MATHEMATICS PROGRAM OUTCOMES,

PROGRAM SPECIFIC OUTCOMES AND COURSE OUTCOMES

PROGRAMME OUTCOMES

Students who choose B.A/B.Sc with Mathematics as one subject develop the ability to think critically, logically and analytically and hence use mathematical reasoning in everyday life. Pursuing a degree in mathematics will introduce the students to a number of interesting and useful ideas in preparations for a number of mathematics careers in education, research, government sector, business sector and industry. The programme covers the full range of mathematics, from classical Calculus to Number Theory (Cryptography) and Modern Algebra. The course lays a structured foundation of Calculus, Real & Complex analysis, Abstract Algebra, Differential equations, Number theory Linear Algebra and Graph theory. An exceptionally broad range of topics covering Pure & Applied Mathematics cater to varied interests and ambitions of the students. Skill enhancement Courses enable the student acquire the skill relevant to the main subject. Choices from Discipline Specific Electives provides the student with liberty of exploring his interests within the main subject. The well-structured programme empowers the student with the skills and knowledge leading to enhanced career opportunities in industry, commerce, education, finance and research. Further the programme

- Inculcate critical thinking to carry out scientific investigation objectively without being biased with preconceived notions.
- Equip the student with skills to analyze problems, formulate hypothesis, evaluate and validate results, and draw reasonable conclusions thereof.
- Prepare students for pursuing research or careers in mathematical sciences and allied fields
- Imbibe effective scientific and/or technical communication in both oral and writing.

• Continue to acquire relevant knowledge and skills appropriate to professional activities and demonstrate highest standards of ethical issues in mathematical sciences.

PROGRAMME SPECIFIC OUTCOMES

• Understanding of the fundamental axioms in mathematics and capability of developing ideas based on them.

• Inculcate mathematical reasoning.

• Prepare and motivate students for research studies in mathematics and related fields.

• Provide knowledge of a wide range of mathematical techniques and application of mathematical methods/tools in other scientific and engineering domains.

• Provide advanced knowledge on topics in pure mathematics, empowering the students to pursue higher degrees at reputed academic institutions.

• Strong foundation on Abstract Algebra, Real Analysis and complex Analysis.

• Good understanding of number theory which can be used in modern online cryptographic technologies.

• Nurture problem solving skills, thinking, creativity through assignments, project work.

• Assist students in preparing (personal guidance, books) for competitive exams e.g. NET, GATE, etc.

COURSE OUTCOMES:

Semester I	**Course : Differential Calculus (UMTTC-101)** **Course Objectives:** The primary objective of this course is to introduce the basic tools of calculus and to understand the extension of the studies of single variable differential calculus to functions of two or more independent variables **Course Learning Outcomes:** This course will enable the students to: i) Understand concepts of limit and continuity on **R** through ϵ-δ definition. ii) Learn the conceptual variations when advancing in calculus from one variable to multivariable discussions. iii) Sketch curves in a plane using its mathematical properties in the different coordinate systems of reference. iv) Learn the applications of mean value theorem and Taylor's theorem.
Semester II	**Course : Differential Equations (UMTTC-202)** **Course Objectives:** The main objectives of this course are to introduce the students to the exciting world of Differential Equations (Ordinary Differential equations and Partial Differential equations) and their applications. **Course Learning Outcomes:** The course will enable the students to: i) Understand basic concepts of Differential Equations ii) Solve first order linear and non-linear differential equation and linear differential equations of higher order using various techniques.

