Department of Mathematics
PROGRAMME OUTCOME, PROGRAMME SPECIFIC OUTCOME, LEARNING OUTCOME AND COURSE OUTCOME

B.Sc.(Mathematics)

PROGRAMME OUTCOME	Formulating and developing mathematical arguments in a logical manner. Identifying and Evaluating the formulated problems in advanced areas of mathematics and its applications.
PROGRAMME SPECIFIC OUTCOME	One can able to form the Mathematical models and able to analyze the results Numerically and Graphically. Will be able to use programming languages to solve Mathematical problems of higher orders.
LEARNING OUTCOME	Helps to develop scientific skills and prove to be beneficial for the society. Useful in their further studies as well in research work. Beneficial for interdisciplinary science careers.
COURSE OUTCOMES (8 Theory & Practical courses)	
Mathematics-I	• Understand the concept of rank of a matrix and its relation to solution of linear system of equations, learning the idea of Eigen values, Eigen vectors, Cayley-Hamilton theorem. • Recognize the algebraic equations representing geometric objects such as line, plane, sphere, cylinder, cone and analyze them. • Learn the basic skills of successive differentiation, partial and total differentiation, calculation of Jacobians, recognize homogenous functions leading to Euler's theorem. Compute integrals using Reduction formulae and Leibnitz rule.
Mathematics Practical - I	• Introduced to Free and Open Source Software (FOSS Tools) PYTHON to perform basic mathematical operations and functions. • Learn computations with matrices, solution of linear algebraic systems (both manual and using PYTHON). • Understands PYTHON commands for differentiation, integration to find nth derivatives, partial derivatives, Jacobians and reduction formulae. • Understand PYTHON commands for equation of a sphere, cone and cylinder.

Mathematics-II	• Students able to recognize the mathematical objects called groups. • Link the fundamental concepts of groups, semigroups, abelian groups, subgroups and permutation of a group. • Learn to solve problems related to angle between radius vector and tangent and angle between two curves. • Learn to express the curves in pedal form, derivative of an arc, the center of curvature, asymptotes, evolutes and envelopes of the given curve. • Learn to find the length of an arc, area of plane curve, surface area and volume of revolution. • Learn to solve a linear equations, Bernoulli's equations, exact equations. • Learn to solve non-linear and first order, higher degree (solve for p, x, y), Clairaut's equations. • Learn to find orthogonal trajectories in Cartesian and polar form and its applications.

Mathematics Practical - II	• To understand PYTHON commands to verify closure, associative, identity and inverse axioms. • Learn to plot the standard Cartesian curves, Polar curves, Parametric curves, Surface Area and Volume of curves. • Learn to compute for linear, Bernoulli's differential equation, exact differential equation, non-linear differential equation (both manually and using PYTHON command).
Mathematics-III	• Develop an understanding of Order of an element of a group, order of a group, Cyclic group, coset decomposition of a group leading to the proof of Lagrange's theorem on finite groups and it's applications. • Understand the basic ideas of convergence and divergence of sequences and series and the methods used for their tests. Basic knowledge of summation of series. • Determine the continuity, differentiability of functions defined on subsets of the real line. Understand the mean value theorems and their proofs which lead to - the L'Hospital's rule for finding limits of functions and the Taylor's theorem and it's applications.
Mathematics Practical - III	• Develop understanding and verification of Lagrange's theorem on finite groups and calculation of cosets of a subgroup of a group using FOSS tools. • Learn the method of analysing convergence of sequences and series, summation of series using Maxima. • Write Scilab/Maxima programs to illustrate continuity, differentiability of functions, mean value theorems, calculate limits using L'Hospital's rule.
Mathematics-IV	• Comprehend the important concepts of Normal subgroup, Quotient group, Homomorphism of groups, proof of FTH, Permutation groups and the Cayley's theorem and it's proof. • Learn the skill of finding the full & half range Fourier series expansion of a given function. • Develop ability to test continuity and differentiability of functions of more than one

