



THE MADURA COLLEGE

An Autonomous Institution affiliated to Madurai Kamaraj University

Re-accredited (3rd cycle) with 'A' grade by NAAC

Vidya Nagar, T.P.K. Road, Madurai – 625 011

DEPARTMENT OF MATHEMATICS

Course Outcomes mapped with POs

PROGRAMME : M.Sc. (Mathematics)

| Course Code | Course Title | CLO | Mapping of CO with PO | | | | | | |
|-------------|------------------|---|-----------------------|-----|-----|-----|-----|-----|-----|
| | | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| 21P1MMC1 | REAL ANALYSIS-I | Remembering the basic concepts of real field and basic topology | 2 | 3 | 2 | 1 | 3 | - | - |
| | | Understand the idea of numerical sequence & series | 2 | 3 | 2 | 1 | 3 | - | - |
| | | Understand the concept of limit and continuity with various conditions | 2 | 3 | 2 | 1 | 3 | - | - |
| | | Identifying the concept of derivatives and its properties | 2 | 3 | 2 | 1 | 3 | - | - |
| | | Analyzing the concept of convergence with various conditions | 2 | 3 | 2 | 1 | 3 | - | - |
| 21P1MMC2 | ABSTRACT ALGEBRA | Recall the concepts of counting principle, Normalizer group and understand the parts of Sylow's theorems. | 3 | 2 | 2 | 2 | 1 | - | - |
| | | Understand the different kinds of ideas about finite abelian groups and theorems about polynomial rings | 3 | 2 | 2 | - | 1 | - | - |
| | | Examine splitting field in rational fields, extension fields, splitting fields and understand about Eisenstein criterion | 3 | 2 | 3 | - | 2 | - | - |
| | | Use the concept of Galois theory and able to apply it in several extension fields. | 3 | 2 | - | - | 2 | - | - |
| | | Examine whether the polynomial is solvable in radicals and learn about Wedderburn theorem. | 3 | - | - | 2 | 3 | - | - |
| 21P1MMC3 | TOPOLOGY | Verify whether or not a given set together with a collection of its subsets a topological space, to construct the topologies generated by bases and sub-bases, to determine | - | - | 2 | 1 | 3 | - | - |

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| | | the closure and interior of a set, to find the product of two topological spaces, identify continuous functions | | | | | | | |
| | | Compare the box and the product topologies, to recognize metrizable spaces, to identify connected topological spaces, to construct 100% connected spaces out of given ones, to find out connected subspaces of the real line. | - | 1 | 2 | 2 | 3 | - | - |
| | | Determine the compactness of a topological space, to find out compact subspaces of the real line | - | 1 | 2 | 2 | 3 | 2 | - |
| | | Recognize various types of topological spaces such as first & second countable, Lindeloff, Hausdorff based on the countability and separation axioms | - | 2 | 3 | 2 | 3 | 2 | - |
| | | Prove certain named theorems on separation and compactness | - | 2 | 3 | 2 | 3 | 2 | - |
| 21P1MMC4 | ORDINARY DIFFERENTIAL EQUATIONS | Knowing the basic concepts Linearly Independent and dependent functions for solving Linear differential equations. | 3 | 2 | 3 | 3 | 3 | - | - |
| | | Acquire understanding of Homogeneous and Non-Homogeneous of second and higher order ODE's and solves them. | 3 | 2 | 3 | 3 | 3 | - | - |
| | | Solve problems using methods of undetermined coefficients, reduction of the order of equation and able to pertain Legendre equations. | 3 | 3 | 3 | 3 | 3 | - | - |
| | | Able to analyze problems in linear second order differential equations and able to pertain Bessel functions | 3 | 3 | 3 | 3 | 3 | - | - |
| | | Know about exact differential equations and existence, uniqueness and continuity of solutions of first order ODE's | 2 | 2 | 2 | 3 | 2 | - | - |
| 21P1MME1(A) | NUMBER THEORY AND CRYPTOGRAPHY | Understand the concept of divisibility and congruence. | 2 | 1 | 3 | 2 | 3 | - | - |
| | | Learn the idea of Quadratic residues and reciprocity. | 1 | - | 3 | 2 | 1 | - | - |
| | | Solve the number theoretical functions . | 1 | 1 | 3 | 2 | 2 | - | - |
| | | Identify and solve Diophantine equations. | - | - | 3 | 2 | 3 | - | - |
| | | Implement number theoretical concepts in cryptography. | 2 | 2 | 3 | 2 | 3 | - | - |
| 21P1MME1(B) | NUMERICAL ANALYSIS | Understanding the theoretical and practical aspects of the use of numerical methods | 2 | 3 | 2 | 3 | - | - | - |

