

## **DEPARTMENT OF MATHEMATICS**

### **B. Sc MATHEMATICS ;**

The Mathematics program promotes mathematical skills and knowledge for their intrinsic beauty, effectiveness in developing proficiency in analytical reasoning, and utility in modeling and solving real world problems. To responsibly live within and participate in the transformation of a rapidly changing, complex, and interdependent society, students must develop and unceasingly exercise their analytical abilities. Students who have learned to logically question assertions, recognize patterns, and distinguish the essential and irrelevant aspects of problems can think deeply and precisely, nurture the products of their imagination to fruition in reality, and share their ideas and insights while seeking and benefiting from the knowledge and insights of others.

Students majoring in Mathematics attain proficiency in

***PO 1: Critical thinking:*** Think critically and communicate clearly mathematical concepts and solutions to real world problems. Develop an understanding of the precise language of Mathematics, and be able to integrate mathematical arguments with their critical thinking skills

***PO 2: Problem solving:*** Be able to solve problems using a broad range of significant mathematical techniques. recognize real-world problems that are amenable to mathematical analysis, and formulate mathematical models of such problems.

***PO 3: Effective communication:*** Develop effective communication skills in English and regional / national language. Students will be able to explain fundamental mathematical concepts or analyses of real-world problems to non-mathematicians and present mathematics clearly and precisely to an audience of peers and faculty

### **MAT1B01 Foundations of mathematics**

#### **1. Course Outcomes**

**As a course in Mathematics, students will be able to:**

- **Acquires Fundamental Basics of Set Theory**
- **Learn the set theoretic notations and operations and its vein diagrams**
- **Get access to the Boolean Algebra its notations and truth table presentations**
- **Formulate Logical statements and Proofs of Mathematical ideas**
- **Witness the practical situations where use the ideas of logic and number theory**
- **Learn different type of functions**

## **2.Program Specific Outcomes**

Upon completion of this course, students should be able to:

- **Understand the basic theory of sets, relations and functions**
- **Solve practical problems using set theory and logic**
- **Construct proofs of mathematical ideas by different ways**
- **Get used with the mathematical symbols**
- **Explain why mathematical thinking is valuable in daily life.**

## **MAT2B02: CALCULUS**

### **1. Course Outcomes**

As a course in Mathematics, students be able to:

- **Describe the concepts and applications of derivatives and higher order derivatives**
- **Acquires the concept of asymptotes and envelopes**
- **Understand application of integration**
- **Apply the techniques of double and triple integral to various problems of finding length of plane curves, surface areas and volumes of surfaces of revolution**
- **Get access to know application of mathematics in physics**

## **2. Program Specific Outcomes**

Upon completion of this course, students should be able to:

- **Find Critical points ,concavity and nature of the function**
- **Sketch graph of a function**
- **Understand the ideas of double and triple integrals and their applications in finding the lengths,areas and volumes of irregular objects**
- **Solving and model applied problems**
- **Solve practical problems in physics using mathematics**

## **MAT3B03: CALCULUS AND ANALYTIC GEOMETRY**

### **1. Course Outcomes**

As a course in Mathematics, students be able to:

- **Acquire knowledge of logarithmic functions and exponential functions and its applications**
- **Expand functions using Taylor's and Maclaurin's series, Leibnitz theorem and use their applications**
- **Learn L'Hospital rule and Hyperbolic functions**
- **Understand the concepts of sequence ,series, convergence and difference tests for convergence related to series and sequence**
- **Acquire knowledge of conic sections and polar co-ordinates**

### **2. Program Specific Outcomes**

Upon completion of this course, students should be able to:

- **Apply Taylor's and Maclaurin's series, Leibnitz theorem for finding functions**
- **Use logarithmic functions and exponential functions on appropriate practical situations**

- Solve problems using L'Hospital rule and Hyperbolic functions
- Find limits of sequences and series. Also test the convergence of series by using respective convergence tests
- Understand the ideas of conics and their applications

## **MAT4B04: THEORY OF EQUATIONS, MATRICES AND VECTOR CALCULUS**

### **1. Course Outcomes**

As a course in Mathematics, students be able to:

