BISHOP HEBER COLLEGE (AUTONOMOUS)
TIRUCHIRAPPALLI – 620017
TAMILNADU, INDIA

COURSE OUTCOMES

DEPARTMENT OF MATHEMATICS

STRUCTURE OF THE SYLLABUS

PROGRAM NAME	COURSE	COURSE CODE	COURSE NAME
B Sc Mathematics	Core I	U21MA101	Algebra, Trigonometry and Differential Calculus
B Sc Mathematics	Core II	U21MA202	Integral Calculus and Analytical Geometry of Three Dimensions
B Sc Mathematics	Elective I	U21MA2:1	Vector Calculus
B Sc Mathematics	Core III	U21MA303	Sequences and Series
B Sc Mathematics	Core IV	U21MA304	Differential Equations and Laplace Transforms
B Sc Mathematics	Allied III	U21MAS31	Mathematical Statistics I
B Sc Mathematics	Core V	U21MA405	Theory of Equations and Fourier Series
B Sc Mathematics	Allied IV	U21MAS42	Mathematical Statistics II
B Sc Mathematics	Allied Practical	U21MA4P1	Mathematical Statistics III
B Sc Mathematics	Core VI	U21MA506	Algebra
B Sc Mathematics	Core VII	U21MA507	Real Analysis
B Sc Mathematics	Core VIII	U21MA508	Mechanics
B Sc Mathematics	Core IX	U21MA509	Numerical Methods
B Sc Mathematics	Elective II	U21MA5:2	Graph Theory
B Sc Mathematics	Core X	U21MA610	Complex Analysis
B Sc Mathematics	Core XI	U21MA611	Discrete Mathematics
B Sc Mathematics	Core XII	U21MA612	Elementary Number Theory
B Sc Mathematics	Elective III	U21MA613	Operations Research
B Sc Mathematics	Elective II	U21MA6:3	Mathematical Modeling

Core Course I: ALGEBRA, TRIGONOMETRY AND DIFFERENTIAL CALCULUS
Semester: I **Course Code: U21MA101**
Credit: 4 **Hours/Week: 5**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Find the Eigen values, Eigen vectors of a given matrix and diagonalize the matrices.	K3	I
CO2	Describe circular functions as a series	K5	II
CO3	Formulate Curvature, Radius of curvature, Evolutes and Involutes of any curve	K5	III
CO4	Examine the higher derivatives, Maxima and Minima of given functions.	K4	IV
CO5	Apply higher derivatives in the practical situation problems.	K3	IV
CO6	Verify Euler's theorem for partial differentiation	K6	V

Core course II: INTEGRAL CALCULUS AND ANALYTICAL GEOMETRY OF THREE DIMENSIONS
Semester: II **Course Code: U21MA202**
Credits: 5 **Hours/Week: 5**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Evaluate the solution of integrals of some functions	K5	I
CO2	Solve complex integrals by beta and gamma functions	K3	II
CO3	Evaluate Multiple integrals	K5	III
CO4	Explain straight line in three dimensions	K5	IV
CO5	Interpret about sphere	K5	V
CO6	Illustrate tangent plane to a given sphere	K2	V

Elective Course I: VECTOR CALCULUS

Semester: II **Course Code: U21MA2:1**
Credits: 5 **Hours/Week: 6**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Explain about derivative of vector and scalar functions	K5	I
CO2	Evaluate gradient and directional derivative of scalar point functions	K5	I
CO3	Estimate divergence and curl of a vector point functions	K6	II
CO4	Determine vector integration	K5	III
CO5	Evaluate line, surface and volume integrals	K5	IV
CO6	Apply Stoke's and Greens theorem to compute the integrals	K3	V

Elective Course I: MATHLAB

Semester: II **Course Code: U21MA2:2**
Credit: 5 **Hours/Week: 6**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Discuss the MATLAB Basics, MATLAB interface and M Files	K3	I
CO2	Analyze Functions and Expressions, MATLAB Graphics	K5	II
CO3	Formulate MATLAB programming	K5	III
CO4	Examine SIMULLINK and GUIS SIMULINK, Monte Carlo Simulation	K4	IV
CO5	Construct Linear Economic Models, Linear Programming	K3	IV
CO6	Verify the applications, Numerical solution of the Heat Equation, Model of Traffic flow and Troubleshooting	K6	V