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| | | Analyzing the Numerical value of Integration by comparing the analytical solution | 2 | 2 | 2 | 3 | - | - | - |
| | | Finding the intermediate values using cubic spline. | 2 | 2 | 2 | 3 | 2 | - | - |
| | | Knowing the methods of cubic spline to solve the differential equations | 2 | 3 | 2 | 3 | 2 | - | - |
| | | Finding the numerical solution of partial differential equations using various approximation methods | 2 | 3 | 2 | 3 | 2 | - | - |
| 21P2MMC5 | REAL ANALYSIS-II | Remembering the upper and lower integrals and the Riemann conditions. | 2 | 3 | 2 | 1 | 3 | - | - |
| | | Determine the Functions of several variables | 2 | 3 | 2 | 1 | 3 | - | - |
| | | Understand the concept of Differentiation of integrals | 2 | 3 | 2 | 1 | 3 | - | - |
| | | Identifying the concept of Lebesgue measure | 2 | 3 | 2 | 1 | 3 | - | - |
| | | Analyzing the concept of Lebesgue integral. | 2 | 3 | 2 | 1 | 3 | - | - |
| 21P2MMC6 | LINEAR ALGEBR | Remembering the basic concepts of Linear transformation | 2 | 3 | 2 | 1 | 3 | - | - |
| | | Understand the idea of algebra of polynomials | 2 | 3 | 2 | 1 | 3 | - | - |
| | | Understand the concept of Determinants and matrix with various conditions | 2 | 3 | 2 | 1 | 3 | - | - |
| | | Identifying the concept of diagonalization and its properties | 2 | 3 | 2 | 1 | 3 | - | - |
| | | Analyzing the concept of Rational and Jordan forms | 2 | 3 | 2 | 1 | 3 | - | - |
| 21P2MMC7 | MECHANICS | Understand the concepts of mechanical system, energy, momentum and d'Alembert's principle | 3 | 2 | 2 | 2 | 1 | - | - |
| | | Use the concept of Lagrange's equations in simple systems and in Routhian procedure, Liouville's system. | 3 | 2 | 2 | - | 1 | - | - |
| | | Evaluate stationary values using Hamilton's equations and find about Liouville's system | 3 | 2 | 3 | - | 2 | - | - |
| | | Use Hamilton Jacobi theory and find pfaffin differential form, Liouville's system stackel's theorem | 3 | 2 | - | - | 2 | - | - |
| | | Acquire the knowledge about canonical transformations, momentum transformations and poisson brackets | 3 | - | - | 2 | 3 | - | - |
| 21P2MMC8 | PARTIAL DIFFERENTIAL EQUATIONS | Explain the basic concepts of Partial Differential Equations and solve the various types of partial differential equation like Cauchy's problem ,linear equation of first order, Surfaces orthogonal to given system of surfaces. | 3 | 2 | 3 | 3 | 3 | - | - |

