# DEPARTMENT OF MATHEMATICS
## COURSE OUTCOME

| Sl. No. | Core | COURSE OUTCOME |
|---------|------|----------------|
| 1 | CC – I CALCULUS | **Objective:** The main emphasis of this course is to equip the student with necessary analytic and technical skills to handle problems of mathematical nature as well as practical problems. More precisely, main target of this course is to explore the different tools for higher order derivatives, to plot the various curves and to solve the problems associated with differentiation and integration of vector functions.<br>**Expected Outcomes:** After completing the course, students are expected to be able to use Leibnitz's rule to evaluate derivatives of higher order, able to study the geometry of various types of functions, evaluate the area, volume using the techniques of integrations, able to identify the difference between scalar and vector, acquired knowledge on some the basic properties of vector functions. |
| 2 | CC – II Discrete Mathematics | **Objective:** This is a preliminary course for the basic courses in mathematics and all its applications. The objective is to acquaint students with basic counting principles, set theory and logic, matrix theory and graph theory.<br>**Expected Outcomes:** The acquired knowledge will help students in simple mathematical modeling. They can study advance courses in mathematical modeling, computer science, statistics, physics, chemistry etc. |
| 3 | CC – III Real Analysis | **Objective:** The objective of the course is to have the knowledge on basic properties of the field of real numbers, studying Bolzano-Weierstrass Theorem , sequences and convergence of sequences, series of real numbers and its convergence etc. This is one of the core courses essential to start doing mathematics.<br>**Expected Outcome:** On successful completion of this course, students will be able to handle fundamental properties of the real numbers that lead to the formal development of real analysis and understand limits and their use in sequences, series, differentiation and integration. Students will appreciate how abstract ideas and rigorous methods in mathematical analysis can be applied to important practical problems |
| 4 | CC – IV Differential equations | **Objective:** Differential Equations introduced by Leibnitz in 1676 models almost all Physical, Biological, Chemical systems in nature. The objective of this course is to |

| | | |
|---|---|---|
| | | familiarize the students with various methods of solving differential equations and to have a qualitative applications through models. The students have to solve problems to understand the methods. |
| | | **Expected Outcomes:** A student completing the course is able to solve differential equations and is able to model problems in nature using Ordinary Differential Equations. This is also prerequisite for studying the course in Partial Differential Equations and models dealing with Partial Differential Equations. |
| 5 | CC – V Theory of Real functions | **Objective:** The objective of the course is to have knowledge on limit theorems on functions, limits of functions, continuity of functions and its properties, uniform continuity, differentiability of functions, algebra of functions and Taylor's theorem and, its applications. The student how to deal with real functions and understands uniform continuity, mean value theorems.<br><br>Expected Outcome: On the completion of the course, students will have working knowledge on the concepts and theorems of the elementary calculus of functions of one real variable. They will work out problems involving derivatives of function and their applications. They can use derivatives to analyze and sketch the graph of a function of one variable, can also obtain absolute value and relative extrema of functions. This knowledge is basic and students can take all other analysis courses after learning this course. |
| 6 | CC – VI Group Theory-I | **Objective:** Group theory is one of the building blocks of modern algebra. Objective of this course is to introduce students to basic concepts of group theory and examples of groups and their properties. This course will lead to future basic courses in advanced mathematics, such as Group theory-II and ring theory.<br>Expected Outcomes: A student learning this course gets idea on concept and examples of groups and their properties . He understands cyclic groups, permutation groups, normal subgroups and related results. After this course he can opt for courses in ring theory, field theory, commutative algebras, linear classical groups etc. and can be apply this knowledge to problems in physics, computer science, economics and engineering. |