Core Course III: SEQUENCES AND SERIES

Semester: III **Course Code: U21MA303**
Credits: 4 **Hours/Week: 5**

At the end of this course, the students will be able to

CO.No.	Course Outcomes	Level	Unit
CO 1	Explain on basic terminology and convergence of sequences	K5	I
CO 2	Illustrate properties of convergent and divergent sequences.	K2	II
CO 3	Solve problems by applying properties	K3	II
CO 4	Explain the behavior of series and convergence of geometric series	K5	III
CO 5	Determine if a series convergent or divergent by applying various test	K5	IV
CO 6	Solve the alternating series problems.	K3	V

Core Course IV: DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORMS

Semester: III **Course Code: U21MA304**
Credits: 4 **Hours/Week: 5**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Solve ordinary differential equations of first and second order.	K3	I
CO2	Find Particular integral for various forms of X.	K5	I
CO3	Solve exact differential equations of first order but of higher degree.	K3	II
CO4	Identify the standard form of partial differential equation.	K4	III
CO5	Define Laplace and inverse Laplace transforms.	K3	IV
CO6	Apply Laplace transforms to solve differential equations.	K6	V

Allied course III: MATHEMATICAL STATISTICS I

Semester: III **Course Code: U21MAS31**
Credits: 4 **Hours/Week: 4**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Analyse statistical data using the measure of central tendency, measures of dispersion, skewness, and kurtosis.	K4	I
CO2	Apply the basic probability rules under additive and multiplication laws, illustrating independent and mutually exclusive events	K3	II
CO3	Identity the characteristics of different discrete and continuous distribution.	K2	II
CO4	Distinguish various density function and find mathematical expectation, moments, and characteristics function.	K5	III
CO5	Determine expectation, variance and moment generating function of continuous random variable	K5	IV
CO6	Evaluate the correlation and regression.	K5	V

Core Course V: THEORY OF EQUATIONS AND FOURIER SERIES

Semester: IV **Course Code: U21MA405**
Credits: 5 **Hours/Week: 6**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Relation between the roots and coefficients of a polynomial equation	K5	I
CO2	Identify reciprocal equations from polynomial equations and apply relevant methods to solve them	K3	II
CO3	Apply rules of signs to find the real roots and imaginary roots of a polynomial equation.	K3	III
CO4	Determine the transformed equation by increasing or decreasing the roots of the given equation.	K3	III
CO5	Explain periodic functions and find Fourier series expansion for them	K5	IV
CO6	Distinguish between odd and even functions and apply the formulae to find the Fourier series expansion accordingly	K4	V

Allied course IV: MATHEMATICAL STATISTICS II

Semester: IV **Course Code: U21MAS42**
Credits: 4 **Hours/Week: 6**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Apply the theoretical discrete and Continuous distribution	K3	I
CO2	Analyze the Normal, Gamma, Beta, Exponential, Chi-square distributions.	K4	II
CO3	Identify Sampling, Parameter and Statistic, Estimators, Rao-Cramer inequality.	K3	III
CO4	Evaluate Test of significance, Null hypothesis, Sampling distributions.	K5	IV
CO5	Evaluate Chi-Square probability cure, Chi-Square distribution, F-Statistic, ANOVA (one way classification).	K5	V
CO6	Evaluate Samplings, Null hypothesis, Test of significance, Chi – Square distribution	K5	V

Allied Practical – Mathematical Statistics III

Semester: IV **Course Code: U21MA4P1**
Credit: 2 **Hours/Week: 4**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO 1	Download and install R and R Studio	K2	I
CO 2	Learn to apply R programming for data processing	K2	II
CO 3	Develop codes using R for analyzing statistical data	K3	III
CO 4	Produce data visualizations using packages	K3	II
CO 5	Compute basic summary statistics	K3	V
CO 6	Use different modules of R for different applications to analyse data.	K4	IV