- Acquires the knowledge of rank of a matrix , characteristic roots and characteristic vectors
- Understands the various applications of the theory of matrices to a wide variety of problems
- Learn Polynomial Equations and Fundamental Theorem of Algebra.
- Apply cylindrical coordinates in practical situations
- Know the basic ideas of theory of equations
- Acquire knowledge of Different methods for solving polynomials
- Get access to different methods for finding inverse of a matrix
- Covert system of equations into matrix and solve it using matrix theory

### **2. Program Specific Outcomes**

Upon completion of this course, students should be able to:

- Find rank of a matrix , characteristic roots and characteristic vectors
- Solve polynomials using different methods

- Use matrix theory in appropriate situations and solve system of equations
- Do practical problems using cylindrical coordinates

## **MAT5B05: VECTOR CALCULUS**

### **1. Course Outcomes**

As a course in Mathematics, students be able to:

- Acquire the knowledge of functions of several variables and their limits, continuity and differentiation
- Develops competency in applying the idea of partial derivatives
- Acquires the basic ideas of double and triple integral
- Acquires the concept of finding partial derivatives and associated rules
- Use the Lagrange multiplier method to find extrema of functions with constraints
- Learn triple integration, greens theorem and divergence theorem and use them to solve practical problems

### **2. Program Specific Outcomes**

Upon completion of this course, students should be able to:

- Solve problems related to functions of several variables
- Applies the knowledge of Lagrange multipliers in finding the extreme values of functions
- Develops skill in finding the partial derivatives of functions of several variables and various rules associated
- Solve double and triple integral problems
- Apply green's theorem and divergence theorem

## **MAT5B06 : ABSTRACT ALGEBRA**

### **1. Course Outcomes**

As a course in Mathematics, students be able to:

- **Reveal the beauty and symmetry in nature**
- **Acquires the basic knowledge of binary operation, Group, Subgroup and Cyclic Groups**
- **Know the permutation groups and cayley's theorem**
- **Explains different terms related to algebra**
- **Learn the different algebraic structures in sets like ring, field and their applications**
- **Produce rigorous proofs of propositions arising in the context of abstract algebra**

### **2. Program Specific Outcomes**

Upon completion of this course, students should be able to:

- **Develop abstract way of thinking**
- **Identify different algebraic structures in different sets and able to prove them**
- **Apply theorems in algebra wisely to do problems**
- **Understand the importance of algebra in mathematics**

## **MAT5B07 : BASIC MATHEMATICAL ANALYSIS**

### **1. Course Outcomes**

As a course in Mathematics, students be able to:

- **Know what is real numbers and its algebraic properties**
- **Describe fundamental properties of the real numbers that lead to the formal development of real analysis**
- **Describes the terms sequence, limit, convergence and limit point**
- **Construct rigorous mathematical proofs of basic results in real analysis**
- **Learn different theorems on convergence**
- **Acquire knowledge of complex numbers and their properties**

## **2.Program Specific Outcomes**

**Upon completion of this course, students should be able to:**

- **Understand and appreciate the algebraic structures of real numbers**
- **Solve problems in analysis and complex**
- **Do mathematical proofs using theorems and propositions in real analysis and complex analysis**
- **Determine the continuity, differentiability, and integrability of functions defined on subsets of the real line**

## **MAT5B08: DIFFERENTIAL EQUATIONS**

### **1.Course Outcomes**

**As a course in Mathematics, students be able to:**

- **Acquire knowledge of first order and second order differential equations**
- **Learn different methods of solving first order and second order differential equations**
- **Get acquainted with system of differential equations and their solving methods**
- **Get the knowledge of Laplace transformations and boundary value problems**
- **Describe the concepts of Fourier series and its applications**
- **Find power series solutions of differential equations**

## **2. Program Specific Outcomes**

**Upon completion of this course, students should be able to:**

- **Apply the knowledge of differential equations in practical problems**
- **Solve first order and second order differential equations by using different methods**
- **Determine solutions of differential equations using Fourier series**
- **Determine solutions of differential equations using Laplace transformations**
- **Solve boundary value problems**