| | | |
|---|---|---|
| 7 | CC – VII Partial differential equations and system of ODEs | **Objective:** The objective of this course is to understand basic methods for solving Partial Differential Equations of first order and second order. In the process, students will be exposed to Charpit's Method, Jacobi Method and solve wave equation, heat equation, Laplace Equation etc. They will also learn classification of Partial Differential Equations and system of ordinary differential equations. |
| | | **Expected Outcomes:** After completing this course, a student will be able to take more courses on wave equation, heat equation, diffusion equation, gas dynamics, non linear evolution equations etc. All these courses are important in engineering and industrial applications for solving boundary value problem. |
| 8 | CC – VIII Numerical Methods and Scientific Computing | **Objective:** Calculation of error and approximation is a necessity in all real life, industrial and scientific computing. The objective of this course is to acquaint students with various numerical methods of finding solution of different type of problems, which arises in different branches of science such as locating roots of equations, finding solution of systems of linear equations and differential equations, interpolation, differentiation, evaluating integration. |
| | | **Expected Outcome:** Students can handle physical problems to find an approximate solution. After getting trained a student can opt for advance courses in numerical analysis in higher mathematics. Use of good mathematical software will help in getting the accuracy one need from the computer and can assess the reliability of the numerical results, and determine the effect of round off error or loss of significance. |
| 9 | CC – IX Topology of Metric spaces | **Objective:** This is an introductory course in topology of metric spaces. The objective of this course is to impart knowledge on open sets, closed sets, continuous functions, connectedness and compactness in metric spaces. |
| | | **Expected Outcomes:** On successful completion of the course students will learn to work with abstract topological spaces. This is a foundation course for all analysis courses in future. |
| 10 | CC – X Ring Theory | **Objective:** This is a second course in modern algebra which deals with ring theory. Some basics of ring theory like rings, subrings, ideals, ring homomorphisms and their properties and. This course is an integral part of any course on Modern |

| | | algebra the ohers being Group theory and Field Theory. |
|---|---|---|
| | | **Expected Outcomes:** After completing this course, this will help students to continue more courses in advanced Ring theory modules, Galois groups. |
| 11 | CC – XI Multivariable Calculus | **Objective:** The objective of this course to introduce functions of several variable to a student after he has taken a course in one variable calculus. The course will introduce partial derivatives and several of its consequences and will introduce double and triple integrals along with line integrals which are fundamental to all streams where calculus can be used. |
| | | **Expected Outcomes:** After reading this course a student will be able to calculate partial derivatives, directional derivatives, extreme values and can calculate double, triple and line integrals. He will have idea of basic vector calculus including green's theorem, divergence theorem.and stokes theorem. He can take courses in calculus on manifolds, Differential geometry and can help in numerical computations involving several variables. |
| 12 | CC – XII Linear Algebra | **Objective:** Linear algebra is a basic course in almost all branches of science. A full course in undergraduate program will help students in finding real life applications later.. The objective of this course is to introduce a student the basics of linear algebra and some of its application |
| | | **Expected Outcomes:** The student will use this knowledge wherever he/She goes after undergraduate program. It has applications in computer science, finance mathematics, industrial mathematics, bio mathematics and what not. |
| 13 | CC – XIII Complex analysis | **Objectives:** The objective of the courseis aimed to provide an introduction to the theories for functions of a complex variable. The concepts of analyticity and complex integration are presented. The Cauchy's theorem and its applications, the calculus of residues and its applications are discussed in detail. <br> **Expected Outcomes:** Students will be able to handle certain integrals not evaluated earlier and will know a technique for counting the zeros of polynomials. This course is prerequisite to many other advance analysis courses. |
| 14 | CC – XIV Group Theory-II | **Objective:** The objective of this course **i**s to be exposed to more advanced results in group theory after completing a basic course. The course introduces results on automorphism, commutator subgroup, group action Sylow theorems etc. |
| | | **Expected Outcomes:** The knowledge of automorphism helps to study |