Core Course VI: ALGEBRA

Semester: V **Course Code: U21MA506**
Credits: 6 **Hours/Week: 6**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Analyze of groups, Subgroups, Cyclic groups, Order of an element, Cosets and Lagrange's Theorems.	K4	I
CO2	Analyze Normal subgroups and Quotient groups	K4	II
CO3	Identify different algebraic structure of Isomorphism and Homomorphism	K3	II
CO4	Analyze Rings and Fields and Homomorphism of Rings.	K4	III
CO5	Analyze Vector Spaces, Subspaces, Linear Transformations, Span of a set, Linear independence.	K4	IV
CO6	Evaluating Basis and Dimension, Rank and Nullity, Matrix of a Linear Transformation	K5	V

Core Course VII: REAL ANALYSIS

Semester: V **Course Code: U21MA507**
Credits: 6 **Hours/Week: 6**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Describe fundamental properties of the real numbers that lead to the development of real analysis	K5	I
CO2	Illustrate the properties of continuous function using limit function	K3	II
CO3	Study the algebra of derivatives	K6	III
CO4	Construct the mathematical proof of Mean value theorem by using the derivatives and continuous functions	K4	IV
CO5	Explain the Riemann integral	K4	V
CO6	Explain concept of fundamental theorem.	K5	V

Core Course VIII: Mechanics

Semester: V **Course Code: U21MA508**
Credits: 5 **Hours/Week: 6**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	know various methods of finding the resultant of a finite number of forces and methods of resolving forces	**K2**	**I**
CO2	understand the effect of different types of forces acting at a point in equilibrium	**K5**	**II**
CO3	resolve a given force and find equation of catenary	**K5**	**II**
CO4	analyse the motion of a projectile	**K3**	**III**
CO5	know the various properties of motion of a projectile, a simple harmonic motion and orbital motion	**K4**	**III, IV**
CO6	analyse simple harmonic and orbital motions	**K6**	**V**

Core Course IX: NUMERICAL METHODS

Semester: V **Course Code: U21MA509**
Credits: 4 **Hours/Week: 5**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Solve algebraic and transcendental equations using appropriate methods	K3	I
CO2	Determine the solution for system of algebraic equations by various methods	K5	II
CO3	Classify various interpolation methods	K4	III
CO4	Work out numerical differentiation and integration whenever and wherever usual methods are not applicable	K4	IV
CO5	Work numerically on the ordinary differential equations using different methods	K3	V
CO6	Evaluate derivative at a value using an appropriate numerical method	K6	V

Core Course X: COMPLEX ANALYSIS

Semester: VI **Course Code: U21MA610**
Credits: 6 **Hours/Week: 6**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Unit
CO1	Analyze the concept of analytic function on complex plane	K4	I
CO2	Analyze the effect of bilinear transformation on complex plane.	K4	II
CO3	Evaluate complex integrals for entire functions using Cauchy's Integral Formula.	K5	III
CO4	Express a complex function as a Taylor series, power series and Laurent series.	K5	IV
CO5	Classify the singularities of a complex function	K4	IV
CO6	Evaluate Contour integrals using the Residue theorem	K5	V

Core Course XI: DISCRETE MATHEMATICS

Semester: VI **Course Code: U21MA611**
Credits: 5 **Hours/Week: 6**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Solve various types of recurrence relations	K3	I
CO2	Classify various types of recursive functions	K4	II
CO3	Analyze lattices as algebraic structures	K4	III
CO4	Simplify logical functions by using Karnaugh maps	K5	IV
CO5	Explain the basics of information and coding theories	K2	V
CO6	Explain the notion of information in a mathematically sound way	K2	V

CORE COURSE XII: ELEMENTARY NUMBER THEORY

Semester: VI **Course Code: U21MA612**
Credits: 5 **Hours/Week: 6**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Recall absolute value, Divisibility of integers, GCD and LCM	K1	I
CO2	Explain Division algorithm and Euclidean algorithm	K2	I
CO3	Apply Euclid's theorem and Unique factorization theorem	K3	II
CO4	Categorize the numbers as Perfect, Abundant, deficient, amicable, and Triangular of numbers	K4	III
CO5	Interpret the complete residue system and linear congruency of integers	K5	IV
CO6	Discuss the Fermat's theorem, Wilson's theorem, and Lagrange's theorem	K6	V