## **MAT6B09: REAL ANALYSIS**

### **1. Course Outcomes**

**As a course in Mathematics, students should be able to:**



- Explains convergence of a series
- Identifies different tests for convergence of a series
- Explains Continuity and Discontinuity of various functions in different contexts
- Differentiate Uniform continuity from continuity and related theorems
- Acquire the idea about Riemann Integration
- Learn the concepts of convergence of sequence of functions and series of functions
- Learn improper integrals and Beta ,Gamma functions

## 2. Program Specific Outcomes

Upon completion of this course, students should be able to:

- Solve problems on convergence of series
- Apply the definitions of Continuity and Uniform continuity to explain different properties of functions
- Integrate different functions using Riemann Integration
- Solve problems on convergence of sequence of functions and series of functions
- Solve different Improper integrals
- Use Beta and Gamma functions wisely in practical applications

## **MAT6B10 : COMPLEX ANALYSIS**

### 1. Course Outcomes

As a course in Mathematics, students be able to:

- **Explain the fundamental ideas of Analytic Functions**
- **Introduce elementary complex functions**
- **Understand the significance of differentiability for complex functions and be familiar with the Cauchy-Riemann equations**
- **Discuss basic methods of complex integration**
- **Understand the basic methods of complex integration and its application in contour integration**
- **Learn power series and Laurent series expression of complex valued functions**
- **Learn the concept of singularities and different type of singularities**
- **Use the Cauchy Residue Theorem to evaluate integrals and sum series**

## **2.Program Specific Outcomes**

**Upon completion of this course, students should be able to:**

- **Conceive the concepts of analytic functions and will be familiar with the elementary complex functions and their properties**
- **Apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions including the fundamental theorem of algebra**
- **Understand the basic methods of complex integration and its application in contour integration.**
- **Represent functions as Taylor, power and Laurent series, classify singularities and poles, find residues and evaluate complex integrals using the residue theorem**
- **Use the residue theorem to compute complex line integrals and real integrals**

## **MAT6B11 : NUMERICAL METHODS**

### **1.Course Outcomes**

As a course in Mathematics, students should be able to:

- **Derive appropriate numerical methods to solve algebraic and transcendental equations**
- **Perform an error analysis for various numerical methods**
- **Prove results for various numerical root finding methods**
- **Learn the concept of interpolation and study different methods of interpolation**
- **Acquire the knowledge of interpolation to solve differential and integration problems**
- **Learn different methods to solve system of equations and finding the inverse of a matrix**
- **Learn Numerical Solutions of Ordinary Differential Equations**

### **2.Program Specific Outcomes**

Upon completion of this course, students should be able to:

- **Solve an algebraic or transcendental equation using an appropriate numerical method**
- **Solve a linear system of equations using an appropriate numerical method**
- **Perform an error analysis for a given numerical method**
- **Verify results for numerical root finding methods**
- **Apply interpolation methods wisely to solve differential equations**
- **Apply interpolation methods wisely to integration problems**

- Use matrix theory to solve system of equations
- Solve Numerical Solutions of Ordinary Differential Equations

## **MAT6B12 : NUMBER THEORY AND LINEAR ALGEBRA**

### **1. Course Outcomes**

As a course in Mathematics, students should be able to:

- Reveal the beauty of numbers and hidden mathematical properties in them
- Learn the concept congruence and Chinese remainder theorem
- Study Fermat's little theorem and pseudoprimes Wilson's theorem.
- Acquire more knowledge about the divisors of numbers
- Learn the concept of vector spaces , basis and dimension
- Study linear transformations and theorem related to them

### **2. Program Specific Outcomes**

Upon completion of this course, students should be able to:

- Get an idea of numbers and their mathematical properties
- Solve system of equations using Chinese remainder theorem
- Solve problems using Fermat's little theorem and pseudoprimes Wilson's theorem.
- Find number of divisors and sum of divisors of each number
- Solve problems related to vector spaces , basis and dimension

- Work with problems related to linear transformations

## **MAT6B13 (E02) : LINEAR PROGRAMMING**

### **1. Course Outcomes**

As a course in Mathematics, students should be able to:

