Semester : II **Major Core V**

Name of the course : Modules and Vector Spaces

Course code : PM2021

Number of hours per week	Credits	Total number of hours	Marks
6	5	90	100

Objective:

To understand the concept of Modules and the advanced forms of Matrices related to Linear Transformations.

Course Outcome

CO	Upon completion of this course the students will be able to :	PSOs addressed	CL
CO - 1	recall the definitions and properties of Vector Spaces and Subspaces	PSO - 2	R
CO - 2	analyze the concepts Linear Independence, Dependence and Basis	PSO - 2	An
CO - 3	apply the definition and properties of Linear transformation and Matrices of Linear transformation	PSO - 3	Ap
CO - 4	gain knowledge about characteristic polynomial, eigen vectors, eigen values and eigen spaces as well as the geometric and the algebraic multiplicities of an eigen value	PSO - 1	U
CO - 5	learn and apply Jordan form and triangular form for computations	PSO - 4	U

Total contact hours: 90 (Including lectures, assignments and tests)

Unit	Section	Topics	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
I	**Module**					
	1	Basic definitions and examples	4	Recall the definitions and basic concepts of fields and modules	Lecture with illustration	Evaluation through:

	2	Quotient modules and module homomorphism	4	Express the fundamental concepts of field theory, module theory and theory of quotient modules	Lecture with illustration	Unit Test Quiz
	3	Generation of Modules	4	Recall the definitions and basic concepts of module theory. Understand the theorems in modules.	Lecture	Formative assessment I
	4	Direct sums and Free Modules	3	Demonstrate the use of module theory to compute Direct sums and Free Modules.	Lecture with illustration	
II	**Vector Spaces**					
	1	Elementary basic concepts: Vector space, Subspace, Vector space homomorphism	3	Recall the definitions and basic concepts of Vector spaces and Subspaces.	Lecture with illustration	Unit Test Quiz
	2	Linear span, Finite dimensional vector space, Linearly dependent, Linearly independent	4	Learn the definition of Linear span and Finite dimensional vector space. Analyze the conceptslinearly dependent and inearly independent.	Lecture	Problem Solving
	3	Basis, dimension	4	Learn the concept of basis and dimension. Use the concept of basis and dimension in finite dimensional vector space	Lecture with illustration	Formative assessment I

	4	Dual Spaces	3	Understand the theorems in dual spaces.	Lecture	
III	**Linear Transformations**					
	1	Algebra of Linear Transformation, Regular, Singular, Range, Rank	3	Recall the definition of vector space homomorphism. Understand the concept of Regular, Singular, Range and Rank of Linear Transformations.	Lecture with illustration	Unit Test Quiz Problem Solving Online Assignment on range Formative assessment I, II
	2	Characteristic Root, Characteristic vector, Matrices	5	Gain knowledge about Characteristic root and Characteristic vector. Apply the definition and properties of Linear transformation and Matrices of Linear transformation	Lecture with illustration	
	3	Canonical Forms: Triangular Form, Similar, Invariant subspace	4	Learn and apply triangular form for computations	Lecture	
	4	Canonical Forms: Nilpotent Transformation, Index of nilpotence	4	Recall the definitions and basic concepts of Linear Transformations. Understand the theorems in nilpotent Linear Transformations.	Lecture	
IV	**Canonical Forms**					

	1	Jordan form	4	Learn and apply Jordan form for computations.	Lecture	Unit Test Class Test Quiz Seminar on Canonical Forms Formative assessment II
	2	Rational Canonical Form, Companion matrix, Elementary divisor, Characteristic polynomial	4	Gain knowledge about Companion matrix, Elementary divisor and Characteristic polynomial.	Lecture	
	3	Trace	4	Understand the properties of trace and Jacobson Lemma.	Lecture	
	4	Transpose, Symmetric matrix, Adjoint	3	Understand the properties of Transpose, Symmetric matrix and Adjoint.	Lecture	
V	**Determinants and Quadratic forms**					
	1	Determinants, Secular equation	3	Find determinant of a triangular matrix. Understand Cramer's Rule.	Lecture with illustration	Unit Test Quiz Problem Solving
	2	Hermitian, Unitary	4	Recall the properties of real and complex numbers and apply these concepts in Linear transformation. Develop the knowledge of Hermitian and Unitary Linear transformation.	Lecture with illustration	

	3	Normal Transformation	3	Recall the properties of real and complex numbers and apply these concepts in Normal transformation.	Lecture	Seminar on Quadratic forms
	4	Real Quadratic forms, Congruent	4	Learn and apply Quadratic form for computations.	Lecture	Formative assessment II

Course Instructor(Aided): Dr.T.Sheeba Helen HOD(Aided) :Dr.V.M.Arul Flower Mary

Course Instructor(S.F): Dr.C.Jenila HOD(S.F) :Mrs.J. Anne Mary Leema

Semester : II **Major Core VI**

Name of the Course : Analysis II

Subject code : PM2022

No. of hours per week	Credits	Total No. of hours	Marks
6	5	90	100

Objectives: 1. To make the students understand the advanced concepts of Analysis.

2. To pursue research in Analysis related subjects.

Course Outcome

CO	Upon completion of this course the students will be able to :	PSOs addressed	CL

CO -1	recall the definition of continuity, boundedness and some results on uniform convergence	PSO-1	R
CO -2	recognise the difference between pointwise and uniform convergence of a sequence of functions and Riemann Stieltjes integrals.	PSO-2	An
CO -3	understand the close relation between equicontinuity and uniform convergence of sequence of continuous function and rectifiable curves	PSO-3	U
CO -4	learnParseval's theorem, Stone Weierstrass theorem and know about its physical significance in terms of the power of the Fourier components.	PSO-4	U
CO -5	utilize the definition of differentiation and partial derivative of function of several variables to solve problems	PSO-3	Ap

Total contact hours: 90 (Including lectures, assignments and tests)

