Annai College of Arts & Science
Quality Education for Today & Tomorrow
Kovilacheri, Kumbakonam. 612 503. Ph: 0435 2453007
Accredited by NAAC with "B" Grade & Recognized by UGC under Section 2(f) & 12(B)
Affiliated to Bharathidasan University, Tiruchirappalli. E-Mail:acasdmn@gmail.com

DEPARTMENT OF MATHEMATICS

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Programme outcomes, Programme Specific Outcomes and Course Outcomes

HOD **IQAC** **PRINCIPAL**

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DEPARTMENT OF MATHEMATICS

Programme outcomes

PO1: Motivate for research in Mathematical sciences and to apply rigorous, analytic, highly numerate approach to analyze, execute tasks and solve problems in daily life and at work.

PO2: It evaluates how the various sub-disciplines are inter related, the ability to use techniques from different areas and in-depth knowledge about chosen topics.

PO3: To be able to independently read mathematical and statistical literature of various types including survey articles, scholarly books and online e-resources.

PO4: Evaluate hypothesis, theories, methods and evidence within their proper contexts.

PO5: Mathematics majors at SNMV will be able to apply critical thinking skills to solve problems that can be modeled mathematically, to critically interpret numerical and graphical data.

PO6: Be able to analyze, test, interpret and form independent judgments in both academic and non-academic contexts.

Programme Specific Outcomes

PSO1 : Create, select and apply appropriate techniques, resources and modern technology in multi-disciplinary environment.

PSO2 : Career Opportunities exist in teaching in Schools & Colleges (after M.Sc.,B.ed/Net/PhD) where any of the science subjects is an important discipline.

PSO3 : Critically interpret data, write reports and apply the basics of rules of evidence.

PSO4 : Select, interpret and critically evaluate information from a range of sources that include books, scientific reports, journals, case studies and the internet.

PSO5 : Develop proficiency in the analysis of complex physical problems and the use of mathematical or other appropriate techniques to solve them.

PSO6 : Criticize mathematical arguments developed by themselves and others

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Course Outcomes

Formulate short proofs using the following methods: direct proof, indirect proof, proof by contradiction, and case analysis .Apply the logical structure of proofs and work symbolically with connectives and quantifiers to produce logically valid, correct and clear arguments. Write solutions to problems and proofs of theorems that meet rigorous standards based on content, organization and coherence, argument and support.

Name of the Course With Subject Code	Course Outcomes
Algebra (P16MA11)	**CO1**: Gain expertise in the basic concepts of group theory with the help of numerous examples. **CO2**: Discuss in detail about permutation groups and Normal subgroups and discuss on counting tricks in algebra. **CO3**: Illustrate Jordan holder theorem with examples. **CO4**: Bring out the key steps involved in proving Sylow theorems. **CO5**: Use Sylow's theorems to classify groups of finite order upto 120. **CO6**: Understand how the number theoretic concepts of the integers serve as a motivation for the algebraic concepts for Rings. **CO7**: Learn how to obtain the Field of Quotients of an integral domain. **CO8**: Identify various forms of Polynomial rings. Further they will be able to discuss about Euclidean domains.

Real Analysis (P16MA12)	**CO1**: Inculcate interest in analysis and understand how pictures and leading questions get into the strategy of proofs **CO2**: Gain mastery in the fundamental concepts such as sets and functions, Induction principle, Finite and Infinite sets. In real number system they would get insight **CO3**: Appreciate the role of least upper bound property in real analysis which underlies all crucial results. **CO4**: Understand the basic concepts in metric spaces geometrically and with rigor. **CO5**: Realize the key idea convergence of sequences and the quantitative inequality estimates. Here numerous examples would have demonstrated the role of inequalities. **CO6**: Learn the crucial concept of continuity of functions and uniform continuity and work on problems emphasizing these ideas of real analysis. **CO7**: Study thoroughly the metric topology and discuss the ideas connecting compactness and continuity and connectedness and continuity **CO8**: Utilize the Banach contraction principle in formulating and solving various important problems.
Ordinary Differential Equations (P16MA13)	**CO1**: Find the general solution of the first order linear homogeneous equations **CO2**: Understand the utility of the theory of power series which is studied in Real Analysis course through solving various second order Differential equations. **CO3**: Get introduced to the Hyper geometric functions which arises in connection with solutions of the second order ordinary differential equations with regular singular points. **CO4**: Solve the problems arises in Mathematical physics using properties of special functions.