Elective II: MATHEMATICAL MODELLING

Semester: VI **Course Code: U21MA6:2**
Credits: 5 **Hours/Week: 6**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Analyze the behavior of a dynamic system through mathematical models in terms of ordinary differential equations	K4	I, II
CO2	Discuss the problem of global stability in population Dynamics	K6	II
CO3	Discuss the motion of particles in space	K6	III
CO4	Construct mathematical modelling through difference equation for the problem occur in mathematics, statistics and in actuarial science	K6	IV
CO5	Solve typical problem situations which can be modelled through graphs	K6	V
CO6	Understand the applications of differential equations, difference equations and graph theory in Mathematical modelling.	K2	I - V

Elective Course III: Operations Research

Semester: VI **Course Code: U21MA6:3**
Credits: 5 **Hours/Week: 6**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO 1	Understand the system of a business organization and converting the given problem into Linear Programming Problem, Transportation problem	**K2**	**I, II, III**
CO 2	Solve Linear Programming Problem using Simplex method, Big M method and Two-Phase method.	**K3**	**II**
CO 3	Solve Transportation problems which arises in industries / business organizations in such a way that to reduce transportation cost.	**K3**	**III**
CO 4	Analyze the given assignment problems and assign persons or machines to complete tasks in such a way that to reduce man hours or cost.	**K4**	**III**
CO 5	Determine the project duration using critical path and network diagram	**K5**	**IV**
CO 6	Estimate economic order quantity for given problems	**K6**	**V**

Elective Course III - Information Theory

Semester: VI **Course Code: U21MA6:4**
Credit: 5 **Hours/Week: 6**

At the end of this course, the students will be able to

S.No.	Course Outcomes	Level	Unit
CO1	Axioms for a measure of uncertainty	**K3**	**I**
CO2	The Shannon entropy and its properties	**K5**	**I**
CO3	Ingredients of noiseless coding problem	**K4**	**II**
CO4	Decoding schemes	**K3**	**III**
CO5	The converse to the coding theorem for time-discrete Gaussian Channel	**K2**	**IV**
CO6	Axiomatic characterization of Shannon entropy due to Shannon and Fadeev	**K3**	**V**

NMEC Course I: MATHEMATICS FOR COMPETITIVE EXAMINATIONS

Semester: I **Course Code: U21MA3E1**

Credits: 2 **Hours/Week: 2**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Find LCM and HCF for given numbers	K1	I
CO2	Find Square roots and Cube roots	K2	II
CO3	Solve problems on partnership	K2	II
CO4	Solve the problems on profit and loss, Time and Distance	K2	III
CO5	Solve the problems on trains, boats, and Streams	K2	IV
CO6	Find simple and compound interest problems	K2	V

NMEC – II – Statistical Applications (Practical)

Sem. IV **Course Code: U21MAPE2**

Credits: 2 **Hours/Week: 2**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	UNIT
CO 1	Download and install R and RStudio	K2	I
CO 2	Learn to apply R programming for data processing	K2	I
CO 3	Develop codes using R for analyzing statistical data	K3	II
CO 4	Produce data visualizations using packages	K3	III
CO 5	Compute basic summary statistics	K3	IV
CO 6	Use different modules of R for different applications to analyse data.	K4	V

SBEC Course I: MATHEMATICS FOR COMPETITIVE EXAMINATIONS

Semester: I **Course Code: U21MA1S1**

Credits: 2 **Hours/Week: 2**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Find LCM and HCF for given numbers	K1	I
CO2	Find Square roots and Cube roots	K2	II
CO3	Solve problems on partnership	K2	II
CO4	Solve the problems on profit and loss, Time and Distance	K2	III
CO5	Solve the problems on trains, boats, and Streams	K2	IV
CO6	Find simple and compound interest problems	K2	V

SBEC Course II - Introduction to Scientific Computing (OCTAVE)