Unit	**Section**	**Topics**	**Lecture hours**	**Learning outcomes**	**Pedagogy**	**Assessment/ evaluation**
I	**Riemann Stieltjes Integral**					
	1	Definition and existence of Riemann Stieltjes integrals	3	To understand the definition existence of Riemann Stieltjes integrals	Lecture with Illustration	Evaluation through test
	2	Theorems related to Riemann Stieltjes integrals	3	To understand the theorems related to Riemann Stieltjes integrals	Lecture	Short Test
	3	Properties of Riemann Stieltjes integrals	3	To understand the properties of Riemann Stieltjes integrals	Lecture with Illustration	Slip Test

	4	Fundamental theorem of Calculus and related problems	3	To understand and apply this theorem in various problems	Lecture with Illustration	Quiz
	5	Rectifiable curves and problems	3	To understand rectifiable curves and able to do the problems related to it.	Lecture with Illustration	Formative Assessment Test
II	**Sequences and series of functions**					
	1	Definition and examples of convergence sequence	3	Recall the definition understand the examples of convergence sequence	Lecture with Illustration	Test
	2	Definition and theorems based on uniform convergence and continuity	5	To distinguish between convergence and uniform convergence	Lecture	Open book assignment
	3	Theorems based on uniform convergence and differentiation	4	To understand the relation between the uniform convergence and differentiation	Lecture	Q&A
	4	Problems based on sequences and series of functions	4	To analyze and solve the problems	Group Discussion	Formative Assessment Test
III	**Equicontinuous families of function**					
	1	Definition and theorems based on equicontinuous families of functions	5	To understand the definition and theorems based on equicontinuous families of functions	Lecture with Illustration	Quiz
	2	Definition of uniformly closed algebra and uniformly closure	4	To understand the concept of uniformly closed algebra in various theorems	Lecture with Illustration	Slip Test

	3	Stone Weierstrass theorem	2	To learn Stone Weierstrass theorem	Lecture	Test
	4	Problems on equicontinuous families of functions	3	To apply the concept of equicontinuousand solve problems	Group Discussion	Brain Stroming
IV	**Some special functions**					
	1	Definition, Theorems and examples of analytic function and power series	4	To learn the concept of power series	Lecture with Illustration	Quiz
	2	The algebraic completeness of the complex field	3	To get the idea of algebraic completeness of the complex field	Lecture and group discussion	Test
	3	Definition and theorems related to Fourier Series	3	To learn the definition and theorems related to Fourier Series	Lecture with Illustration	Quiz and Test
	4	Problems related to Fourier Series and Dirichlet Kernel	2	To understand the significance of Fourier series and apply it in problems	Lecture with Illustration	Formative Assessment Test
	5	Localisation Theorem and Parseval's theorem	2	To learn the concept of trigonometric series	Lecture	Short Test
V	**Differentiation**					
	1	Introduction of differentiation , Definition of total and partial derivative and examples	4	To identify total derivative problems	Lecture with Illustration	Quiz
	2	Theorems and examples based on Partial derivatives	4	To apply the concept of Partial derivatives	Lecture with Illustration	Short Test

	3	Definition of continuously differentiable and related theorems	3	To utilize the concept of continuously differentiable	Lecture with Illustration	Open Book Assignment
	4	Contraction principle and related theorems	2	To interpret the concept of contraction principle	Lecture with Illustration	Assignment
	5	The inverse function theorem and problems	3	To develop the proof technique and solve problems.	Lecture with Illustration	Formative Assessment Test

Course Instructor(Aided): Dr. K. Jeya Daisy HOD(Aided) :Dr. V. M. Arul Flower Mary

Course Instructor(S.F): Ms. C.JoselinJenisha HOD(S.F) :Ms.J. Anne Mary Leema

Semester : II Major Core VII

Name of the Course : Partial Differential Equations

Course Code : PM2023

No. of hours per week	Credits	Total No. of hours	Marks
6	4	90	100

Objectives:

1. To formulate and solve different forms of partial differential equations.
2. Solve the related application oriented problems.

Course Outcome

CO	Upon completion of this course the student will be able to:	PSOs addressed	CL
CO-1	recall the definitions of complete integral, particular integral and singular integrals.	PSO-2	R
CO-2	learn some methods to solve the problems of non- linear first order partial differential equations. homogeneous and non homogeneous linear partial differential equations with constant coefficients and solve related problems.	PSO-1	U

CO-3	analyze the classification of partial differential equations in three independent variables – cauchy's problem for a second order partial differential equations.	PSO-3	An
CO-4	solve the boundary value problem for the heat equations and the wave equation.	PSO-4	Ap
CO-5	apply the concepts and methods in physical processes like heat transfer and electrostatics.	PSO-5	Ap

Total contact hours: 90 (Including lectures, assignments and tests)

Unit	Section	Topics	Lecture hours	Learning outcomes	Pedagogy	Assessment/ evaluation
I	**Non -linear partial differential equations of first order**					
	1	Explanation of terms, compactible system of first order equations, Examples related to compactible system	3	To Recall the definitions of complete integral, particular integral and singular integral	Lecture	Quiz
	2	Charpit's Method and problems, Problems related to charpit's method	4	ToAnalyzeCharpit's Method and to solve the problems.	Lecture	Assignment
	3	Problems related to charpit's method	2	To Learn Charpit's Method methods to solve the problems	Lecture	Test
	4	Solving problems using charpit's method	3	To Learn Charpit's Method methods to solve the problems	Lecture with group discussion	Test
	5	Problems related to charpit's method	3	To Learn Charpit's Method methods to solve the problems	Lecture	Assignment
II	**Homogeneous linear partial differential equation with constant coefficient**					
	1	Homogeneous and non- homogeneous linear equation with constant coefficient,	2	To Analyze homogeneous linear partial differential	Lecture	Test