- Study convex sets and related theorems
- Defines a LPP in standard form and Canonical form
- Identifies a feasible solution, a basic feasible solution and an optimal solution using simplex method
- Understands duality theorems and dual simplex method
- Uses dual simplex method to find optimal solutions
- Explains the Transportation Problem and formulate it as an LPP and hence solve the problem
- Determine that an Assignment Problem is a special case of LPP and hence solve by Hungarian method Identifies

### **2. Program Specific Outcomes**

Upon completion of this course, students should be able to:

- Understand the new term LPP
- Understand Transportation Problem, Assignment problem
- Formulate and model a linear programming problem from a word problem and solve them graphically in 2 and 3 dimensions
- Place a Primal linear programming problem into standard form and use the Simplex Method to solve it

- Understands duality theorems and dual simplex method
- Explains the Transportation Problem and formulate it as an LPP and hence solve the problem
- Determine that an Assignment Problem is a special case of LPP and hence solve by Hungarian method

### **MAT5D03 : MATHEMATICS FOR SOCIAL SCIENCES**

#### **1. Course Outcomes**

As a course in Mathematics, students should be able to:

- Make students aware of basics of mathematics and its applications
- Learn concepts of graph ,equations and functions
- Acquire knowledge of limit, continuity and differentiation and their applications
- Know different type of functions

#### **2.Program Specific Outcomes**

Upon completion of this course, students should be able to:

- Solve problems in graph ,equations and functions
- Apply differentiation in respective problems
- Find logarithm and exponential of numbers

### **MAT 1C01 : MATHEMATICS**

#### **1. Course Outcomes**

As a course in Mathematics, students should be able to:

- Learn the concepts of limit
- Describe the concepts and applications of derivatives and higher order derivatives

- Acquires the concept of asymptotes and envelopes
- Understand application of integration
- Apply the techniques of double and triple integral to various problems of finding length of plane curves, surface areas and volumes of surfaces of revolution
- Get access to know application of mathematics in physics

## 2. Program Specific Outcomes

Upon completion of this course, students should be able to:

- Solve problems related to limit
- Find Critical points ,concavity and nature of the function
- Sketch graph of a function
- Understand the ideas of double and triple integrals and their applications in finding the lengths,areas and volumes of irregular objects
- Solving and model applied problems
- Solve practical problems in physics using mathematics

## MAT2C02 : MATHEMATICS

### 1. Course Outcomes

As a course in Mathematics, students should be able to:

- Acquire knowledge of hyperbolic functions
- Understand application of integration in practical situations
- Learn improper integrals
- Know the concept sequence, series and their convergence

- Learn different coordinate systems
- Understand multi variable functions and their properties

## 2. Program Specific Outcomes

Upon completion of this course, students should be able to:

- Identify hyperbolic functions and solve problems related it
- Apply different coordinate systems in appropriate situations
- Use integration to find area and surface revolution of curves
- Solve improper integral problems
- Solve problems on multivariable functions

## MAT3C03 : MATHEMATICS

### 1. Course Outcomes

As a course in Mathematics, students should be able to:

- Study differential equations, especially first order differential equations and their solving methods
- Convert system of equations into matrix problem and solve it using matrix theory
- Study Vector Differential Calculus
- Understand of concept of double and triple integration

### 2. Program Specific Outcomes

Upon completion of this course, students should be able to:

- Solve first order differential equations using different methods
- Solve system of equations using matrix



- **Apply the ideas in Vector Differential Calculus to solve practical problems in physics**
- **Convert problems into integration problems and find the values by using different theorems in double and triple integration**

## **MAT4C04 : MATHEMATICS**

### **1. Course Outcomes**

**As a course in Mathematics, students should be able to:**

- **Acquire the knowledge of second order differential equations**
- **Solve Numerical Solutions of Ordinary Differential Equations**
- **Determine solutions of differential equations using Fourier series**
- **Determine solutions of differential equations using Laplace transformations**
- **Solve boundary value problems**

### **2. Program Specific Outcomes**

**Upon completion of this course, students should be able to:**

- **Find solutions of second order differential equations**
- **Solve Numerical Solutions of Ordinary Differential Equations**
- **Determine solutions of differential equations using Fourier series**
- **Determine solutions of differential equations using Laplace transformations**
- **Solve boundary value problems**



## M.Sc MATHEMATICS ;

This course is designed to help students build the foundations for a successful career in mathematics research. You'll have the freedom to choose from a variety of advanced lecture modules across pure and applied mathematics. Possible topics range from algebra, geometry and topology, to the ways that mathematics can be used in finance or studies of nature.