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| | | Acquire the knowledge of Nonlinear Partial Differential Equations of the first order and solve the special types of first order partial differential equations | 3 | 2 | 3 | 3 | 3 | - | - |
| | | Illustrate the basic concepts of second order Partial Differential Equations and explain the various methods of second order partial equations. | 3 | 3 | 3 | 3 | 3 | - | - |
| | | Able to analyze problems in the area of Laplace's equation, Boundary value problems, Diffusion equation and the use of Integral Transforms | 3 | 3 | 3 | 3 | 3 | - | - |
| | | Ability to calculate the solutions of one dimensional wave equations and three dimensional problems. | 2 | 2 | 2 | 3 | 2 | - | - |
| 21P2MME2(A) | FUZZY SETS AND ITS APPLICATIONS | Illustrate the concepts of Classical Sets, fuzzy sets, fuzzy points and α - cuts.. | 3 | 3 | 3 | 2 | 1 | - | - |
| | | Analyze the axioms and build operations on fuzzy sets | 3 | 3 | 3 | 3 | 1 | - | - |
| | | Able to know the concept of various relations of fuzzy sets. Using this to analyse the properties and operations of Crisp and Fuzzy relations . | 3 | 3 | 2 | 2 | 1 | - | - |
| | | Apply and evaluate multistage decision making in dynamic systems. | 3 | 3 | 3 | 3 | 1 | - | - |
| | | Enhance the knowledge in various branches like Fuzzy Systems, Genetic Algorithms, Medicine, Economics. | 3 | 2 | 3 | 2 | 2 | - | - |
| 21P2MME2(B) | FLUID DYNAMICS | Analyze and understand physical concept involved in fluid flow problems with the application of the momentum and energy equations | 3 | 3 | 2 | 2 | 2 | - | - |
| | | Analyze and understand physical concept involved in inviscid fluid problems | 3 | 3 | 2 | 2 | 2 | - | - |
| | | Model some two dimensional flows of viscous and inviscid fluid flows. | 3 | 3 | 2 | 2 | 2 | - | - |
| | | Model some three dimensional flows of viscous and inviscid fluid flows. | 3 | 3 | 2 | 2 | 2 | - | - |
| | | Analyze and find mathematical solution of some fluid flow problems and interpret results physically. | 3 | 2 | 2 | 2 | 2 | - | - |
| 21P3MMC9 | | Use Cauchy's integral Theorem and formula to compute line integral. | - | 2 | 3 | 2 | 3 | 2 | - |


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| | COMPLEX ANALYSIS | Understand Cauchy's Integral Formula on open sets on the plane and know about poles , residues and singularities. | - | 2 | 2 | 2 | 3 | 2 | - |
| | | Apply the Cauchy's integral formula in residue theorems and in evaluation of definite integrals. | - | 2 | 2 | 2 | 3 | 2 | - |
| | | Analyze and represent the sum function of a power series as an Analytic Function. | - | 2 | 3 | 2 | 3 | 2 | - |
| | | understand the concept of conformal mapping and use of the reflection principle. | - | 2 | 3 | 2 | 3 | 2 | - |
| 21P3MMC10 | DIFFERENTIAL GEOMETRY | Recall and Analyze Knowledge in space curves | 2 | 3 | 2 | 1 | 3 | 2 | - |
| | | Demonstrate the metric concepts in surfaces | 2 | 3 | 2 | 1 | 3 | 2 | - |
| | | Determine geodesics on curves | 2 | 3 | 2 | 1 | 3 | 2 | - |
| | | Examine surfaces of revolution | 2 | 3 | 2 | 1 | 3 | 2 | - |
| | | Estimate principal curvature and line of curvature | 2 | 3 | 2 | 1 | 3 | 2 | - |
| 21P3MMC11 | MATHEMATICAL STATISTICS | Introducing the basic concepts of Probability random Variable, | 2 | 3 | 2 | 1 | 3 | 3 | 2 |
| | | Understand the idea of Probability Distributions, Density functions | 2 | 3 | 2 | 1 | 3 | 3 | 2 |
| | | Understand the concept of Moment generating function techniques | 2 | 3 | 2 | 1 | 3 | 3 | 2 |
| | | Identifying the concept of Order Statistics and its properties | 2 | 3 | 2 | 1 | 3 | 3 | 2 |
| | | Analyzing the concept of convergence with various conditions | 2 | 3 | 2 | 1 | 3 | 3 | 2 |
| 21P3MDC | STOCHASTIC PROCESSES AND POINT GROUPS OF MOLECULES | Correlate the concepts of stochastic processes with illustrations | 3 | 3 | 2 | 2 | 2 | 2 | - |
| | | Illustrate Markov chain and its applications | 3 | 3 | 2 | 2 | 2 | 2 | - |
| | | Compare the conceptualization of pure birth and death process | 3 | 3 | 2 | 2 | 2 | 2 | - |
| | | Infer the basic concepts of statistical mechanics and apply them to derive the distribution law of particles mechanics | 2 | 1 | 1 | - | 2 | - | 1 |
| | | Study the structure of atoms and molecules with reference to point groups. | 2 | 1 | 1 | - | 2 | - | 1 |