		Solution of finding homogeneous equation with constant coefficient, Theorem I, II		equations with constant coefficients		
	2	Method of finding complementary function, Working rule for finding complementary function, Alternative working rule for finding complementary function	2	To Learn some methods to solve the problems of homogeneous linear partial differential equations with constant coefficients	Lecture	Test
	3	Some examples for finding Complementary function	3	To find Complementary function	Lecture	Test
	4	General method and working rule for finding the particular integral of homogeneous equation and some example	3	To find particular integral of homogeneous equation	Lecture	Test
	5	Examples to find the particular integral	3	To find particular integral	Lecture	Test
III	**Non – homogeneous linear partial differential equations with constant coefficient**					
	1	Definition, Reducible and irreducible linear differential operators, Reducible and irreducible linear partial differential equations with constant coefficient, Determination of	2	Analyze non-homogeneous linear partial differential equations with constant coefficients and to solve the problems	Lecture with group discussion	Quiz

		complementary function				
	2	General solution and particular integral of non-homogeneous equation and some examples of type 1	3	To solve problems related to non-homogeneous equations of type 1	Lecture	Assignment
	3	Some examples of type 2	3	To solve problems related to non-homogeneous equations of type 2	Lecture	Assignment
	4	Some problems related to type 3	3	To solve problems related to non-homogeneous equations of type 3	Lecture	Formative Assessment
	5	Examples related to type 4, Miscellaneous examples for the determination of particular integral	4	To solve problems related to non-homogeneous equations of type 4	Lecture	Assignment
IV	**Classification of P.D.E. Reduction to Canonical (or normal) forms.**					
	1	Classification of Partial Differential equations of second order - Classification of P.D.E. in three independent variables	2	To classify Partial Differential equations of second order & of P.D.E. in three independent variables	Lecture	Test
	2	Cauchy's problem for a second order P.D.E. Characteristic equation and Characteristic curves of the second order P.D.E.	2	To solveCauchy's problem for a second order P.D.E.	Lecture	Test
	3	Laplace transformation. Reduction to	4	To reduce hyperbolic equation to its Canonical forms.	Lecture	Assignment

		Canonical (or normal) forms.(Hyperbolic type)				
	4	Laplace transformation. Reduction to Canonical (or normal) forms.(Parabolic type)	4	To reduce Parabolic equation to its Canonical forms.	Lecture	Test
	5	Laplace transformation. Reduction to Canonical (or normal) forms.(Elliptic type)	3	To reduce elliptic equation to its Canonical forms.	Lecture	Test
V	**Boundary Value Problem**					
	1	A Boundary value problem, Solution by Separation of variables, Solution of one dimensional wave equation, D'Alembert's solution, Solution of two dimensional wave equation	3	To Solve the boundary value problems for the wave equations	Lecture	Quiz
	2	Vibration of a circular membrane, Examples related to vibration of a circular membrane	4	To Solve the boundary value problems related to vibration of a circular membrane	Lecture	Test
	3	Solution of one dimensional heat equation, Problems related to solution of one dimensional heat equation	4	To Solve the boundary value problems for the heat equations	Lecture	Formative Assessment

	4	Solution of two dimensional Laplace's equation	3	To find the Solution of two dimensional Laplace's equation	Lecture	Test
	5	Solution of two dimensional heat equation	3	To Apply the concepts and methods in physical processes like heat transfer and electrostatics	Lecture	Assignment

Course Instructor(Aided): Ms.J.C.Mahizha HOD(Aided) :Dr. V. M. Arul Flower Mary

Course Instructor(S.F): Ms. V. Princy Kala HOD(S.F) :Ms. J. Anne Mary Leema

Semester : II **Major Core VIII**

Name of the Course : Graph Theory

Course Code : PM2024

No. of hours per week	Credits	Total No. of hours	Marks
6	4	90	100

Objectives:

1. To introduce the important notions of graph theory.

2. Develop the skill of solving application oriented problems.

Course Outcome

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	identify cut vertices and understand various versions of connectedness of a graph.	PSO-1	An
CO - 2	understand the concept of Digraphs and characterize Eulerian Digraphs.	PSO-4	U,C
CO - 3	recall the definitions of Matchings and design proof for characterization of graphs containing a 1-factor.	PSO-1	R

CO - 4	solve problems involving coloring and learn necessary conditions for planar graphs.	PSO-2,3	Ap
CO - 5	learn the basic definitions of domination and review the concept of distance in a graph.	PSO-4	U

Total contact hours: 90 (Including lectures, assignments and tests)

Unit	Section	Topics	Lecture hours	Learning outcomes	Pedagogy	Assessment/ evaluation
I	**Connectivity**					
	1	Cut vertices - Definitions and Examples, Theorems based on Cut vertices, Theorems based on Cut vertices	4	Recall the basic definitions and fundamental concepts of graph theory	Lecture with illustration	Test
	2	Blocks - Definition and Example, Theorem based on nonseparable, Properties of blocks in a nontrivial connected graph, Connectivity - Definitions and Examples	3	Identify blocks and understand various versions of connectedness of a graph	Lecture	Test
	3	Hassler Whitney's Theorem, Theorems based on Connectivity, Connectivity and edge-connectivity number for the cubic graph	4	Solve problems involving connectivity	Lecture with Group Discussion	Test
	4	Harary graphs, Theorems based on Harary graphs,	4	Understand the concept of Harary graphs and Geodetic Sets.	Lecture	Test

		Geodetic Sets - Definitions and Examples, Theorem based on Geodetic Sets				
II	**Digraphs**					
	1	Strong Digraphs - Definitions and Examples, The First Theorem of Digraph Theory, Theorems related to Digraphs	3	To understand the definition of Strong Digraphs and prove theorems related to Digraphs	Lecture	Test
	2	Theorems related to Eulerian, Theorem related to Strong orientation	3	To prove theorems related to Eulerian and Strong orientation	Lecture	Formative Assessment Test
	3	Tournaments - Definitions and Examples, Theorem related to Tournaments	3	To practice various Theorems related to Tournaments	Lecture	Test
	4	Theorem based on Tournament and Hamiltonian path, Theorem based on strong tournament	3	Understand the concept of Hamiltonian path, and strong tournament	Lecture	Test
III	**Matchings and Factorization**					
	1	Matchings - Definitions and Examples, Theorem related to matching, Theorem related to system of distinct representatives	3	Identify Matchingsand prove theorems	Lecture	Quiz