You'll be able to get valuable mathematics research experience by working with an experienced mathematician on a dissertation topic of your choice. Throughout the course, you'll have lots of opportunities to improve your problem solving and presentation skills, and learn how to create persuasive and logical arguments.

### MT1C01 Algebra- I

#### Course Outcomes

As a course in Mathematics, students be able to:

- Acquire deep knowledge of finite groups and their representations
- Learn the concepts factor groups and different series of groups
- Get knowledge of group action and its applications
- Explain Sylow theory and isomorphism theorems
- Describe ring of polynomials and more about irreducible polynomials

#### Program Specific Outcomes

Upon completion of this course, students should be able to:

- Write finite groups as product of cyclic groups
- Solve problems in algebra using sylow theory
- Apply notion of group action of sets to solve practical problems
- Find irreducible polynomials using different tests

### MT1C02 Linear Algebra

#### 1. Course Outcomes

As a course in Mathematics, students be able to:

- Acquire more knowledge about vector spaces and associated theorems

- Linear Algebra emphasizes the concept of vector spaces and linear transformations which are essential in simplifying various scientific problems.
- Explains the concepts of linear transformations and elementary canonical forms
- Understand the concept of inner product spaces

## 2. Program Specific Outcomes

Upon completion of this course, students should be able to:

- It aims at inculcating problem solving skills within students to enable them compute large linear systems.
- Solve problems in linear algebra using various theorems and results related to it
- Understand concepts of linear transformations and elementary canonical forms and apply them in practical situations
- Identify inner product spaces

## MT1C03 Real Analysis-I

### 1. Course Outcomes

As a course in Mathematics, students be able to:

- Understand the fundamental properties of real numbers
- Acquire the knowledge of continuity and differentiation
- Explain the Riemann stieltjes integration
- Explore the stone weistrass theorem

## 2. Program Specific Outcomes

Upon completion of this course, students should be able to:

- Describe fundamental properties of the real numbers that lead to the formal development of real analysis.
- Construct rigorous mathematical proofs of basic results in real analysis.

- Appreciate how abstract ideas and regions methods in mathematical analysis can be applied to important practical problems.

## MT1C04 Number Theory

### 1. Course Outcomes

As a course in Mathematics, students be able to:

- Acquire the knowledge of divisors and theorems related to them
- Explore the use of Chinese remainder theorem
- Study more about prime numbers and theorems about prime numbers
- Study analytical approach to number theory problems
- Learn basics of cryptography and some methods in cryptography
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### 2. Program Specific Outcomes

Upon completion of this course, students should be able to:

- Prove results involving divisibility and greatest common divisors
- Solve systems of linear congruences
- Find integral solutions to specified linear Diophantine Equations
- Apply Euler-Fermat's Theorem to prove relations involving prime numbers
- Good idea about prime numbers
- Understand and appreciate the use of number theory in cryptography

## MT1C05 Discrete Mathematics

### 1. Course Outcomes

As a course in Mathematics, students be able to:

- Study basics in Boolean algebra and related problems
- Learn basics in Graph theory and its applications
- Acquire the knowledge of automata and finite automata

## 2. Program Specific Outcomes

Upon completion of this course, students should be able to:

- Understand Boolean algebra and its applications
- Convert practical problems into graph theory problems and solve them
- Use automata effectively and motivated to learn other computer languages

## MT2C07 Algebra- II

### 1. Course Outcomes

As a course in Mathematics, students be able to:

- Study more about irreducible polynomials and its applications
- Study the extension fields and related theorems
- Acquire the knowledge of Field theory especially the automorphisms of fields
- Learn Galois theory