| | | more on field theory. Students learn on direct products, group actions, class equations and their applications with proof of all results . This course helps to opt for more advanced courses in algebra and linear classical groups. |
|---|---|---|
| 15 | DSE – I Linear Programming | **Objective:** The objective of this course is to familiarize industrial problems to students with various methods of solving Linear Programming Problems, Transportation Problems, Assignment Problems and their applications. Also, students will know the application of linear Programming method in Game Theory.<br>**Expected Outcomes:** More knowledge on this topic in higher studies will help students to deal industrial models. This is also prerequisite for studying advanced courses in Nonlinear Programming Problems, Inventory Control Problem and Queuing Theory etc. |
| 16 | DSE – II Probability and Statistics | **Objective:** The objective of the course is to expertise the student to the extensive role of statistics in everyday life and computation, which has made this course a core course in all branches of mathematical and engineering sciences.<br><br>**Expected Outcome:** The students shall learn probability and statistics for various random variables, multivariate distributions, correlations and relations. He shall learn law of large numbers and shall be able to do basic numerical calculations. |
| 17 | DSE – III Differential Geometry | **Objective:** After learning methods on curve tracing and Analytic Geometry, the objective of this course is to teach Differential geometry of curves and surfaces which trains a student using tools in calculus to derive intrinsic properties of plain curves and space curves.<br>**Expected Outcome:** After completing this course a student will learn on serret-Frenet formulae, relation between tangent, normal and binormals, first and second fundamental forms and ideas on various curvatures. He has scope to take more advanced courses in surface theory and geometry. |
| 18 | DSE – IV Number Theory | **Objective**: The main objective of this course is to build up the basic theory of the integers, prime numbers and their primitive roots, the theory of congruence, quadratic reciprocity law and number theoretic functions, Fermat's last theorem, to acquire knowledge in cryptography specially in RSA encryption and decryption.<br>**Expected Outcomes**: Upon successful completion of this course students will able to know the basic definitions and theorems in number theory, to identify order of an integer, primitive roots, Euler's criterion, the Legendre symbol, Jacobi symbol and their properties, to understand modular arithmetic number-theoretic functions and apply them to cryptography. |

| | | |
|---|---|---|
| 19 | GE – I **CALCULUS AND DIFFERENTIAL EQUATIONS** | **Objective:** Calculus invented by Newton and Leibnitz is powerful analytical tool to solve mathematical problems which arise in all branches of science and engineering. The main emphasis of this course is to equip the student with necessary analytic and technical skills to handle problems of a mathematical nature as well as practical problems using calculus and differential equation. The aim should be to expose the students to basic ideas quickly without much theoretical emphasis with importance on applications.<br><br>**Excepted Outcomes:** After completing the course, students are expected to be able to apply knowledge of calculus and differential equations in the areas of their own interest. |
| 20 | GE – II ALGEBRA | **Objective:** This is a preliminary course for the basic courses in mathematics like, abstract algebra and linear algebra. The objective is to acquaint students with the properties of natural numbers i.e. Euclidean algorithm, congruence relation, fundamental theorem of arithmetic, etc. The basics of linear algebra i.e. vector spaces, matrices are introduced here.<br><br>**Expected Outcomes:** The acquired knowledge will help students to study further courses in mathematics like, group theory, ring theory and field theory and linear algebra. It has applications not only in higher mathematics but also in other science subjects like computer science, statistics, physics, chemistry etc. |
| 21 | GE – III **REAL ANALYSIS** | **Objective:** The objective of the course is to have the knowledge on basic properties of the field of real numbers, studying Bolzano-Weiersstrass Theorem , sequences and convergence of sequences, series of real numbers and its convergence etc. This is one of the core courses essential to start doing mathematics.<br><br>**Expected Outcome:** On successful completion of this |

| | | |
|---|---|---|
| | | course, students will be able to handle fundamental properties of the real numbers that lead to the formal development of real analysis and understand limits and their use in sequences, series, differentiation and integration. Students will appreciate how abstract ideas and rigorous methods in mathematical analysis can be applied to important practical problems. |
| 22 | GE – IV NUMERICAL METHODS | **Objective:** Calculation of error and approximation is a necessity in all real life, industrial and scientific computing. The objective of this course is to acquaint students with various numerical methods of finding solution of different type of problems, which arises in different branches of science such as locating roots of equations, finding solution of nonlinear equations, systems of linear equations, differential equations, Interpolation, differentiation, evaluating integration.<br><br>**Expected Outcome:** Students can handle physical problems to find an approximated solution. After getting trained a student can opt for advance courses in Numerical analysis in higher mathematics. Use of good mathematical software will help in getting the accuracy one need from the computer and can assess the reliability of the numerical results, and determine the effect of round off error or loss of significance. |