	2	The Marriage Theorem, Theorem based on perfect matching, Gallai identities	3	To practice various Theorems	Lecture with illustration	Test
	3	Factorization - Definitions and Examples, Tutte's Theorem, Petersen's Theorem	3	To understand the concept Factorization with examples and theorems	Lecture with group discussion	Test
	4	Theorem based on 1- factor, Theorem based on 2-factorable, Hamiltonian Factorization, Theorem based on Hamiltonian Factorization	3	To compare the concepts 1- factor and 2-factorable, Hamiltonian and Factorization	Lecture	Assignment
	5	Theorem based on Kirkman triple system, Theorem based on Hamiltonian cycles and 1-factor, Decompositions and Graceful Labelings- Definitions and examples, Theorems related to Graceful labeling	3	To understand the definitions of Hamiltonian cycles, Decompositions and Graceful Labelings.		Formative Assessment Test
IV	**Planarity and Coloring**					
	1	Planar Graphs Planar Graphs - Definitions and Examples, The Euler Identity, Consequence of Euler Identity,	3	Cite examples of planar and nonplanar graphs	Lecture with illustration	Quiz

		Theorems related to Planar Graphs				
	2	Necessary condition for a graph to be planar, Kuratowski's Theorem, Vertex Coloring - Definitions and Examples, The Four Color Theorem	3	Learn necessary conditions for planar graphs	Lecture	Test
	3	Theorems and Examples related to chromatic number, An upper bound for the chromatic number of a graph in terms of its maximum degree, Brook's Theorem, Theorem based on triangle - free graph	3	To practice various Theorems	Lecture	Test
	4	Theorem based on triangle - free graph, Edge Coloring- Definitions and Examples, Vizing's Theorem, Theorems related to edge chromatic number	3	Understand the concept of Edge Coloring and edge chromatic number	Lecture	Test
	5	The Five Color Theorem, The Heawood Map Coloring Theorem and it's corollary	3	To practice various Theorems	Lecture with group discussion	Test
V	**Distance and Domination**					

	1	Distance - The center of a graph, Definitions and examples	3	To identify the center of a graph	Lecture	Assignment
	2	Theorems based on center of a graph, Distant Vertices, Periphery of the graph.	3	To practice various Theorems	Lecture with illustration	Assignment
	3	Theorems based on eccentricity, Theorems based on boundary vertex .Definition of interior vertex and related theorem .	3	To practice various Theorems	Lecture	Test
	4	The domination number of a graph- Definitions and Examples. Theorems related to domination number of a graph. Bounds for domination number.	3	To understand the concepts of domination and to practice various theorems	Lecture with illustration	Assignment
	5	Stratification. Definition of stratified graph. Definition of F domination number and F coloring. Theorems related to Fdomination number and F coloring	3	To understand the facts of Stratification and to practice various Theorems	Lecture with group discussion	Assignment

Course Instructor(Aided): Dr.V.Sujin Flower HOD(Aided) :Dr. V. M. Arul Flower Mary

Course Instructor(S.F): Dr.J.C.Eveline HOD(S.F) :Ms. J. Anne Mary Leema

Semester **: II** **Elective II**

Name of the Course **: Classical Dynamics**

Course Code **: PM2025**

No. of hours per week	Credits	Total No. of hours	Marks
6	4	90	100

Objectives:

1. To gain deep insight into concepts of Dynamics.

2. To do significant contemporary research.

Course Outcome

CO	Uponcompletion ofthiscoursethestudents Willbeableto:	PSO addressed	CL
CO–1	recall the concepts of Newton's laws of motion, momentum, acceleration, motion of a particle.	PSO-4	R
CO–2	understanding the generalized co-ordinates of the Mechanical system.	PSO-1	U
CO–3	apply D'Alembert's Principle to solve the problems involving System of particles.	PSO-2	Ap
CO-4	Solve the Newton's equations for simple configuration using Various methods.	PSO-1	C
CO-5	transforming the Lagrangian equations to Hamiltonian equations.	PSO-2	U
CO-6	define the canonical transformations and Lagrange and Poisson brackets.	PSO-4	R

Total contact hours: 90 (Including lectures, assignments and tests)

Unit	Section	Topics	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
I	**The Mechanical System**					
	1	Introduction on the Mechanical System, equations	3	Understanding the generalized co-ordinates,	Lecture	Short Test

		of motion, generalized coordinates , degrees of freedom, configuration space		degrees of freedom, configuration space of the Mechanical system.		
	2	Holonomic constraints, Nonholonomic constraints, Unilateral constraints and examples	3	To define Holonomic constraints, Nonholonomic constraints, Unilateral constraints with illustration	Lecture and group discussion	Test
	3	Virtual displacement and virtual work, Principle of virtual work, D' Alembert's Principle,	3	To identify virtual displacement and virtual work, Principle of virtual work, D' Alembert's Principle,	Lecture	Test
	4	Generalized force and examples, Potential energy, work and kinetic energy, Conservation of energy	3	Define Generalized force with examples, Potential energy, work and kinetic energy, Conservation of energy	Lecture	Test
	5	Equilibrium and stability, angular momentum, generalized momentum and examples.	3	To study generalized momentum, angular momentum and examples.	Lecture	Test

