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Programme Learning Outcomes of B.A./B.Sc. with Mathematics as a Subject

1. Bachelor's degree in Mathematics is the culmination of in-depth knowledge of algebra, calculus, geometry, differential equations and several other branches of Mathematics. This also leads to study of related areas like computer science and statistics. Thus, this programme helps learners in building a solid foundation for higher studies in Mathematics.

2. The skills and knowledge gained has intrinsic beauty, which also leads to proficiency in analytical reasoning. This course can be utilized in modelling and solving real life problems.

3. Students undergoing this programme learn to logically question assertions, to recognize patterns and to distinguish between essential and irrelevant aspects of problems. They also share ideas and insights while seeking and benefitting from knowledge and insight of others. This helps them to learn behave responsibly in a rapidly changing interdependent society.

4. Students completing this programme will be able to present Mathematics clearly and precisely, make vague ideas precise by formulating them in the language of Mathematics, describe mathematical ideas from multiple perspectives and explain fundamental concepts of Mathematics to non-mathematicians.

5. Completion of this programme will also enable the learners to join teaching profession in primary and secondary schools.

6. This programme will also help students to enhance their employability for government jobs, jobs in banking, insurance and investment sectors, data analyst jobs and jobs in various other public and private enterprises.

7. Equip the student with skills to analyze problems, formulate a hypothesis, evaluate and validateresults, and draw reasonable conclusions thereof.

8. Prepare students for pursuing research or careers in industry in mathematical sciences and allied fields.

9. Have an appreciation of how various sub-disciplines of mathematics are related.

Course learning outcomes

Course learning outcomes of each course in B.A./B.Sc. with Mathematics as a subject are as follows:

B.Sc.-1/B.A.-1 (Semester-1)

Paper: Algebra

Course Learning Outcomes: On completion of course, students are able to

- Understand the concept of Matrices and their use in formulating and solving various problems of Mathematics and other subjects like Physics, Economics.
- Understand the importance of roots of real and complex polynomials and learn various methods of obtaining roots.
- Familiarize with relations, equivalence relations and partitions.
- Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix, using rank.
- Find eigen values and corresponding eigenvectors for a square matrix.
- Be able to implement different methods to find roots of cubic and biquadratic equations.

Paper: Calculus

Calculus the language of motion and change and it is used in analysing a system.

Course Learning Outcomes: This course will enable the students to:

- Calculate the limit and examine the continuity of a function at a point.
- Understand the consequences of various mean value theorems for differentiable functions.
- Sketch curves in Cartesian and polar coordinate systems.
- Calculate length of a curve, area and volume enclosed in a curve and their applications.
- Apply derivative tests in optimization problems appearing in social sciences, physical sciences, life sciences and a host of other disciplines.

Paper: Solid Geometry

Course Learning Outcomes: This course will enable the students to:

- Understand the coordinate geometry and its uses.
- Sketch curves in Cartesian and polar coordinate systems.
- Understand the solid shapes in three dimensions and their mathematical representations.

B.Sc.-1/B.A.-1 (Semester-2)

Paper: Number theory and trigonometry

Number theory is famous for generating easy-to-ask, hard-to-answer questions and that is one reason for its popularity.

Course Learning Outcomes: This course will enable the students to:

- Understand of the basic structures of number theory define terms, explain their significance, and apply them in context.
- Employ De Moivre's theorem in a number of applications to solve numerical problems.
- Learn about some important results in the theory of numbers including the prime number theorem, Chinese remainder theorem, Wilson's theorem and their consequences.
- Learn about number theoretic functions, modular arithmetic and their applications.
- Familiarize with modular arithmetic and find primitive roots of prime and composite numbers.
- Know about open problems in number theory, namely, the Goldbach conjecture and twin-prime conjecture.

Paper: Ordinary Differential Equations

Ordinary Differential Equations (ODE) encountered in various real various branches of sciences, social science and Engineering. Due to their importance, students must need to recognise ODEs and learn to solve ODEs.

Course Learning Outcomes: The course will enable the students to:

- Understand the genesis of ordinary differential equations.
- Learn various techniques of getting exact solutions of solvable first order differential equations and linear differential equations of higher order.
- Grasp the concept of a general solution of a linear differential equation of an arbitrary order and also learn a few methods to obtain the general solution of such equations.
- Describe the different methods to solve linear differential equations of second order
- Formulate mathematical models in the form of ordinary differential equations to suggest possible solutions of the day-to-day problems arising in physical, chemical and biological disciplines.

Paper: Vector Calculus

Applications of this course can be seen in physics, economics, optimization, etc. It is used extensively in physics and engineering, especially in the description of electromagnetic fields and fluid flow

Course Learning Outcomes: This course will enable the students to:

- Understand basics of vectors, representation of vectors, gradient, divergence and curl and their physical meanings.
- Inter-relationship amongst the line integral, double and triple integral formulations.
- Realize importance of Green, Gauss and Stokes' theorems in other branches of mathematics.

B.Sc.-1/B.A.-1 (Semester-3)

Paper: Advanced Calculus

This course is the backbone of various subjects in mathematics and numerous applications in in physics, engineering and in other mathematical contexts.

Course Learning Outcomes: This course will enable the students to:

- Calculate the limit and examine the continuity of a function at a point.
- Understand the consequences of various mean value theorems for differentiable functions.
- Apply derivative tests in optimization problems appearing in social sciences, physical sciences, life sciences and a host of other disciplines.
- Learn various properties of curves including Frenet-Serret formulae and their applications.
- Know the interpretation of the curvature tensor, Geodesic curvature, Gauss and Weingarten formulae.
- Understand the role of Gauss's theorem and its consequences.