Semester: III **Course Code: U21MAPS2**

Credit: 2 **Hours/Week: 2**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Exercise
CO1	Create, initialize, and display simple variables and simple strings and use simple formatting for variable.	K6	1
CO2	Evaluate basic operations on matrices.	K5	1, 2
CO3	Classify different subplots from a given plot and colour plot data.	K4	3
CO4	Explain conditional statements and different type of loops based on simple examples.	K2	4, 5, 6, 7
CO5	Develop OCTAVE codes to solve algebraic equations.	K3	8, 9
CO6	Illustrate using different modules of OCTAVE to solve algebraic differential equations.	K2	10, 11

SBEC Course III – Programming in C (Linux OS)

Semester: V **Course Code: U21MAPS3**

Credits: 2 **Hours/Week: 2**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Exercise
CO 1	Describe the advantages of working in Linux Operating System	**K2**	**-**
CO 2	Develop program for solving algebraic equations	**K3**	**1,2**
CO 3	Develop C coding for solving numerical integral problems	**K3**	**3,4**
CO 4	Solve Initial Value Problems numerically using C programming	**K3**	**5,6**
CO 5	Solve Boundary Value Problems numerically using C programming	**K3**	**7**
CO 6	Construct programs using C for numerical computing in Linux OS	**K6**	**-**

STRUCTURE OF THE SYLLABUS

PROGRAM NAME	COURSE	COURSE CODE	COURSE NAME
M Sc Mathematics	Core I	P21MA101	Real Analysis
M Sc Mathematics	Core II	P21MA102	Linear Algebra
M Sc Mathematics	Core III	P21MA103	Ordinary Differential Equations
M Sc Mathematics	Core IV	P21MA104	Calculus of Variations,Integral Equations and Transforms
M Sc Mathematics	Elective I	P21MA1:1	Graph Theory
M Sc Mathematics	Core V	P21MA205	Algebra
M Sc Mathematics	Core VI	P21MA206	Partial Differential Equations
M Sc Mathematics	Core VII	P21MA207	Fluid Dynamics
M Sc Mathematics	Elective II	P21MA2:P	Object Oriented Programming in C++
M Sc Mathematics	Elective III	P21MA2:3	Differential Geometry
M Sc Mathematics	VLOC	P17VL2:1 / P17VL2:2	Religious Instructions / Moral Instructions
M Sc Mathematics	Core VIII	P21MA308	Topology
M Sc Mathematics	Core IX	P21MA309	Measure and Integration
M Sc Mathematics	Core X	P21MA310	Complex Analysis
M Sc Mathematics	Core XI	P21MA311	Probability and Statistics
M Sc Mathematics	Elective IV	P21MA3:4	Problem Solving in mathematics
M Sc Mathematics	Core XII	P21MA412	Functional Analysis
M Sc Mathematics	Core XIII	P21MA413	Numerical Analysis
M Sc Mathematics	Core XIV	P21MA414	Operations Research
M Sc Mathematics	Elective V	P21MA4:5	Stochastic Processes
M Sc Mathematics	Project	P21MA4PJ	Project

Core Course I: REAL ANALYSIS

Semester: I **CourseCode: P21MA101**
Credits: 5 **Hours/Week: 6**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Analyze the Metric space and functions defined on Metric Space	K4	I
CO2	Analyze the characteristics of compact set and perfect set.	K4	I
CO3	Explain how the continuity function preserve the compactness and connectedness of sets.	K5	II
CO4	Analyze the differentiability of various functions and characteristics of differentiable functions.	K4	III
CO5	Explain the existence of R-S Integral and its properties	K5	IV
CO6	Explain the uniform convergence of sequences and series of real functions and nature of the limit functions.	K5	V

Core Course II: LINEAR ALGEBRA

Semester: I **Course Code: P21MA102**
Credits : 5 **Hours/Week : 6**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Explain the concept of vector spaces and classify vector spaces based on their dimension.	K5	I
CO2	Determine the relationship between the matrices and linear transformations.	K5	II
CO3	Construct new ideals from the annihilating polynomials.	K6	III
CO4	Determine the eigenvalues and eigenvectors for the given matrix.	K5	IV
CO5	Build new invariant subspaces so that the given vector space can be written as a direct sum of its invariant subspaces.	K6	V
CO6	Examine the geometric perspectives of vectors.	K4	V