II	**Derivation of Lagrange's equations**					
	1	Problems using Lagrange's equation, Form of the equations of motion, Nonholonomic systems.	3	To solve problems using Lagrange's equation, Form of the equations of motion and Non holonomic systems.	Lecture	Test
	2	Spherical pendulum, Double pendulum, Lagrange Multiplier and constraint forces	3	To define Spherical pendulum, Double pendulum, Lagrange Multiplier and constraint forces	Lecture and discussion	Test
	3	Particle in whirling tube, A particle with moving support,	3	To understand particle in whirling tube, and the particle with moving support,	Lecture	Formative Assessment
	4	Rheonomic constrained system, Ignorable coordinates, Example based on the Kepler Problem	3	To define rheonomic constrained system, Ignorable coordinates and example based on the Kepler Problem	Lecture	Test
	5	Routhian Function, Conservative systems, Natural systems, Liouville'ssystem	3	To understand Routhian Function, Conservative systems, Natural systems	Lecture	Test

				and Liouville's system		
III	**Hamilton's Principle**					
	1	Stationary values of afunction, Constrained Stationary values, Stationary value of a definite integral.	3	To define stationary values of a function, Constrained Stationary values and stationary value of a definite integral.	Lecture and discussion	Test
	2	Solving The Brachistochrone problem and Geodesic path Case of n independent variables	3	To solve the Brachistochrone problem and Geodesic path Case of n independent variables	Lecture	Test
	3	Multiplier Rule, Derivation of Hamilton's Equations The form of the Hamiltonian function	3	To understand Multiplier Rule, and Derivation of Hamilton's Equations and the form of the Hamiltonian function	Lecture and discussion	Test
	4	Legendre transformation The form of the Hamiltonian function Problems based on Hamilton's Equations	3	To evaluate the form of the Hamiltonian function Problems based on Hamilton's Equations	Lecture	Test
	5	Modified Hamilton's Principle Principle	3	To understand Modified Hamilton's	Lecture	Formative Assessment

		of least action, Problems based on other Variational Principles		Principle ,Principle of least action and Problems based on other Variational Principles		
IV	**Hamilton's Principal function**					
	1	Introduction on Hamilton's Principal function The canonical integral Pfaffian differential forms	3	To understand the foundation of Hamilton's Principle and differential forms.	Lecture	Test
	2	The Hamilton - Jacobi equation, Illustration of the Hamilton- Jacobi equation	3	To understand The Hamilton - Jacobi equationwith Illustration	Lecture	Test
	3	Any complete solution of the Hamilton - Jacobi equation leads to a solution of the Hamilton Problem	3	Evaluating any complete solution of the Hamilton - Jacobi equation	Lecture	Test
	4	Kepler's Problem. Jacobi's theorem, Conservative systems	3	To learn Kepler's Problem. Jacobi's theorem and Conservative systems	Lecture	Test
	5	Ignorable coordinates, Modified Hamilton - Jacobi equation Examples on	3	To understand Ignorable coordinates, Modified Hamilton - Jacobi equation with Examples	Lecture and discussion	Test

		Ignorable coordinates				
V	**Canonical Transformations**					
	1	Introduction to Differential forms and generating functions, Canonical Transformations Principle form of generating functions	3	To understand Differential forms generating functions, Canonical Transformations and Principle form of generating functions	Lecture	Test
	2	Further comments on the Hamilton-Jacobi method, Examples on Canonical Transformations, Some simple transformations	3	To identify the Hamilton-Jacobi method with Examples on Canonical Transformations and some simple transformations	Lecture	Test
	3	Homogenous canonical transformations, Point transformations, Momentum transformations	3	To understand Homogenous canonical transformations, Point transformations, Momentum transformations	Lecture	Test
	4	. Examples based on Special transformations,	3	To identify examples based on Special transformations	Lecture	Test
	5	Introduction to Lagrange and Poisson brackets, Problems based on	3	To understand Lagrange and Poisson brackets,	Lecture	Formative Assessment

		Lagrange and Poisson brackets, The bilinear Covariant		Problems based on Lagrange and Poisson brackets and the bilinear Covariant		

Course Instructor(Aided): Ms. J. Befija Minnie HOD(Aided) :Dr. V. M. Arul Flower Mary

Course Instructor(S.F): Ms. V.G. Michael Florance HOD(S.F) :Ms. J. Anne Mary Leema

Semester : IV **Major Core XII**

Name of the Course :Complex Analysis

Subject code : PM1741

Teaching Plan

Unit	Section	Topics	Lecture hours	Learning outcomes	Pedagogy	Assessment /evaluation
I	**Complex Functions**					
	1	Introduction to theConcept of Analytic Function - Analytic functions	4	To understand the concept of analytic function	Lecture with illustration	Test
	2	Polynomials	2	To understand the concept and practice theorems	Lecture with illustration	Test
	3	Rational functions	4	To understand the concept and practice theorems	Video	Test
	4	Elementary Theory of Power Series-Sequences, Series	2	To understand the concept of sequences & series	Lecture	Test
	5	Uniform Convergence	2	To understand the concept Uniform Convergence and develop theorems	Lecture with group disscussion	Formative Assessment Test I
II	**Power series**					
	1	Definition and Problems related to Power Series and Radius of Convergence	4	To understand the definition of Power Series and Radius of Convergence and solve problems based on the concept	Lecture with group disscussion	Assignment
	2	Abel's theorem, Abel's limit theorem	3	To understand the concept and practice theorems	Lecture	Quiz
	3	The Exponential	3	To understand the concept and practice theorems and solve problems based on the concept	Lecture with illustration	Formative Assessment Test I &II
	4	Trigonometric functions, The periodicity	4	To understand the concept of Trigonometric functions& The periodicity and solve problems based on the concept	Lecture with group disscussion	Test
III	**Analytic functions as mappings**					
	1	conformality - Arcs and	5	To understand the	Lecture	Test