	CO5: Understand the importance of studying well-posedness of the problem namely existence, uniqueness and continuous dependence of first order differential equations through Picard's theorem. **CO6**: Understand the utility of the concepts from linear algebra and analysis in the study of system of first order equations. **CO7**: Discuss the Qualitative properties of solutions of first and second order equations. Also they will be able to work on numerous problems using comparison theorem in Sturm Liouville problems. **CO8**: Learn the nature of solutions which involves critical points and phase portrait of nonlinear equations.
Graph Theory (P16MA14)	**CO1**: To study the concepts of Connectivity and vertex and edge connectivity and its applications **CO2**: To introduce the concept of colouring and its implication in planar graphs **CO3**: To introduce the notion of Eulerian and Hamiltonian graphs **CO4**: To give a rigorous introduction to the basic concepts of Graph Theory **CO5**: To give applications of Graph Theory in other disciplines **CO6**: Applications to real life problems **CO7**: Introduction to advance topics in graph theory **CO8**: Algorithms in graph theory
Integral Equations, Calculus of variations and Transforms (P16MA15)	**CO1**: Understand the concepts of variation and its properties. **CO2**: Use Euler's equation to solve various types of variational problems with fixed boundaries.. **CO3**: Modify the Euler's formula for a class of curves with moving boundary points. **CO4**: Solve problems related with reflection and refraction, diffraction of light rays.

	CO5: Derive sufficient conditions based on second variation. **CO6**: Classify Fredholm , Volterra and singular type integral equations **CO7**: Solve integral equations using Fredholm Theorem, Fredholm Alternative theorem and method of successive approximations. **CO8**: Study in detail the spectral properties of bounded linear operators.
Complex analysis (P16MA21)	**CO1**: Understand the complex number system from geometric view point. **CO2**: Appreciate and work on the topology of extended complex plane. **CO3**: Get expertise in the concept of convergence of sequences and series of complex numbers, continuity and differentiability of function on complex numbers. **CO4**: Workout the path integrals on the complex plane. **CO5**: Understand the central theme of Cauchy theory,viz., existence of local primitives and local power series expansion. **CO6**: Get acquainted with various techniques of proving fundamental theorem of algebra, open mapping theorem, maximum modulus theorem and Liouville/s theorem **CO7**: Classify singularities, compute poles and residues and understand the Laurent series expansion **CO8**: Appreciate how topological ideas of the homotopy theory is used for proving the homotopy version of Cauchy theorem.

Linear Algebra (P16MA22)	**CO1**: Realise that the subject evolves as a generalization of solving a system of linear equations. **CO2**: Discuss in detail the basic concepts of Linear dependence, basis and dimension of a vector space. The students will be able to demonstrate how the geometric ideas turns into rigorous proofs. **CO3**: Master the dimension formula and rank and nullity theorem which are often exploited. **CO4**: Capture the idea of producing lot of structure preserving maps (Linear transformations). Further the study of algebras of linear maps would be accomplished. **CO5**: Having got trained in numerous examples the student realizes the isomorphic theory of Linear transformations and matrices. **CO6**: Understand that the central theme of structure theory of linear maps is to decompose the given vector space as a direct sum of generalized the eigen spaces using the given map on it. **CO7**: To find the Jordan canonical forms of various Linear transformation and thereby able to Solve various problems. **CO8**: Understand that linear Algebra plays a fundamental role in many areas of mathematics including Algebra, Geometry, Functional analysis and which finds widest application in Physics, Chemistry and elsewhere
Partial Differential Equations (P16MA23)	**CO1**: Classify first order partial differential equations and their solutions. **CO2**: Solve first order equations and nonlinear partial differential equations using various methods. **CO3**: Use the method of characteristics to solve first order partial differential equations. **CO4**: Identify and solve the three main classes of second order equations, elliptic, parabolic and hyperbolic.