Core Course III - ORDINARY DIFFERENTIAL EQUATIONS

Semester : 1 **Course Code: P21MA103**
Credits: 4 **Hours/Week: 6**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Solve ordinary differential equations using suitable methods.	K3	I
CO2	Identify the existence of special functions and their properties.	K3	II
CO3	Apply suitable methods to solve linear systems of first order equations	K3	III
CO4	Deduct the analytical properties of a solution of a boundary value problem.	K5	IV
CO5	Analyze the stability and critical points of system of nonlinear equations.	K4	V
CO6	Construct models to solve problems in Physics.	K6	V

Core Course IV - CALCULUS OF VARIATION, INTEGRAL EQUATIONS AND TRANSFORMS

Semester : I **Course Code: P21MA104**
Credits : 4 **Hours/Week: 6**

At the end of this course, the students will be able to

CO.No.	Course Outcomes	Level	Unit
CO1	Identify extreme values of functional	K3	I
CO2	Evaluate Euler-Lagrange equation to find differential equations for stationary paths.	K5	I
CO3	Distinguish isoperimetric problems of standard types.	K4	II
CO4	Solve integral equations using Green's function in one and more unknown functions.	K6	III
CO5	Analyze the relationship between integral and differential equations and transform one type into another.	K4	IV
CO6	Analyze engineering problems by using Fourier Transform Techniques.	K4	V

Elective I - GRAPH THEORY

Semester : I **Course Code: P21MA1:1**
Credits : 4 **Hours/Week: 6**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Determine a shortest route between two nodes in a network	K5	I
CO2	Explain the concept of connectivity in communication networks	K5	II
CO3	Explain the Euler tours and Hamiltonian cycles concept in finding shortest paths	K5	II
CO4	Determine the scheduling concept using edge colouring of graphs	K5	III
CO5	Explain the partitioning concept using the chromatic number of graphs	K5	IV
CO6	Design the different networks using directed graphs	K6	V

Elective I - Finite Difference Methods

Semester : I **Course Code : P21MA1:2**
Credits : 4 **Hours/Week: 6**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Classify Difference equation	K2	I
CO2	Solve Difference equation	K3	II
CO3	Analyze the stability of Linear and Non-linear system	K4	III
CO4	Solve Boundary Value Problems	K6	IV
CO5	Construct Difference equation for Partial Differential equation	K3	V
CO6	Solve Partial Differential equation using difference equation	K6	V

Core Course: V - ALGEBRA

Semester: II **Course Code: P21MA205**
Credits: 5 **Hours/Week: 6**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	analyze structure and properties of finite abelian groups	K4	I
CO2	understand the properties of Internal and External direct products and modules	K2	II
CO3	construct finite extensions of fields	K6	III
CO4	construct Roots of polynomials and more about roots	K6	III
CO5	describe the concept of Automorphism and the elements of Galois theory	K5	IV
CO6	investigate solvability of polynomials through Galois theory	K3	V

Core Course – VI- PARTIAL DIFFERENTIAL EQUATIONS

Semester : II **Course Code : P21MA206**
Credits : 4 **Hours/Week: 6**

At the end of this course, the students will be able to

Co.No.	Course Outcomes	Level	Unit
CO1	solve the first order linear partial differential equations using Charpit's and Jacobi's method	K3	I
CO2	analyze the view of the Monge-cone	K4	I
CO3	explain the integral surface through a given curve for a quasi-linear partial differential equation	K5	II
CO4	solve the second and higher-order partial differential equations in Physics by using the method of separation of variables	K3	III
CO5	interpret the concept of boundary value problems under Laplace equation	K5	IV
CO6	justify the convergence of the solution to a heat conduction equation using Duhamel's principle	K5	V