		closed curves, Analytic Functions in Regions		definition of Arcs and closed curves& Analytic Functions in Regions	with illustration	
	2	Conformal Mapping	3	To understand the concept of Conformal Mapping	Lecture	Test
	3	Length and Area, Linear transformations - The linear group	2	To understand the concepts and give illustrations	Lecture	Quiz
	4	The Cross Ratio, Symmetry	5	To understand the concepts of The Cross Ratio&Symmetry and develop theorems.	Lecture with group disscussion	Formative Assessment Test II
IV	**Complex Integration**					
	1	Fundamental theorems - Line Integrals ,Rectifiable Arcs	4	To understand the concept and practice theorems	Lecture with illustration	Test
	2	Line Integrals as Functions of Arcs, Cauchy's Theorem for a Rectangle, Cauchy's Theorem in a Disk	4	To practice theorems based on this concepts	Lecture	Test
	3	Cauchy's integral formula, The Index of a Point with Respect to a Closed Curve	3	To understand the concept and practice theorems related to this concepts.	Lecture with illustration	Test
	4	The Integral Formula, Higher Derivatives	2	To solve problems using this concepts.	Lecture	Formative Assessment Test II &III
	5	Local Properties of Analytic Functions - Removable singularties and Taylor's theorem, Zeros and poles.	4	To understand the concepts and give illustrations& practice theorems	Seminar	
V	**The local mapping**					
	1	The maximum principle, The General Form of Cauchy's Theorem	5	To understand the concept and practice theorems related to this concepts.	Lecture with illustration	Assignment
	2	Chains and Cycles, Simple Connectivity, Homology	3	To understand the concept and practice theorems related to this concepts.	Lecture with illustration	Quiz
	3	The General Statement of Cauchy's Theorem (statement only), The Calculus of Residues	3	To understand the concept about Calculus of Residues.	Lecture	Test
	4	The Residue Theorem, The Argument Principle	2	To understand the concept and practice	Lecture with illustration	Formative Assessment

				theorems related to this concepts.		Test III
	5	Evaluation of Definite Integrals.	2	To solve problems related to Definite Integrals.	Video	Test

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Semester : IV **Major Core XIII**

Name of the Course : Functional Analysis

Subject code : PM1742

Teaching Plan

Unit	Section	Topics	Lecture hours	Learning outcomes	Pedagogy	Assessment/ evaluation
I	**Normed linear space**					
	1.	Definition and, examples of a normed linear space and a Banach Space, Small preliminary results,Theorem-N/M is a Banach space	2	To understand the concept ofnormed linear space	Lecture	Test
	2.	Properties of a Closed unit sphere Holder's Inequality and Minkowski's Inequality, Equivalent conditions theorem on continuous linear transformations	3	To understand the Properties of a Closed unit sphere	Lecture with illustrations	Group Discussion
	3.	$B(N,N^1)$is a Banach space,Functionals and it's properties	2	To understand the concept ofFunctionals and it's properties	Lecture	Test
	4.	Definition of an Operator and small results on operators Side result of Hahn Banach theorem Hahn Banach theorem	4	Defining the Operator	Lecture	Test
	5.	Theorem based on N*, Theorem based on functional in N*, Problems based on Normed linear spaces	2	To apply the definitions to prove the theorem	Lecture with illustrations	Group discussion
II	**Conjugate space**					
	1.	Definitions of second conjugate space, induced functional,weak topology, weak* topology,strong	5	To understand the definition of conjugate space,weak* topology,strong topology.	Lecture	Test

		topology,B(N,N1)is a Banach space Functionals and it's properties				
	2.	Theorem on isometric isomorphism of Open mapping theorem) Open mapping theorem	5	To apply the definition and Lemmato prove the theorem	Lecture	Q&A
	3.	Theorem on Projection Closed Graph TheoremUniform , Boundedness Theorem on isometric isomorphism	5	To practice theorems related to this concepts.	Lecture	Formative Assessment Test
III	**Hilbert Space**					
	1.	Definition and examples,Properties of a Hilbert Space,Schwarz Inequality,Parallelogram lawTheorem on Convex subset of a Hilbert Space	3	To understand the Definition of a Hilbert Space	Lecture	Quiz
	2.	Theorem on Orthogonal Complements, Theorem on Orthogonal Complements, Theorem on closed linear subspaces	2	To apply the laws to prove the theorem	Lecture with illustration	Test
	3.	Theorem on the direct sum of closed linear subspace M of a Hilbert Space and M† Bessel's Inequality Orthonormal Sets	5	To apply the Bessel's Inequality on Theorems	Lecture with group discussion	Brain storming
	4.	Theorems on Orthonormal Sets Gram –Schmidt Orthogonalization Process Theorem on Conjugate Space H*	5	To understand the concept of Schmidt Orthogonalization Process	Lecture	Assignment
IV	**Adjoint operator**					
	1.	Definition and small results, Theorem on the properties of an adjoint operator Theorem on the properties of an adjoint operator	3	Acquire the knowledge about properties of an adjoint operator	Lecture with illustration	Q&A
	2.	Theorem-The set of all self adjoint operators is a real Banach space, Theorems on self adjoint operators Theorems on self adjoint	3	Applying theorems on self adjoint operators	Lecture	Q&A

		operators				
	3.	Properties on Normal and Unitary Operators , Theorems on Normal and Unitary Operators, Theorems on Normal and Unitary Operators, Projections-Definitions and preliminaries Theorems on Projections	5	Acquire the knowledge about Normal and Unitary Operators	Lecture	Slip Test
	4.	Theorems on Projections, Theorems on invariant subspace Projection theorem Problems on Projections	4	Apply the concept of invariant subspace on theorems	Lecture	Formative Assessment Test
V		**Eigen vectors and Eigen values**				
	1.	Eigen vectors and Eigen values, Results on Eigen vectors and Eigen values, Properties of matrices	3	To understand the definition of Eigen vectors and Eigen values	Lecture with illustration	Quiz
	2.	Properties of matrices Theorems on Matrices, Theorem on similar matricesand Properties of Determinants	4	To categorize the Properties of matrices on Theorems	Lecture	Test
	3.	Properties of Determinants, Theorems on Determinants, Theorems on Determinants and Side results of Spectral Theorem	5	To know Properties of Determinants	Lecture	Slip Test
	4.	Spectral Theorem and Spectral Resolution Theorem on Spectral Resolution	4	To apply the previous results on Spectral Theorem	Lecture	Assignment

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Semester : IV **Major Core XIV**