	variable and to extend the Taylor's series expansion for them. Determine the maxima & minima of functions of two variables. • Learn the mathematical tool of Laplace transform and its properties to solve linear differential equations which govern L-C-R circuits. • Computational skill of finding all the solutions of second and higher order linear differential equations with constant coefficients, linear equations with variable coefficients.
Mathematics Practical - IV	• Verify normality of a subgroup, test for homomorphism and isomorphism of groups using Maxima. • Find Fourier series expansion of the given periodic functions. • Find Laplace and Inverse Laplace transforms of some standard functions using maxima and use them to solve linear differential equations. • Solve 2nd order linear differential equations by finding CF and PI (maxima program). • Find maxima and minima of functions of two variables.
Mathematics-V	• Obtained knowledge in Ring theory-comprehend the ideas of subrings, Ideals, quotient rings, Field, homomorphism, proof of FTH. • Understands the ideas of scalar field and vector field and computation of gradient, divergence, circulation and Laplacian and their geometric and physical interpretations. • Develop basic skills of Numerical Methods: finite differences, interpolation of different data structures, Numerical integration.
Mathematics Practical - V	• Understand different types of Rings and their verification through Scilab programs. • Learn calculation of gradient, divergence, curl, Laplacian of scalar and vector fields and their identities using maxima programs. • Use scilab tool to do interpolation and numerical integration.
Mathematics-VI	• Gain knowledge of basic ideas of calculus of variations' such as – functional, variational problem, Euler's equation, Geodesics, Brachistochrone problem and Isoperimetric problems.

	• Understand the ideas of Line and Multiple Integrals and develop skills to evaluate them and apply them to solve geometric problems of finding areas and volumes of surfaces and solids. • Learn the important Integral theorems – Green's theorem, Gauss theorem, Stokes' theorem – and their proofs and some problems there on.
Mathematics Practical - VI	• Understand use of Euler's equation to solve variational problems such as Brachistochrone problem, isoperimetric problems through hand computation and maxima programs. • Evaluate line and multiple integrals of different types using maxima commands. • Verify integral theorems, evaluate given integrals through maxima programs.
Mathematics-VII	• Analyse vectors geometrically and algebraically, Recognize the concepts of the terms span, linear independence, basis, and dimension, and apply these concepts to various vector spaces and subspaces. Use matrix algebra to represent linear transformations and find rank,nullity, singularity. • Learn basic concepts of 'curvilinear' coordinate systems and their inter-relation, conversion. • Acquire skill to solve total and simultaneous differential equations. • Develop thorough understanding of the basic ideas of formation, classification and solution of 'Partial differential equation'.
Mathematics Practical - VII	• Comprehend through practical calculation (using maxima) the important ideas of linear algebra such as span, linear independence, basis, and dimension, matrix of linear transformations and verify rank- nullity theorem. • Solve total and simultaneous differential equations. • Develop skill to solve different types of partial differential equations. • Learn solution of one dimensional wave and heat equations under Dirichlet conditions.
Mathematics-VIII	• Compute sums, products, quotients, conjugate, modulus, and argument of complex numbers. Write equation of straight line, circle in complex form.

	• Understand the significance of differentiability of complex functions and be familiar with the Cauchy-Riemann equations and determine whether a given function is analytic. • Define Bilinear transformation, cross ratio, fixed point, Write the bilinear transformation which maps real line to real line, unit circle to unit circle, real line to unit circle. • Find parametrizations of curves, and compute complex line integrals directly. Use Cauchy's integral theorem and formula to compute line integrals. • Learn 'Numerical methods' of solving algebraic and transcendental equations, systems of linear algebraic equations, computing largest Eigen value of a square matrix and solution of ordinary differential equation of first by Euler, Taylor and Runge-Kutta methods.
Mathematics Practical - VIII	• Write maxima programs to verify check analyticity of complex functions, use Milne-Thomson method to construct analytic functions, check orthogonality and hormonicity of real and imaginary parts of analytic functions. • Learn the important ideas of bilinear transformations, cross ratios and their preservance under bilinear transformation. • Evaluate integrals using Cauchy's Integral theorem (using scilab). • Employ the numerical methods in solving the algebraic equations, system of equations. Find largest Eigen value (using scilab). • Solve ODEs using Euler's method and Runge-Kutta method (using scilab)