Core Course VII – FLUID DYNAMICS

Semester : II **Course Code: P21MA207**
Credits : 5 **Hours/Week : 6**

At the end of this course, the students will be able to

CO.No.	Course Outcomes	Level	Unit
CO1	Estimate the kinematics of a fluid through equations of motion of the fluid.	K5	I
CO2	Derive Euler's Equation of motion and Bernoulli's equation	K6	II
CO3	Apply the special methods for treating problems in three dimensional flows and two-dimensional flows	K3	III
CO4	Explain complex velocity potentials	K5	IV
CO5	Analyze the applications of circle theorem	K4	IV
CO6	Prove the Navier-Stokes equations of motion of a viscous fluid	K5	V

Elective Course II - OBJECT ORIENTED PROGRAMMING IN C ++

Semester: II **Course Code: P21MA2:P**
Credits : 4 **Hours/Week: 6**

At the end of this course, the students will be able to

CO.No.	Course Outcomes	Level	Exercise
CO 1	Develop programming skills of students using object-oriented programming concepts in C++	K3	1
CO 2	Construct program for friend function and inline function.	K6	2,3
CO 3	Explain the concept of copy constructor and constructor overloading	K5	4,5
CO 4	Classify the types of Inheritance	K4	6,7,8,9
CO 5	Compare the function overloading, Unary and Binary operator overloading and virtual function.	K5	10,11,12,13
CO 6	Designing the programming for formulating, Manipulating and File Handling	K6	14,15

Elective Course III: DIFFERENTIAL GEOMETRY

Semester: II **Course Code: P21MA2:3**
Credits: 4 **Hours/Week: 4**

At the end of this course, the students will be able to

CO.No	Course Outcomes	Level	Unit
CO1	Explain the basic concepts and definitions of space curves and planes.	K5	I
CO2	Explain the Existence and Uniqueness theorem under Intrinsic equations.	K5	II
CO3	Discuss the theory of surfaces and curves on surfaces.	K6	III
CO4	Explain the concept of metric on the surface	K5	III
CO5	Examine local non-intrinsic properties of a surface	K4	IV
CO6	Solve the techniques of differential calculus in the field of geometry.	K6	V

Elective III: Introduction to Data Envelopment Analysis [DEA]

Semester: III **Course Code: P21MA2:4**
Credit: 4 **Hours/Week: 6**

At the end of this course, the students will be able to

Co.No.	Course Outcomes	Level	Unit
CO1	Analyze decision making units, linear programming problems, fractional programming problems	K4	I
CO2	Describe mathematical modeling of DEA	K5	II
CO3	Formulate CRS DEA and VRS DEA	K5	III
CO4	Examine DEA application in an educational Institute	K3	IV
CO5	Demonstrate DEAP software	K4	V
CO6	Evaluation of DEA problems through DEAP software	K6	V

Core Course VIII: TOPOLOGY

Semester: III **Course Code: P21MA308**
Credits: 5 **Hours/Week: 6**

At the end of this course, the students will be able to

CO.No.	Course Outcomes	Level	Unit
CO1	Define topological spaces, continuous functions, metric topology, connected space, compact space, normal space, complete metric spaces and compactness in metric spaces.	K1	I – V
CO2	Identify different topological spaces.	K3	I – V
CO3	Construct continuous functions on topological spaces.	K5	I – V
CO4	Prove the properties of topological spaces, continuous functions, metric topology, connected space, compact space, normal space, complete metric spaces and compactness in metric spaces.	K4	I – V
CO5	Classify connected spaces and compact spaces.	K5	II&III
CO6	Distinguish and relate Hausdorff, regular and normal spaces and the compactness of a metric space into a complete metric space	K6	IV&V

Core Course IX: MEASURE AND INTEGRATION

Semester: III **Course Code: P21MA309**
Credits: 5 **Hours/Week: 6**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Analyze Borel and Lebesgue measurability of subsets of Real number system	K4	I
CO2	Evaluate the integration of non-negative functions by which integration of general functions is derived.	K5	II
CO3	Interpret Lebesgue and Riemann integration	K5	II
CO4	Conclude how a measure on a ring of sets can be extended to one on a generated sigma-ring.	K5	III
CO5	Analyze signed measure which decomposes the space into positive and negative parts.	K4	IV
CO6	Evaluate integration of functions defined on the Cartesian product space.	K5	V