Name of the course : Operations

Research Course code : PM1743

Teaching Plan

Unit	Modules	Topics	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
I	**Elements of DP model**					
	1	Elements of the DP Model, Network model, Backward recursive equation	4	Recall the definitions and basic concepts of linear programming, Express the fundamental concepts of network model	Lecture with illustration	Short Test Formative assessment I
	2	More on the definition of the state Examples of DP models and computation	3	Express the fundamental concepts of dynamic programming	Lecture with PPT illustration	
	3	Reliability problem, Optimal subdivision problem, Forward and backward recursive equation	3	Understand the significance and application of Reliability problem, Optimal subdivision problem , backward recursive equation	Lecture discussion	
	4	Solution of linear programming by dynamic programming	2	Formulate and solve LPP by dynamic programming	Lecture with illustration	
	5	Game theory	3	Express the fundamental concepts of Game theory	Lecture discussion	
II	**Arrow (Network) Diagram**					
	1	Introduction Arrow (Network) ,Diagram Representations	3	Recall the definitions and basic concepts Arrow (Network) ,Diagram Representations	Lecture with illustration	Short Test Formative assessment I, II Seminar on Arrow (Network) Diagram
	2	Critical Path Calculations, Problem based on critical Path Calculations, Determination of floats	4	Understand the significance and application of Critical Path Calculations, Problem based on critical Path Calculations, Determination of	Lecture with PPT illustration	

				floats		
	3	Construction of the Time Chart and Resource Leveling, Problems based on Time Chart and Resource Leveling	4	Understand the construction of the Time Chart and Resource Leveling, Problems based on Time Chart	Lecture with PPT illustration	
	4	Probability and Cost Considerations in Project Scheduling . Problems based on Probability and Cost Considerations in Project Scheduling .	2	Understand the properties of Probability and Cost Considerations in Project Scheduling	Lecture with discussion	
III	**Generalised Inventory model**					
	1	Introduction, Generalised Inventory model, Types of Inventory Models	4	Understand the theory of Inventory model	Lecture with illustration	Short Test Formative assessment II Seminar on Generalised Inventory model
	2	Deterministic Models, Single Item Static Model, Problems based on Single Item Static Model	4	Understand the significance and application of Single Item Static Model	Lecture with illustration	
	3	Single Item Static Model with Price Breaks, Problems based on Single Item Static Model with Price Breaks	3	Understand the theory of Single Item Static Model with Price Breaks	Lecture with illustration	
	4	Multiple - Item static Model with Storage Limitations, Problems based on Multiple - Item static Model with Storage Limitations	2	Understand the theory of Multiple - Item static Model with Storage Limitations	Lecture with PPT illustration	
	5	Single – Item static Model with Storage Limitations, Planning horizontal theorem	2	Understand the theory of Single – Item static Model with Storage Limitations, Planning horizontal theorem	Lecture with discussion	
IV	**Queueing Model**					
	1	Basic Elements of the Queueing Model, Roles of Poisson Distributions, Roles of Exponential Distributions	3	Understand the theory of Queueing Model	Lecture with PPT illustration	Short Test Formative assessment III
	2	Arrival process, Examples of arrival process	2	Recall the definitions and basic concepts of Poisson	Lecture with illustration	

				Distributions and Exponential Distributions		
	3	Departure process, Queue with Combined Arrivals and Departure	3	Understand the theory of Queue with Combined Arrivals and Departure	Lecture with illustration	
	4	Problems based on Queue with Combined Arrivals and Departure	2	Formulate and solve Problems based on Queue with Combined Arrivals and Departure	Lecture with illustration	
	5	Queueing Models of Type : (M/M/1): (GD/∞/∞), Problems based on: (M/M/1): (GD/∞/∞)	3	Understand the theory of Queueing Models of Type : (M/M/1): (GD/∞/∞)	Lecture with discussion	
	6	(M/M/1): (GD/N/∞) , Problems based on (M/M/1): (GD/N/∞)	3	Understand the theory of Queueing Models of Type : (M/M/1): (GD/N/∞)	Lecture with discussion	
V	**Types of Queueing Models**					
	1	Queueing Model (M/G/1): (GD/∞/∞), (M/M/C) : (GD/∞/∞)	4	Recall the definitions and basic concepts of Queueing Model	Lecture with illustration	Short Test Formative assessment III
	2	Problems based on(M/M/C) : (GD/∞/∞), (M/M/∞) : (GD/∞/∞) Self service Model	4	Develop the knowledge of solving problems based on (M/M/C) : (GD/∞/∞), (M/M/∞) : (GD/∞/∞) model	Lecture with illustration	
	3	(M/M/R) : (GD/K/K) R < K - Machine Service, Problems based on(M/M/R) : (GD/K/K) R < K - Machine Service	4	Develop the knowledge of solving problems based on (M/M/R) : (GD/K/K) R < K - Machine Service model	Lecture with illustration	
	4	Tandem or series queues	3	Develop the knowledge of Tandem or series queues	Lecture with PPT illustration	

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Semester : IV **Major Core XV**

Name of the course : Algorithmic Graph Theory

Course code : PM1744

Teaching Plan

Unit	Modules	Topics	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
I	**The Role of Algorithms in Computing and Getting Started**					
	1	Role of algorithms in computing, Data structures and technique	4	Recall the definitions and basic concepts of graph theory, Express the fundamental concepts of algorithms	Lecture with illustration	Evaluation through: Short Test Formative assessment I
	2	Algorithms and other technologies	4	Express the fundamental concepts of technologies	Lecture with PPT illustration	
	3	Insertion sort and its algorithm, Pseudocode conventions	4	Recall the definitions and basic concepts of graph theory, Express the fundamental concepts of pseudocode	Lecture with illustration	
	4	Worst-case and average-case analysis	3	Express the fundamental concepts of algorithms, Demonstrate the use of algorithms in worst case and average case analysis	Lecture with illustration	
II	**Elementary Graph Algorithms**					
	1	Representation of graphs – adjacency list representation, adjacency matrix representation	4	Recall the definitions and basic concepts of graph theory, Express the fundamental concepts of adjacency matrix representation	Lecture with illustration	Short Test Formative assessment I, II
	2	Definitions and Breadth first Search algorithms, Shortest paths and related Lemmas, Corollary and correctness of Breadth	4	Recall the definitions and basic concepts of graph theory, Understand the algorithm of BFS	Lecture with PPT illustration	