Paper: Partial Differential Equations

Course Learning Outcomes: This course will enable the students to:

- Apply a range of techniques to solve first & second order partial differential equations.
- Model physical phenomena using partial differential equations such as the heat, wave and Laplace equations.
- Find complete solution, singular solution and General solution using Charpit's general method, Jacobi's method.
- Classify linear partial differential equations of second order and reduce second order linear partial differential equations to Canonical (Normal) forms
- Understand problems, methods and techniques of calculus of variations.

Paper: Statics

Course Learning Outcomes: This course will enable the students to:

- Familiarize with the concepts of different types of forces, moments and couples. It is very useful for mathematicians, physicists, astronomers, and engineers.
- Understand necessary conditions for the equilibrium of particles acted upon by various forces and learn the principle of virtual work for a system of coplanar forces acting on a rigid body.
- Determine the centre of gravity of some materialistic systems and discuss the equilibrium of a uniform cable hanging freely under its own weight.
- Understand about wrenches, null lines and planes, and stable and unstable equilibrium.

B.Sc.-1/B.A.-1 (Semester-4)

Paper: Sequences and series

This course is very useful in partial differential equations, control theory, economics, functional analysis and many more.

Course Learning Outcomes: This course will enable the students to:

- Understand many properties of the real line $\mathbb{R}$ and learn to define sequence in terms of functions from $\mathbb{N}$ to a subset of $\mathbb{R}$.

- Assimilate the notions of limit of a sequence and convergence of a series of real numbers.
- Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and to calculate their limit superior, limit inferior, and the limit of a bounded sequence.
- Apply the ratio, root, alternating series and limit comparison tests for convergence and absolute convergence of an infinite series of real numbers.

Paper: Special functions
Course Learning Outcomes: This course will enable the students to:
- Know about piecewise continuous functions, Dirac delta function, Laplace transforms and its properties.
- Solve ordinary differential equations using Laplace transforms.
- Familiarize with Fourier transforms of functions between Laplace and Fourier transforms.
- Explain Parseval's identity and applications of Fourier transforms to boundary value problems.
- Learn Fourier series, Bessel's inequality, term by term differentiation and integration of Fourier series.
- Apply the concepts of the course in real life problems.

Paper: Programming in C and Numerical Methods:
This book is aimed at advancing concepts of programming and software code organization within the framework of structural and procedural programming paradigms.

Course Learning Outcomes: This course will enable the students to:
- Have knowledge of Programmer's model of a computer, Algorithms, Flow charts, Data types, Operators and expressions, Input / outputs functions.
- Have knowledge of the concept of Decisions control structure Decision statements, Logical & conditional statements, Implementation of Loops, Switch & Case control structures. Functions, Preprocessors and Arrays.
- Understand a functional hierarchical code organization.
- Define and manage data structure based on problems subject domain.
- Understand defensive programming concepts. They can handle possible errors during program execution.
- Get the numerical solutions of algebraic equations, transcendental equations and simultaneous linear algebraic equations with the help of C language.

B.Sc.-1/B.A.-1 (Semester-5)

Paper: Real Analysis
Course Learning Outcomes: This course will enable the students to:

- Learn some of the properties of Riemann integrable functions, and the applications of the fundamental theorems of integration.
- Learn basic facts about the cardinality of a set.
- Understand several standard concepts of metric spaces and their properties like openness, closedness, completeness, Bolzano-Weierstrass property, compactness, and connectedness.
- Identify the continuity of a function defined on metric spaces and homeomorphisms.

Paper: Group and Ring

Course Learning Outcomes: The course will enable the students to:
- Recognize the mathematical objects called groups and rings.
- Understand the fundamental properties of groups and related theorems.
- Explain the significance of the notions of cosets, normal subgroups, and factor groups.
- Analyze consequences of Lagrange's theorem.
- Learn about structure preserving maps between groups and their consequences.
- Know the fundamental concepts in ring theory such as the concepts of ideals, quotient rings, integral domains, and fields.
- Learn in detail about polynomial rings, fundamental properties of finite field extensions, and classification of finite fields.

Paper: Numerical Analysis

Course Learning Outcomes: This course will enable the students to:
- Represent the outputs of programs visually in terms of well formatted text and plots
- Find numerical solutions of system of linear equations and check the accuracy of the solutions.
- Learn about various interpolating and extrapolating methods.
- Solve initial and boundary value problems in differential equations using numerical methods.
- Apply various numerical methods in real life problems.
- Understand and apply the programming concepts of C which is important for mathematical investigation and problem solving.

B.Sc.-1/B.A.-1 (Semester-6)

Paper: Real and Complex Analysis

Course Learning Outcomes: This course will enable the students to:
- Understand Jacobians, Beta gamma functions and their applications.
- Understand Fourier series expansions and their applications.
- Visualize complex numbers as points of R^2 and stereographic projection of complex plane on the Riemann sphere.
- Understand the significance of differentiability and analyticity of complex functions leading to the Cauchy-Riemann equations.
- Understand mobius transformations.

Paper: Linear Algebra

This course is very useful for the computer science students and control theory researchers.

Course Learning Outcomes: This course will enable the students to:
- Understand the concepts of vector spaces, subspaces, bases, dimension and their properties.
- Relate matrices and linear transformations, compute eigen values and eigen vectors of linear transformations.
- Learn properties of inner product spaces and determine orthogonality in inner product spaces.
- Realize importance of adjoint of a linear transformation and its canonical form.

Paper: Dynamics

Course Learning Outcomes: This course will enable the students to:
- construct free-body diagrams and can discuss easily the motion on smooth and rough planes, general motion of rigid body.
- Understand the analysis of distributed loads.
- Understand a broad knowledge of internal forces and moments.
- Able to apply kepler's law to solve the problems.