	CO5: Solve one dimensional wave equations using method of separation of variables. **CO6**: Classify the boundary value problems and analyse its solutions **CO7**: Solve Heat conduction problem using Fourier series and cosines. **CO8**: Illustrate the use of pde in problems from Engineering and Biological Sciences.
Mathematical Modeling (P16MAE1B)	**CO1**: Do mathematical formulation of a real life problem into a linear programming problem. **CO2**: Solve linear programming problem using graphical method and understand basic feasible solution and optimal solution geometrically. **CO3**: Understand simplex method and revised simplex method and apply the algorithms to solve a plenty of problems.. **CO4**: Understand duality in linear programming problem and solve them.. **CO5**: Find solutions to transportation problems by various techniques. **CO6**: Gain the knowledge of modeling of assignment problem and techniques to solve them. **CO7**: Comprehend two person zero sum game in game theory and solve a plenty of them. **CO8**: Solve networking problems using PERT/ CPM methods.
Stochastic Processes (P16MAE2A)	**CO1**: Give specification of stochastic process and give examples for steady process. **CO2**: Understand Markov chains and explain the generalization of Independent Bernoulli trails. **CO3**: Classify states and chains and discuss stability of a Markov system. **CO4**: Have working knowledge on Markov chains with continuous state space. **CO5**: Identify and work on Markov process with discrete and continuous state space.

	CO6: Describe renewal processes in continuous time using Wald's equation **CO7**: Demonstrate and apply renewal theorems. **CO8**: Analyze transient behaviour of Queuing models.
Classical Dynamics (P16MA31)	**CO1**: Understand the important definitions and introductory concepts like the ideas of virtual work and d'Alembert's principle. **CO2**: Derive Lagrange's equations of motion using d'Alembert's principle. **CO3**: Understand the nature of equations of motion for holonomic and nonholonomic systems. **CO4**: Understand the idea of impulsive constraints. **CO5**: Compare dissipative systems and velocity dependent potentials. **CO6**: Understand the Hamiltonian view point of dynamics in canonical equations of motion and phase space. **CO7**: Understand the concepts of Hamilton - Jacobi theory. **CO8**: Obtain some concrete procedure for solving problems using the theory of canonical transformations.
Measure and Integration (P16MA32)	**CO1:** Appreciate the power of Riemann integration and its drawbacks. They will be able to capture the need for the modern integration theory. **CO2**: Understand the concept of Caratheodory construction of a measure from an outer measure in the concrete cases. **CO3:** Discuss the concept of sigma algebra and their exmples. Student will be able to understand the set of all Lebesque measurable set is a sigma algebra. **CO4**: Observe that the idea of measurable function, simple functions and their properties. **CO5**: Discuss about the importance of monotone convergence theorem, dominated convergence theorem and Fauto's lemma.

	CO6: Prove the completeness of L^p spaces **CO7:** Understand the proof and apply Fubini's theorem in various cases. **CO8**: Comprehend the idea of Hahn and Jordan decomposition and Radon nikodym theorems.
Topology (P16MA33)	**CO1:** Realize how topological spaces and the basic notions of it are generalization of metric spaces. **CO2**: Identify and characterize convergence of sequences, which sets are closed, compact and connected in lots of examples. **CO3:** Explore the continuity of functions in various topological spaces. **CO4:** Elucidate the difference in the concept of base f for a given topology and base generating some topology. **CO5:** Understand generating topologies and product topology as a particular case of it. **CO6:** Demonstrate universal mapping properties in all the three cases viz product topology, weak topology and quotient topology. **CO7:** Prove all the topological properties involved in counting and separation axioms with the help of pictures. **CO8:** Explain the proof of Tietze extension theorem in detail.
Discrete Mathematics (P16MAE3B)	**CO1:** Review and explain the techniques required in addressing problems on permutations and combinations. For illustration, finding how the distribution of distinct objects into non distinct cells are made helps the students to gain the impetus of the subject. **CO2:** Explain how the technique of generating functions and recurrence functions are used to solve the problems in combinatorics. **CO3:** Detail about simultaneous recurrences and use it to solve more problems. **CO4:** Understand and work on the elementary concepts of graphs namely, subgraph, cut