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| 21P3MMDCS | STOCHASTIC PROCESSES, STATISTICAL MECHANICS AND BIOLOGICAL MACROMOLECULES | Correlate the concepts of stochastic processes with illustrations | 3 | 3 | 2 | 2 | 2 | 2 | - |
| | | Illustrate Markov chain and its applications | 3 | 3 | 2 | 2 | 2 | 2 | - |
| | | Compare the conceptualization of pure birth and death process | 3 | 3 | 2 | 2 | 2 | 2 | - |
| | | Infer the basic concepts of statistical mechanics and apply them to derive the distribution law of particles mechanics | 2 | 1 | 1 | - | 2 | - | 1 |
| | | Study the structure of DNA and molecules with reference to Structure of Modelling.. | 2 | 1 | 1 | - | 2 | - | 1 |
| 21P3MME3(A) | DATA STRUCTURES USING C AND C++ | Construct Stack and Queue operation of Data Structure | - | 2 | 3 | 2 | 3 | - | - |
| | | Explain Basic Concept of Data Structures. With Pointer Arrays. Single Linked List –Circular Linked List – Double Linked List . | - | 2 | 2 | 2 | 3 | - | - |
| | | Implement the Tree , Binary Tree Traversal and Merging Tree | - | 2 | 2 | 2 | 3 | 2 | - |
| | | Compute the different Searching Techniques. | - | 2 | 3 | 2 | 3 | 2 | - |
| | | Acquire understanding the knowledge of Graphs and their Applications | - | 2 | 3 | 2 | 3 | 2 | - |
| 21P3MME3(B) | PROGRAMMING WITH VISUAL BASIC | Demonstrate competency in using a Windows IDE | - | 2 | 3 | 2 | 3 | - | - |
| | | Ability to use Control Structures, elementary data structures, collection classes. | - | 2 | 2 | 2 | 3 | - | - |
| | | Design and develop the event-driven applications using Visual Basic | - | 2 | 2 | 2 | 3 | 2 | - |
| | | Ability to view and debug the Windows Forms, common controls, design-view, code view, class diagram view and create menu driven application. | - | 2 | 3 | 2 | 3 | 2 | - |
| | | Apply the knowledge of database methods. | - | 2 | 3 | 2 | 3 | 2 | - |
| 21P3MME3P1(A) | PRACTICAL IN DATA | Implement various operations of data structures | 1 | 3 | - | - | - | - | - |
| | | Design and implement abstract data types such as linked list, stack, queues and trees to solve particular problem | 1 | 3 | 2 | - | - | - | - |

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| | STRUCTURES USING C AND C++ | Understand and implement fundamental algorithms like sorting and searching in various real time applications. | - | 3 | 1 | - | - | - | - |
| | | Apply concepts like virtual functions and polymorphisms and also compute the different Searching Techniques. | 1 | 3 | 2 | - | - | - | - |
| | | Acquire understanding the knowledge of Graphs and their Applications | - | 3 | 2 | - | - | - | - |
| 21P3MME3P1(B) | PRACTICAL IN VISUAL BASIC | Demonstrate fundamental skills in utilizing the tools of a visual environment such as command, menus and toolbars. | 1 | 3 | - | - | - | - | - |
| | | Learn the advantages of Controls in VB | 1 | 3 | 2 | - | - | - | - |
| | | Design and develop the event- driven applications using Visual Basic frame work. | - | 3 | 1 | - | - | - | - |
| | | Implement MDI applications using forms, dialogs, and other types of GUI components. | 1 | 3 | 2 | - | - | - | - |
| | | Acquire the knowledge of database methods. | - | 3 | 2 | - | - | - | - |
| 21P4MMC12 | FUNCTIONAL ANALYSIS | Acquire the fundamentals of normed, Banach & Hilbert Spaces | 2 | 3 | 2 | 1 | 3 | 3 | 3 |
| | | Recall the results in Banach Spaces & Hilbert Spaces | 2 | 3 | 2 | 1 | 3 | 3 | 3 |
| | | Prove standard theorems such as Hahn-Banach theorem, Open mapping theorem, closed graph theorem, Uniform boundedness theorem and spectral theorem | 2 | 3 | 2 | 1 | 3 | 3 | 3 |
| | | Analyze the behaviour of linear operators on normed spaces | 2 | 3 | 2 | 1 | 3 | 3 | 3 |
| | | Elucidate the operators and find the spectrum of operators | 2 | 3 | 2 | 1 | 3 | 3 | 3 |
| 21P4MMC13 | OPTIMIZATION TECHNIQUES | Apply the fundamental concept of Inventory control price break models. | - | 2 | 3 | 2 | 3 | - | - |
| | | Applying the concept of queuing system and analyze the problems in queuing models. | - | 2 | 2 | 2 | 3 | - | - |
| | | Evaluate Subdividing Problem and LPP through Dynamic Programming. | - | 2 | 2 | 2 | 3 | 2 | - |
| | | Acquire understanding the knowledge of NLPP using Chance constrained Programming. | - | 2 | 3 | 2 | 3 | 2 | - |
| | | Analyze the concept of solving nonlinear optimization problems. | - | 2 | 3 | 2 | 3 | 2 | - |

