2.6 Student Performance and Learning Outcomes

2.6.1 Program outcomes, program specific outcomes and course outcomes

Sr. No.	Program	Program Objectives	Program Specific Objectives
1	**BSc Mathematics**	**PO1**: Promotion of self study **PO2**: Promotion of thinking **PO3**: Confidence **PO4**: Creativity **PO5**: Problem Solving **PO6**: Understanding Concepts **PO7**: Development of Writing, Listening and Teaching Skills **PO8**: Group Discussion (Skill of Team work, interpersonal skills) **PO9**: Social Values: Unity in Diversity	**PSO1**: To enable the students to cultivate a mathematical way of thinking i.e. making conjectures, verifying them with further observations, generalizing them, trying to find proofs and making observations. **PSO2** : To enable the students to quantify their experiences in other subjects they study. **PSO3**: To enable the students to learn the basic structures of mathematics through unifying concepts and to motivate these structures through applications. **PSO4**: To enable the students to study mathematics for themselves. **PSO5**: To provide high quality mathematical education at all levels that will be vital for scientific and technological developments.

Attainment of Programme Specific Outcome

Courses Offered

Sr. No.	Course	Course Outcomes
1	FYBSc Algebra and Geometry	On completion of this course students will be expected to • Prove results involving divisibility and greatest common divisors; • Applications of Modular Arithmatics. • Solve systems of linear equations; • Find integral solutions to specified linear Diophantine Equations; • Apply Euler-Fermat's Theorem to prove relations involving prime numbers; • Apply the Wilson's theorem. • Polynomial addition, subtraction, division, multiplication, roots of polynomials. • Transformation, translation and reflection; • Used cut-out shapes as a means to develop the mental transformation of geometric shapes. • Perform translations and rotations of the coordinate axes to eliminate certain terms from equations. • To find nature of general conics. • Find equation of spheres, cylinders and cones from different given
2	FYBSc Calculus and Differential Equations	On completion of this course students will be expected to • Be able to solve algebraic equations and inequalities involving the square root and modulus function understand the difference between equations and identities, and be able to prove simple identities and inequalities • Be able to recognize odd, even, periodic, increasing, decreasing functions • Understand the operation of composition of functions . • Be able to calculate limits by substitution and by eliminating zero denominators • Be able to calculate limits at infinity of rational functions • Be able to calculate limits in indeterminate forms by a repeated use of l'Hˆopital's rule • Be able to use derivatives to find intervals on which the given function is increasing or ecreasing • Find maxima and minima, critical points and inflection points of

		functions and to determine the concavity of curves • Be able to sketch graphs of rational functions. • Understand the concept of indefinite integral as anti-derivative
3	SYBSc (SemI) Multivariable Calculus I	Upon successful completion of Multivariable Calculus the student will be able to: • Perform standard operations on vectors in two-dimensional space and threedimensional space • Compute the dot product of vectors, lengths of vectors, and angles between vectors • Compute the cross product of vectors and interpret it geometrically • Determine the equations of lines and planes using vectors • Identify various quadric surfaces through their equations • Sketch various types of surfaces • Define vector functions of one real variable and sketch space curves • Compute derivatives and integrals of vector functions • Find the arc lengths and curvatures of space curves • Find the velocity and acceleration of a particle moving along a space curve • Define functions of several variables and their limits • Calculate the partial derivatives of functions of several variables • Apply the chain rule for functions of several variables • Calculate the gradients and directional derivatives of functions of several variables • Solve problems involving tangent planes and normal lines • Determine the extrema of functions of several variables • Use the Lagrange multiplier method to find extrema of functions with constraints.
4	SYBSc (SemI) Laplace Transform and Fourier Series	On completion of this unit successful students will: • Able to understand the Laplace transform of elementary functions. • Able to use the rules of integration & definition of Laplace transform students to prove the properties of Laplace transform. • Learns the topics inverse Laplace transform, application of Laplace transform helps to solve linear higher order differential equation , system of differential equations. • Understand the concept of fourier Series which gives the idea of expanding the sectionally continuous functions in to infinite series.
5	SYBSc (SemII) Linear Algebra	On successful completion of this course unit students will be able to • Understand the basic ideas of vector algebra: linear dependence and independence and spanning; • Know how to find the row space, column space and null space of a matrix, and be familiar with the concepts of dimension of a subspace and the rank and nullity of a matrix, and to understand the relationship of these concepts to associated systems of linear equations;