	vertex, blocks. **CO5:** Discuss matching problems and its applications elsewhere. **CO6:** Workout in detail the connectivity of a given graph with help of Menger's theorem **CO7:** Comprehend and work on the concepts of planarity and discuss the dual of a plane graph **CO8:** Elucidate on the famous Four-Color theorem and discuss Tait Coloring.
Functional Analysis (P16MA41)	**CO1:** Understand functional analytic language required to study problems of practical interest. CO2: Prove that all norms on a finite dimensional space are equivalent. **CO3**: Realize an important characterization: A normed linear space is locally compact if and only if it is finite dimensional**.** **CO4:** Comprehend the important of four pillars of functional analysis namely Hahn- Banach theorems, open mapping theorem, closed graph theorem, uniform boundedness principle**.** **CO5:** Gain mastery in basic Hilbert space theory: Projection theorem and Riesz representation theorem. **CO6:** Understand weak topology on a normed linear space and the appreciate Banach-Alaoglu theorem. **CO7:** Get a working knowledge on algebra of bounded linear operator. **CO8**: Study in detail the spectral properties of bounded linear operators**.**
Differential Geometry (P16MA42)	**CO1**: Have a solid understanding of the subjects, linear algebra, mutivariable calculus and differential equations and a basic knowledge of theoretical physics. **CO2**: Sketch and workout graphs,level sets, tangent space and surfaces of given smooth maps. **CO3:** Good knowledge on calculus of vector fields. **CO4:** Understand how Gauss map helps to identify the surfaces that are mapped onto the unit n-sphere.

	CO5: Describe surfaces as a solution sets of differential equations. **CO6:** Exhibit geodesics on surfaces. **CO 7**: Learn how parameterizations of plane curves can be used to evaluate integrals over the curve. **CO8**: Compute the Gaussian curvature of various surfaces.
Advanced Numerical Analysis (P16MA43)	**CO1 :** Solve algebraic and transcendental equations using various iterative methods and study the rate of convergence of those problems. **CO2:** Solve System of Linear Algebraic equations using direct methods and indirect methods. **CO3:** Solve eigen value problems and study the Error analysis. **CO4:** Solve algebraic equations and differential equations using the techniques of interpolation like Lagrange Interpolation **CO5:** Perform curve fitting using least square approximation. **CO6:** Find the numerical value of the derivative of various functions using Euler method and Runge-Kutta method. **CO7:** Calculate the numerical value of a definite integral using methods like quadrature rules in numerical integration. **CO8:** Identify the suitable numerical method and perform error analysis.
Advanced Operations Research (P16MAE4B)	**CO1:** To develop mathematical skills that will provide appropriate foundation for linear programming model, logical integer programming models. **CO2:** To use the simplex methods and its variants, to solve linear programming problem **CO3:** To use the techniques of sensitivity analysis **CO4:** To improve the familiar with running AMPL with common solvers such us MINOS **CO5:** To develop self study

	CO6: To improve graphical solutions for two dimensions problem **CO7:** To use security for closed circuits
Algebraic Topology (P16MAE5A)	**CO1:** To develop graphs, surfaces and homotopy **CO2:** Abelian groups, exact sequence quotient polygon representation **CO3:** To applied the fundamental theorem of circles in continuous function **CO4:** To develop simplicial complexes, stars, joins, collapsing, chain groups, boundary homomorphism **CO5:** To applied geometric applications and persistent homology

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