		first Search theorem				
	3	Breadth-first trees, related Lemma, Definitions and Depth first search algorithms	4	Recall the definitions and basic concepts of graph theory, Understand the algorithm of DFS	Lecture with PPT illustration	
	4	Parenthesis theorem, Corollary on nesting of descendant's intervals, White-path theorem	5	Understand the properties of DFS, Distinguish between BFS and DFS	Lecture with illustration	
III	**Growing a minimum spanning tree and The algorithms of Kruskal and Prim**					
	1	Theorem, Corollary related to Growing a minimum spanning tree	3	Understand the theory of spanning tree	Lecture with illustration	Short Test Formative assessment II Assignment on minimum spanning tree
	2	Kruskal's algorithm	3	Recall the definitions and basic concepts of graph theory, Understand the theory of Kruskal's algorithm	Lecture with illustration	
	3	Prim's algorithm, The execution of Prim's algorithm on the graph	4	Understand the theory of Prim's algorithm	Lecture with illustration	
	4	Problems based on minimum spanning tree	3	Recall the definitions and basic concepts of algorithms	Lecture with PPT illustration	
IV	**The Bellman – Ford algorithm and Dijkstra's algorithm**					
	1	Lemma and Corollary based on correctness of the Bellman-Ford algorithm	5	Understand the theory of Bellman-Ford algorithm	Lecture with PPT illustration	Short Test Formative assessment III
	2	Theorem and definition related to Single-source shortest paths in directed acyclic graphs	3	Recall the definitions and basic concepts of graph theory	Lecture with illustration	
	3	Dijkstra's algorithm, The execution of Dijkstra's algorithm	3	Understand the theory of Dijkstra's algorithm	Lecture with illustration	
	4	Corollary and analysis of Dijkstra's algorithm	4	Understand the execution of Dijkstra's algorithm	Lecture with illustration	
V	**Shortest paths and Matrix multiplication, The Floyd-Warshall algorithm**					
	1	Computing the shortest-	3	Recall the	Lecture	Short Test

		path weights bottom up algorithm		definitions and basic concepts of graph theory	with illustration	Formative assessment III Seminar on shortest paths
	2	Algorithm for matrix multiplication, Improving the running time and technique of repeated squaring	3	Develop the knowledge of shortest paths and establish new relationship in matrix multiplication	Lecture with illustration	
	3	The structure of a shortest path, A recursive solution to the all-pairs shortest paths problem	4	Develop the knowledge of shortest paths and establish new relationship in matrix multiplication	Lecture with illustration	
	4	Computing the shortest-path weights bottom up algorithm, Transitive closure of a directed graph algorithm	4	Develop the knowledge of shortest paths and establish new relationship in matrix multiplication	Lecture with PPT illustration	

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Semester: IV **Elective IV**

Name of the Course:Combinatorics

Subject Code:PM1745

Teaching Plan

Unit	Modules	Topics	Lecture hours	Learning Outcome	Pedagogy	Assessment Evaluation
I	1.	Permutations and combinations	1	To understand Permutations and combinations	Lecture, Illustration	Evaluation through : Class test Quiz Formative assessment- I
	2.	The Rules of sum and product	6	To define the Rules of sum and product and to apply those definitions to solve problems	Lecture, Illustration, Group discussion, Problem Solving	
	3.	Permutations	4	To understand Permutations in detail and to apply the concepts to solve problems	Lecture, Illustration, Discussion, Problem Solving	
	4.	Combinations	3	To understand Combinations in detail and to apply the concepts to solve problems	Lecture, Illustration, Problem Solving	
	5.	Distribution of Distinct Objects	1	To understand the distribution of distinct objects	Lecture, Illustration	
II	1.	Generating Functions	5	To understand generating functions and their types	Lecture, Discussion	Formative assessment- I Multiple choice questions Short test Formative assessment-II
	2.	Generating Functions for Combinations	5	To understand the generating functions for combinations and use them to solve problems	Lecture, Group discussion, Problem Solving	
	3.	Enumerators for	5	To understand the Enumerators	Lecture, Illustration,	

		Permutations .		for Permutations and use them to solve problems	Problem Solving	
III	1.	Recurrence Relations	5	To understand the recurrence relations	Lecture, Group discussion, Problem Solving	Multiple choice questions Unit test Formative assessment- II
	2.	Linear Recurrence Relations with Constant Coefficients	5	To understand the linear recurrence relations with constant coefficients and use them to solve problems	Lecture, Illustration, Problem Solving	
	3.	Solution by the Technique of Generating Functions	5	To solve problems by the technique of generating functions	Lecture, Problem Solving	
IV	1.	The Principle of Inclusion and Exclusion	1	To understand the principle of inclusion and exclusion	Lecture, Group discussion	Formative assessment- II Seminar on permutations with restrictions on relative positions Assignment on derangements and the Rook polynomials Formative assessment- III
	2.	The General Formula	1	To understand the general formula	Lecture, Discussion	
	3.	Derangements	5	To dearrange objects and to solve related problems	Lecture, Illustration, Problem Solving	
	4.	Permutations with Restrictions on Relative Positions	4	To learn permutations with restrictions on relative positions	Lecture, Discussion, Problem Solving	
	5.	The Rook Polynomials	4	To understand the Rook polynomials and to solve related problems	Lecture, Problem Solving	
V	1.	Polya's Theory of Counting	1	To understand Polya's theory of counting	Lecture, Illustration	Seminar on equivalence

						classes under a permutation group and functions
	2.	Equivalence Classes under a Permutation Group	5	To understand equivalence classes under a permutation group	Lecture, Discussion, Problem Solving Problem Solving	Short test
	3.	Equivalence classes of Function	4	To understand equivalence classes of function	Lecture, Group discussion, Problem Solving	
	4.	Weights and Inventories of Functions	4	To understand weights and inventories of functions	Lecture, Illustration, Problem Solving	Formative assessment- III
	5.	Polya's Fundamental Theorem.	1	To understand and prove Polya's fundamental theorem	Lecture	

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