### 2. Program Specific Outcomes

Upon completion of this course, students should be able to

- Find irreducible polynomials over different fields and construct finite fields
- Appreciate and use the connection between normal groups and normal extensions
- Check solvability of the polynomials using Field theory

## MT2C08 Real Analysis-II

### 1. Course Outcomes

As a course in Mathematics, students be able to:

- Acquire the knowledge of measurable sets
- Learn more about integration
- Learn the concept of lebesgue integration
- Explains more about lebesgue integration and theorems related to it
- Study  $L_p$  spaces and its applications
- Understand different measures and its properties

### 2. Program Specific Outcomes

Upon completion of this course, students should be able to

- Use the knowledge of measurable sets and measurable functions
- Understand lebesgue integration and appreciate it
- Apply different theorems and propositions related to measure and integration to solve problems
- Apply  $L_p$  spaces and related theorems in practical problems

## MT2C09 Topology

### 1. Course Outcomes

As a course in Mathematics, students be able to:

- Study about shapes and theory related to it
- Learn basic concepts of topological spaces
- Extend continuous functions to topological spaces
- Learn the concepts of compactness and connectedness
- Study separable axioms and different theorems related to it

## 2. Program Specific Outcomes

Upon completion of this course, students should be able to

- Understand the concept of topological space
- Apply theorems related to topological spaces
- Identify compact and connected sets
- Understand separable axioms and spaces

## MT2C10 ODE and Calculus of Variations

### 1. Course Outcomes

As a course in Mathematics, students be able to:

- Acquire more knowledge about ordinary differential equations
- Study special functions and their applications
- Learn boundary value problems and calculus of variation

### 2. Program Specific Outcomes

Upon completion of this course, students should be able to:

- Solve ordinary differential equations using different methods
- Use special functions to solve differential problems
- Understand application of special functions in physics
- Solve boundary value problems

## MT2C11 Operations Research

### 1. Course Outcomes

As a course in Mathematics, students be able to:

- Study convex sets and related theorems



- Defines a LPP in standard form and Canonical form
  - Identifies a feasible solution, a basic feasible solution and an optimal solution using simplex method
  - Understands duality theorems and dual simplex method
  - Uses dual simplex method to find optimal solutions
  - Explains the Transportation Problem and formulate it as an LPP and hence solve the problem
  - Determine that an Assignment Problem is a special case of LPP and hence solve by Hungarian method Identifies
  - Learn integer linear programming and sensitivity analysis
  - Study flow ,network and theory of games
2. Program Specific Outcomes

Upon completion of this course, students should be able to:

- Place a Primal linear programming problem into standard form and use the Simplex Method to solve it
- Understands duality theorems and dual simplex method
- Explains the Transportation Problem and formulate it as an LPP and hence solve the problem
- Determine that an Assignment Problem is a special case of LPP and hence solve by Hungarian method
- Solve integer linear programming problems
- Understand flow ,network and game theory and its applications

## MT3C12 Multivariable Calculus and Geometry

1. Course Outcomes

As a course in Mathematics, students be able to:

- Acquire deep knowledge of multi variable functions
- Understand differentiation of multivariable functions and theorems related to it
- Study basics of differential geometry
- Learn different concepts in differential geometry

## 2. Program Specific Outcomes

Upon completion of this course, students should be able to:

- Understand multi variable functions and apply them on appropriate situations
- Understand different notions in differential geometry and understand its applications

## MT3C13 Complex Analysis

### 1. Course Outcomes

As a course in Mathematics, students be able to:

- Acquire the knowledge of fundamental concepts of complex analysis
- Learn complex analysis techniques
- Learn the concepts conformality, calculus of residues ,power series expansion, periodic functions,harmonic functions

### 2. Program Specific Outcomes

Upon completion of this course, students should be able to:

- Explain the fundamental concepts of complex analysis and their role in modern mathematics and applied contexts
- Demonstrate accurate and efficient use of complex analysis techniques