Core Course XI: PROBABILITY & STATISTICS

Semester : III **Course Code: P21MA311**
Credits : 4 **Hours/Week: 6**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Exhibit knowledge and understanding of probability as a continuous set function, the notion of discrete and continuous random variable and their probability functions, distribution functions and expectations.	K2	I, II & III
CO2	Measure the expectation of the joint distribution function of a random variable	K3	II
CO3	Find the probabilities of the events having partial or no information by applying Baye's formula and distinguish between independent and dependent events	K5	III
CO4	Determine the probability of different types of random variables like Binomial, Poisson and Normal random variables and evaluate the mean and variance of normal and exponential random variable	K5	III
CO5	Identify the distributions depending on the nature of the data and derive inferences	K4	IV
CO6	Analyse the construction of moment generating functions and to understand different results on random variables	K3	V

Elective IV: Problem Solving in Advanced Mathematics

Semester: III **Course Code: P21MA3:4**
Credits: 4 **Hours/Week: 6**

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Analyse the concepts and Solve problems in Real Analysis	K4	I, II
CO2	Solve problems in Complex Analysis	K4	II
CO3	Construct various Algebric structures and solve problems	K6	III
CO4	Determine the relationships between Linear Algebraic structures and solve problems	K5	IV
CO5	Deduct various properties and apply suitable methods to solve Differential Equations	K5	IV

CO6	Construct Models to solve Physical and real life Problems	**K5**	**V**

Core Course XII: FUNCTIONAL ANALYSIS

Semester : IV **Course Code: P21MA412**
Credits : 5 **Hours/Week: 6**

At the end of this course, the students will be able to

CO.No.	Course Outcomes	Level	Unit
CO1	Acquire Knowledge and Understand the concept of Normed Linear Space and to analyse the structure and properties of Banach Space & Hilbert Space	**K2**	**I, II**
CO2	Understand the properties of different Operators on Hilbert Space	**K3**	**II**
CO3	Analyse the importance of Conjugate Space in defining Operators	**K4**	**III**
CO4	Construct the Spectral Theory based on the developed Operators	**K5**	**III**
CO5	Combine the Algebra of Operators & Topological sets leading to Banach Algebra	**K4**	**IV**
CO6	Analyse the structure of Commutative Banach Algebra	**K4**	**V**

Core Course XIII: NUMERICAL ANALYSIS

Semester: IV **Course Code: P21MA413**
Credits: 4 **Hours/Week: 6**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Recall the basic concepts and definitions of polynomial equations and Iterations.	**K1**	**I**
CO2	Demonstrate the iteration method to find basic solutions and also derive the related equations of iterative methods.	**K2**	**II**
CO3	Analyze and apply the interpolation and approximation methods and using interpolation methods to find solution.	**K4**	**III**
CO4	Survey the differentiation and integration methods based on finite difference operators.	**K4**	**IV**
CO5	Examine the aspects of ordinary differential equations	**K4**	**V**
CO6	Design the techniques of differential equations in stability analysis.	**K6**	**V**

CORE COURSE XIV – OPERATIONS RESEARCH

Semester-IV **Course Code: P21MA414**
Credits: 4 **Hours/Week: 6**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Solve Integer Programming problems	K3	I
CO2	Apply dynamic programming approach to solve Linear Programming Problem.	K3	II
CO3	Understand decision making concepts.	K3	III
CO4	Solve Game theory problems.	K3	III
CO5	Solve inventory problems for various models .	K4	IV
CO6	Solve unconstrained and constrained nonlinear programming problem	K4	V

Elective course V – STOCHASTIC PROCESSES

Semester : IV **Course Code : P21MA4:5**
Credits : 4 **Hours/Week : 6**

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Understand the concepts of Stochastic processes, Markov chain and its real-life applications	K2	I
CO2	Existence of Absorption probabilities, have been investigated.	K4	II
CO3	Analyse and discuss the implications and significance of Birth and Death processes	K4	III
CO4	Able to understand the concepts of Renewal equations and their applications	K3	IV
CO5	To know the concepts of Queueing process	K3	V
CO6	Apply theoretical knowledge acquired to solve realistic problems in real life	K3	V