Semester*   : I
Course Type   : SEC
Course Code**   : MAT-SEC-101
Name of the Course   : Mathematical Skill Development with Software
Learning level***   : 200
Credits   : 3
Contact Hours   : 45
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.
2. J.G. Chakraborty and P.R. Ghosh, Higher Algebra: Classical and Modern, 23rd ed., U.N. Dhur and Sons, 1972.
3. D.M. Burton, Elementary Number Theory, 7th ed., McGraw Hill Education, 2017.
4. M.D. Raisinghania, Ordinary and Partial Differential Equations, S.Chand, 2020.

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.