		• Be familiar with the notion of a linear transformation and its matrix; • Find the Gram-Schmidt orthogonalization of a matrix
6	SYBSc (SemII) Multivariable Calculus II	On completion of this unit successful students will be able : • How to deals with vector valued functions • To understand topics like line integral ,surface integral which generalize integration to functions defined on curves & surfaces. • To understanding the computation of work done ,flux,mass,area of the surfaces. • To understand the Greens theorem , Stokes theorem ,divergence theorem that teaches the relation between integration of functions over surfaces & its boundry,solids & its surface
7	TYBSc (SemIII) Metric Spaces	On completion of this unit successful students will be able to: • Deal with various examples of metric spaces; • Have some familiarity with continuous maps; • Work with compact sets in Euclidean space; • Work with completeness; • Apply the ideas of metric spaces to other areas of mathematics.
8	TYBSc (SemIII) Real Analysis I	By the end of the course, students will be able to: • Explain the completeness of a system of real numbers: a least upper bound, a greatest lower bound. • Elaborate on the topological concepts of the real numbers: open sets, closed sets, accumulation points, closure, open covers, compact sets. • Define and utilize the following concepts: sequence, subsequence, monotone sequence, Cauchy sequence. • Prove that a given function is continuous or discontinuous and classify its points of discontinuity. • Justify the convergence/divergence of a given number series; • Prove some of the classical theorems of real analysis. .
9	TYBSc (SemIII) Group Theory	On completion of this unit successful students will be able to: • Demonstrate when a binary algebraic structure forms a group. • Construct Caley tables. • Determine possible subgroups of a group. • Identify normal subgroups of a group. • Examine symmetric and permutation groups. • Explain group and subgroup orders using Lagrange's theorem. • Identify cyclic subgroups and their generators. • Identify factor group.

		• Implement group axioms. • Apply a range of mathematical techniques to solve a variety of quantitative problems. • Analyze and solve problems individually and/or as par
10	TYBSc (SemIII) Ordinary Differential Equations	On completion of this unit successful students will be able to: • Distinguish between linear, nonlinear, partial and ordinary differential equations. • State the basic existence theorem for 1st order ODE's and use the theorem to determine a solution interval. • Recognize and solve a variable separable differential equation. 4. Recognize and solve a homogeneous differential equation. • Recognize and solve an exact differential equation. • Recognize and solve a linear differential equation by use of an integrating factor. • Make a change of variables to reduce a differential equation to a known form. • Find particular solutions to initial value problems. 10. Solve basic application problems described by first order differential equations.
11	TYBSc (SemIII) Operation Research	On completion of this unit successful students will be able to: • Apply the techniques used in operations research to solve real life problem in mining • Industry select an optimum solution with profit maximization; • Have complete understand of the significant role operation research play in mining • Project completion at every stage of the mines (Skills) use operations research to: 1. Solve transportation problems during the allocation of trucks to excavators 2. Formulate operation research models to solve real life problem 3. Proficiently allocating scarce resources to optimise and maximise profit 4. Eliminate customers / clients waiting period for service delivery turn real life problems into formulation of models to be solve by linear programming etc. • Determine critical path analysis to solve real life project scheduling time and timely • Delivery use critical path analysis and programming evaluation production and review techniques • For timely project scheduling and completion and conduct literature search on the internet in the use of operation research techniques in mining projects execution and completion.

12	TYBSc (SemIII) Number Theory	On completion of this unit successful students will be able to: • Define and interpret the concepts of divisibility, congruence, greatest common divisor, prime, and prime-factorization. • Apply the Law of Quadratic Reciprocity and other methods to classify numbers as primitive roots, quadratic residues, and quadratic non-residues. • Formulate and prove conjectures about numeric patterns. • Produce rigorous arguments (proofs) centered on the material of number theory, most notably in the use of Mathematical Induction and/or the Well Ordering Principal in the proof of theorems.
13	TYBSc (SemIV) Complex Analysis	Upon successful completion Complex Analysis, a student will be able to: • Represent complex numbers algebraically and geometrically, • Define and analyze limits and continuity for complex functions as well as consequences of continuity, • 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, • Analyze sequences and series of analytic functions and types of convergence, • Evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula, and • Represent functions as Taylor, power and Laurent series, classify singularities and poles, find residues and evaluate complex integrals using the residue theorem.
14	TYBSc (SemIV) Real Analysis II	Upon successful completion of this course, students will be able to • Define Riemann integrable and Riemann sums • Prove a theorem about Riemann sums and Riemann integrals • Knowledge of some simple techniques for testing the convergence of sequences and series of functions, and confidence in applying them.
15	TYBSc (SemIV) Ring Theory	Upon successful completion of this course, students will be able • To write precise and accurate mathematical objects in ring theory • For checking the irreducibility of higher degree polynomials over rings. • To understand the concepts like ideals and quotient rings. • To understand the concept of ring homomorphism.
16	TYBSc (SemIV)	Upon successful completion of this course, students will be able to

	Partial Differential Equations	• Explain the concepts and language of partial differential equations. • Understand the difference between ordinary & partial differential equation • Classify the partial differential equations • Solve the partial differential equation using charpits method, Jacobis method.
17	TYBSc (SemIV) Optimization Techniques	Upon successful completion of this course, students will be able to • Formulate optimization problems; • Understand and apply the concept of optimality criteria for various type of optimization problems; • Solve various constrained and unconstrained problems in single variable as well as multivariable; • Apply the methods of optimization in real life situation.
18	TYBSc (SemIV) Graph Theory	Upon successful completion of this course, students should • Be familiar with the definitions and basic theory of graphs; • Be able to implement many of the standard algorithms of graph theory; • Be able to prove simple results in graph theory. • State all of the technical definitions covered in the course (such as a graph, tree, planar graph, coloring, digraph, generating function, linear extension, and other terms). • State all of the relevant theorems covered in the course. • Use these definitions and theorems from memory to construct solutions to problems and/or • Dijkstra's algorithm to find a shortest path spanning tree in a graph or digraph.