- Demonstrate capacity for mathematical reasoning through analyzing, proving and explaining concepts from complex analysis
- Apply problem –solving using complex analysis techniques applied to diverse situations in physics, engineering and other mathematical contexts

## MT3C14 Functional Analysis

### 1. Course Outcomes

As a course in Mathematics, students be able to:

- This area combines ideas from linear algebra and analysis in order to handle infinite-dimensional vector spaces and linear mappings thereof
- The Functional Analysis is related to problems arising in Partial Differential Equations, Measure Theory and other branches of Mathematics
- Know and clearly understand the classic theorems of Functional Analysis.
- To understand the concepts of Banach and Hilbert spaces and to learn to classify the standard examples. In particular, spaces of sequences and functions
- To learn to use properly the specific techniques for bounded operators over normed and Hilbert spaces

### 2. Program Specific Outcomes

Upon completion of this course, students should be able to:

- To learn to recognize the fundamental properties of normed spaces and of the transformations between them
- To be acquainted with the statement of the Hahn-Banach theorem and its corollaries.
- Understand main properties of bounded operators and get an idea to deal with infinite dimensional vector spaces

## MT3C15 PDE and Integral Equations

### 1. Course Outcomes

As a course in Mathematics, students be able to:

- Acquire knowledge of partial differential equations
- Learn to solve linear Partial Differential with different methods
- Solve some physical problems in Engineering and Biological models that results in partial differential equations
- Study Integral Equations and to know that what is the relationship between the integral equations and ordinary differential equations

### 2. Program Specific Outcomes

Upon completion of this course, students should be able to:

- Classify partial differential equations and transform into canonical form
- Solve linear partial differential equations of both first and second order
- Apply partial differential equations to solve practical problems
- Solve problems in integral equations using different methods

## MT4E01 COMMUTATIVE ALGEBRA

### 1. Course Outcomes

As a course in Mathematics, students be able to:

- Acquire knowledge of basic concepts and constructions in commutative algebra
- Study more about rings and modules
- Learn the concept of localization of rings and its applications
- Understand decomposition of ideals
- Learn Artinian and Noetherian rings and modules and related theorems

### 2. Program Specific Outcomes

Upon completion of this course, students should be able to:

- Define basic concepts and constructions in commutative algebra
- Perform simple specific calculations in number rings ,polynomial rings and locations of polynomial rings
- Use the results in commutative algebra to perform simple reasoning to show the properties of rings and modules
- Conduct researches in commutative algebra and its applications

### MT4E11 ADVANCED FUNCTIONAL ANALYSIS

#### 1. Course Outcomes

As a course in Mathematics, students be able to:

- Acquire more knowledge about bounded operators
- Learn the concepts of spectrum of operators and related theorems
- Explains the spectral theory of operators in Hilbert spaces
- Learn dual spaces and its applications

#### 2. Program Specific Outcomes

Upon completion of this course, students should be able to

- Understand and find the spectrum of different operators
- Apply spectral theory to sole practical problems
- Identify dual spaces of different spaces

### MT4E12 DIFFERENTIAL GEOMETRY

#### 1. Course Outcomes

As a course in Mathematics, students be able to:

- Acquire knowledge of key concepts and techniques in Differential geometry
- Learn more about intrinsic geometry of curves and surfaces and its applications

## 2. Program Specific Outcomes

Upon completion of this course, students should be able to

- Acquaint students with basic ideas and techniques of Differential geometry
- Get complete view of calculus ,partial differential equations by studying about surface and curves

## MT4E15 GRAPH THEORY

### 1. Course Outcomes

As a course in Mathematics, students be able to:

- Understand and apply fundamental concepts in Graph theory
- Understand application of graph theory in Chinese postman problem and travelling salesman problem
- Learn the concept of matching of graph and associated theorems
- Get an idea about graph coloring and related problems

### 2. Program Specific Outcomes

Upon completion of this course, students should be able to

- Write precise and accurate mathematical definitions of objects in graph theory
- Use a combination of theoretical knowledge and independent mathematical thinking in creative investigation of questions in graph theory
- Write about graph theory in a coherent and technically accurate manner.
- Apply graph theory in practical situations
-