operators.

Unit – III

Decision control structures and loops: `if` statement, `if-else` statement, `for` loop, `while` loop, `do-while` loop, `switch` statement, `break` statement, `continue` statement, `go to` statement.

Unit – IV

Functions: Defining a function, function prototypes, passing arguments to a function.

Unit – V

Return statement, arrays, defining one and multi-dimensional arrays.

Textbook:

1. E. Balagurusamy, Programming in ANSI C, 8th ed., McGraw Hill Education (India), 2019.

Reference books:

1. T. Jeyapoovan, A First Course in Programming with C, 1st ed., Vikas Publishing House, 2004.
2. Y. Kanetkar, Let Us C, 15th ed., BPB Publications, 2016.
3. B.W. Kernighan, D.M. Ritchie, The C Programming Language, 2nd ed., Pearson Education India, 2015.

PRACTICAL

1. Write a program to find the area of a
    a. circle
    b. rectangle
    c. triangle
2. Write a program to determine whether a given year is a leap year or not
3. Write a program to check whether a given character is a vowel or a consonant
4. Write a program to check whether a given positive integer is prime
5. Write a program to find the factorial of a positive integer using a
    a. loop
    b. recursive function
6. Write a program to find the sum of the following series for a given positive integer N:
$$1! + 2! + \cdots + N!$$
7. Write a program to find the biggest element in an array of integers
8. Write a program to sort a given array of integers in
    a. ascending order
    b. descending order
9. Write a program to find
    a. the sum of two matrices
    b. the product of two matrices
10. Write a program to find the determinant of a
    a. 2×2 matrix
    b. 3×3 matrix
11. Write a program to find the inverse of a
    a. 2×2 matrix
    b. 3×3 matrix

Course Learning Outcome

On successful completion of the course, learners will be able to

1. demonstrate a comprehensive understanding of the syntax, variables, and data types used in the C programming language,
2. apply C programming concepts effectively to solve mathematical problems, including calculating areas, determining leap years, and checking for prime numbers,
3. develop efficient C programs to compute factorials, sum of series, and manipulate arrays for mathematical computation,
4. utilise decision control structures (`if-else`, `switch`) and loops (`for`, `while`, `do-while`) proficiently in mathematical programming scenarios,
5. design and implement modular programs by defining functions, passing arguments, and using return statements to solve mathematical problems.

Syllabi of Mathematics IDC Courses

Semester* **: I**
Course Type **:** IDC
Course Code** **:** MATIDC101
Name of the Course **:** Foundation Course in Mathematics
Learning level*** **:** 100
Credits **:** 3
Contact Hours **:** 50
Total Marks **:** 100
End Semester Marks **:** 70
Internal Marks **:** 30

Course Objective

The main objective of this course is to enable the learners review basic mathematical concepts that are helpful for various competitive examinations.

Unit – I

Place value, face value of digits in decimal number system. Natural numbers, integers, rational numbers. Divisibility of integers. Problems on LCM, GCD, fractions, ratio & proportion, percentage, profit and loss, simple and compound interest.

Unit – II

Unitary method, problems on time and work, speed and distance. Surds, Laws of exponents. Elementary set theory, union, intersection, difference, cartesian product of sets, subsets, number of elements of sets.

Unit – III

Simultaneous Linear equations in two variables and related problems. Quadratic equations and related problems. Arithmetic Progression, Geometric Progression.

Unit – IV

Permutation and Combination, Binomial Theorem for positive integer indices. Introduction to Probability, simple problems.

Unit – V

Matrices: order, transpose, sum, difference, scalar multiple, product, inverse. Symmetric and skew-symmetric matrices. Determinant of a square matrix, problems on evaluating determinants. Elementary row and column operations on matrices. Use of matrices and determinants to solve system of linear equations.

Textbooks:

1. J.C. Chakravarti, Arithmetic for the use of schools and colleges, 16th ed., Sanyal and Co., 1920.
2. J.G. Chakraborty and P.R. Ghosh, Higher Algebra: Classical and Modern, 23rd ed., U.N. Dhur and Sons, 1972.

Reference books:

1. V. Krishnamurthy, C.R. Pranesachar, K.N. Ranganathan, and B.J. Venkatachala, Challenge and thrill of Pre-College mathematics, 4th ed., New Age International, 2022.
2. V.K. Sinha, Introduction to Matrix Theory, 1st ed., Narosa Publishing House, 2014.

Course Learning Outcome

After completion of the course, learners will be able to

1. Understand and apply concepts of numbers, fractions, ratios, percentages, and basic financial calculations.
2. Solve problems related to time, work, speed, distance, exponents, surds, sets, and equations.
3. Apply principles of permutation, combination, binomial theorem, and introductory probability.
4. Demonstrate proficiency in working with matrices, including operations, determinants, and solving linear equations.
5. Apply mathematical concepts to real-life scenarios, develop critical thinking and problem-solving skills, and communicate mathematical ideas effectively.

Semester*	**: II**
Course Type	**:** IDC
Course Code**	**:** MATIDC151
Name of the Course	**:** Geometry
Learning level***	**:** 100
Credits	**:** 3
Contact Hours	**:** 50
Total Marks	**:** 100
End Semester Marks	**:** 70
Internal Marks	**:** 30

Course Objective

The main objective of this course is to introduce coordinate geometry concepts, including distance between points, section formula, and conversion between Cartesian and polar coordinates and to gain proficiency in working with equations of straight lines, conic sections, etc.

Unit – I

Coordinates, distance between two points, section formula, area of a triangle and quadrilateral with given coordinates of vertices, polar coordinates, change of cartesian to polar coordinates.

Unit – II

Straight lines, various forms of equation of a straight line, angles between two straight lines, conditions for parallel and perpendicular lines, lengths of perpendiculars, intersection of two straight lines.

Unit – III

Pair of straight lines, conditions parallel and perpendicular lines, bisector of angles between pair of straight lines, general equation of 2nd degree. Homogeneous equation of 2nd degree.

Unit – IV

Circles, various forms of equation of a circle, condition that the general equation of 2nd degree may represent a circle, tangent and normal to a circle.

Unit – V

Conic sections, parabola, hyperbola, ellipse, their equations in various forms.

Textbook:

1. S.L. Loney, The Elements of Coordinate Geometry, 17th ed., Arihant Publication (India), 2023.

Reference book:

1. J.G. Chakraborty and P.R. Ghosh, Advanced Analytical Geometry, 14th ed., U.N. Dhur and sons, 1987.

Course Learning Outcome

After completion of the course, learners will be able to

1. Apply coordinate geometry to solve real-world problems, such as distance calculations and area determinations.
2. Solve geometric problems involving straight lines, including determining angles, intersections, and perpendiculars.
3. Demonstrate understanding of conic sections and their equations, and solve problems involving parabolas, hyperbolas, and ellipses.