	iii) Formulate, classify and solve linear and non-linear partial differential equations using various methods; and apply these methods in solving some physical problems.
Semester III	**Course : Real Analysis (UMTTC-301)** **Course Objectives:** The course will develop a deep and rigorous understanding of Real line and Real valued functions and of defining terms to prove the results about convergence and divergence of sequences and series of real numbers and real valued functions. These concepts has wide range of applications in real life scenario. **Course Learning Outcomes:** This course will enable the students to: i) Understand many properties of the real line and learn to define sequence in terms of functions from a subset of Natural no's to Real line. ii) Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and to calculate their limit superior, limit inferior, and the limit of a bounded sequence. iii) Apply the ratio, root, alternating series and limit comparison tests for convergence and absolute convergence of an infinite series of real numbers. iv) The geometrical properties of continuous functions on closed and bounded intervals. v) Sequence and series of Real valued functions along with power series and radius of convergence.
Semester IV	**Course : Algebra (UMTTC-401)** **Course Objectives:** The objective of the course is to introduce the fundamental theory of groups and their homomorphisms. Symmetric groups and group of symmetries are also studied in detail. Fermat's Little theorem and Euler's theorem as a consequence of the Lagrange's theorem on finite groups. Concept of Ring and Field and their homomorphism. **Course Learning Outcomes:** The course will enable the students to:

	i) Recognize the mathematical objects that are groups, and classify them as abelian, cyclic and permutation groups, etc; ii) Link the fundamental concepts of Groups and symmetrical figures; iii) Explain the significance of the notion of cosets, normal subgroups, and factor groups. iv) Learn the fundamental concept of Rings, Fields, subrings, integral domains and the corresponding homomorphisms.
Semester V	**Course : Matrices (UMTTE-501)** **Course Objectives:** The primary objective of this course is to introduce the basic tools of theory of equations and matrices to understand their linkage to the real-world problems. Perform matrix algebra with applications. **Course Learning Outcomes:** This course will enable the students to: i) Understand different types of Matrices and their types. ii) Find Rank and also find eigenvalues and corresponding eigenvectors for a square matrix. iii) Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix, using rank. iv) Find matrix form of basic geometric transformations and interpretation of eigenvalues and eigenvectors of such transformations. v) Diagonalize square matrices and learn its applications.
	Course : Linear Algebra (UMTTE-503) **Course Objectives:** The objective of this course is to introduce the fundamental theory of vector spaces, and Linear Transformations. **Course Learning Outcomes**: The course will enable the students to learn about:

	i) The fundamental concept of vector spaces with plenty of examples from different mathematical areas and the corresponding vector subspaces. ii) The concept of linear independence of vectors over a field, the idea of a finite dimensional vector space, basis of a vector space and the dimension of a vector space. iii) Basic concepts of linear transformations, the Rank-Nullity Theorem, matrix of a linear transformation, algebra of transformations and the change of basis and Dual space and dual basis of vector space.
Semester VI	**Course : Numerical Methods (UMTTE-601)** **Course Objectives:** To comprehend various computational techniques to find approximate value for possible root(s) of non-algebraic equations, to find the approximate solutions of system of linear equations and ordinary differential equations. Also, the use of Computer Algebra System (CAS) by which the numerical problems can be solved both numerically and analytically, and to enhance the problem solving skills. **Course Learning Outcomes:** The course will enable the students to learn the following: i) Some numerical methods to find the zeroes of nonlinear functions of a single variable and solution of a system of linear equations, up to a certain given level of precision. ii) Interpolation techniques to compute the values for a tabulated function at points not in the table. iii) Applications of numerical differentiation and integration to convert differential equations into difference equations for numerical solutions.

	Course : Complex Analysis (UMTTE-602) **Course Objectives:** This course aims to introduce the basic ideas of analysis for complex functions in complex variables with visualization through relevant practicals. Particular emphasis has been laid on De Movries theorem and its applications, Analytic Functions Cauchy's theorems, series expansions etc. **Course Learning Outcomes:** The completion of the course will enable the students to: i) Employ De Moivre's theorem in a number of applications to solve numerical problems. ii) Understand the significance of differentiability of complex functions leading to the understanding of Cauchy-Riemann equations. iii) Understand analytic functions and to evaluate the contour integrals and understand the role of Cauchy-Goursat theorem and the Cauchy integral formula. iv) Get familiar with liouville's theorem and the Fundamental theorem of Algebra and expand some simple functions as their Taylor and Laurent series.