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| 21P4MMC14 | GRAPH THEORY | Recognise isomorphic graphs, bipartite graphs & graphical sequences, to find the union, sum & product of two graphs, to determine the radius, diameter, center & adjacency matrix of a graph. | - | - | 2 | 1 | 3 | - | - |
| | | Prove properties of trees, to identify the cut-vertices & bridges of a given graph, to construct the Prufer code for the given tree and vice-versa, to apply Kruskal's and Prim's algorithms for finding a minimum spanning tree in a given tree. | - | 1 | 2 | 2 | 3 | - | - |
| | | Find vertex & edge connectivity of a graph, to recognise Eulerian graphs and certain families of Hamiltonian graphs, to find a maximum matching in a graph, to verify Hall's condition for a given bipartite graph. | - | 1 | 2 | 2 | 3 | 2 | - |
| | | Verify whether or not a graph has a 1-factor applying Tutte's theorem, to find the four independence & covering parameters for a graph and also to establish relationship among them, to derive properties of planar graphs, to apply Kuratowski's theorem for determining a given is a planar graph or not. | - | 2 | 3 | 2 | 3 | 2 | - |
| | | Find chromatic number and chromatic index of a graph, to obtain a vertex coloring of a graph using greedy algorithm, to construct the Mycielskian graph. | - | 2 | 3 | 2 | 3 | 2 | - |
| 21P4MMC15 | MATHEMATICAL METHODS | Remembering the basic concepts of Integral equations | 2 | 3 | 2 | 1 | 3 | 3 | 2 |
| | | Understand the idea of Ordinary integral equations and Singular integral equations | 2 | 3 | 2 | 1 | 3 | 3 | 2 |
| | | Understand the concept of Fourier Transforms, Parseval's theorem | 2 | 3 | 2 | 1 | 3 | 3 | 2 |
| | | Identifying the concept of Hankel transforms, Axisymmetric Dirichlet problem for half space | 2 | 3 | 2 | 1 | 3 | 3 | 2 |
| | | Analyzing the concept of calculus of variations | 2 | 3 | 2 | 1 | 3 | 3 | 2 |
| 21P4MME4(A) | PROGRAMMING IN PYTHON | Explain basic principles of Python Programming Language | 3 | 2 | 2 | 1 | - | 1 | 1 |
| | | Apply operators, mathematical functions in Python and Construct control statements in the Python programs | 3 | 2 | 2 | 2 | 1 | 2 | 2 |

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| | | Categorize types of Arrays and its advantages. Apply Number in arrays and matrices | 3 | 2 | 2 | 2 | 1 | 2 | 2 |
| | | Examine special features of Lists, tuples, functions and dictionaries . | 3 | 2 | 2 | 2 | 1 | 2 | 2 |
| | | Analyze the data via bar graph, different kinds of plots, line graph by importing the suitable python packages | 3 | 3 | 2 | 3 | 1 | 3 | 3 |
| 21P4MME4(B) | PROGRAMMING IN OBJECT ORIENTED SYSTEM DEVELOPMENT | Construct Stack and Queue operation of Data Structure | - | 2 | 3 | 2 | 3 | - | - |
| | | Explain Basic Concept of Data Structures. With Pointer Arrays. Single Linked List –Circular Linked List – Double Linked List . | - | 2 | 2 | 2 | 3 | - | - |
| | | Implement the Tree , Binary Tree Traversal and Merging Tree | - | 2 | 2 | 2 | 3 | 2 | - |
| | | Compute the different Searching Techniques. | - | 2 | 3 | 2 | 3 | 2 | - |
| | | Acquire understanding the knowledge of Graphs and their Applications | - | 2 | 3 | 2 | 3 | 2 | - |


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