RAO PAHLAD SINGH DEGREE COLLEGE
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DEPARTMENT OF MATHEMATICS

PROGRAMME SPECIFIC OUTCOMES

(1) Understand the concept of limit of functions, continuity and differentiability of functions.

(2) Expound upon the concept of Riemann inerrability.

(3) Understand the concepts of Differential Geometry, Operation Research, Hydrostatics and Mathematical languages such as Programming in C, Matlab.

(4) Solve linear and nonlinear equations and calculate definite integral using an appropriate numerical method.

(5) Use the methods to design experiments, analysis and interpretation of data and synthesize the information to provide valid conclusion.

(6) To develop ones own learning capacity.

(7) Prepare and motivate students for research studies in mathematics and related fields.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject : Algebra **Class: B.A. 1st Sem.**

Course Objective

1. Work with matrices and determine if a given square matrix is invertible.
2. Learn to solve systems of linear equations and application problems requiring them.
3. Learn to compute determinants and know their properties.
4. Learn to find and use eigenvalues and eigenvectors of a matrix.
5. Learn about and work with vector spaces and subspaces.

Course Outcomes

After the completion of the course, Students will be able to

1. Find the inverse of a square matrix.
2. Solve the matrix equation Ax = b using row operations and matrix operations.
3. Find the determinant of a product of square matrices, of the transpose of a square matrix, and of the inverse of an invertible matrix
4. Find the characteristic equation, eigenvalues and corresponding eigenvectors of a given matrix.
5. Determine if a given matrix is diagonalizable.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Calculus **Class: B.A. 1st Sem.**

Course Objective

1. Use the fact that the derivative is the slope of the tangent line to the curve at a given point to help determine the derivatives of simple linear functions.
2. Determine whether the equation of a function given is differentiable or continuous at a particular value of x.
3. Determine the information from a graph that when the second derivative is positive the graph is concave upward, when the second derivative is negative the graph is concave downward, and when there is a switch in sign there is an inflection point.
4. Understand the various forms of a line including: standard form, point slope form, and slope intercept form.
5. Calculate definite integrals that may involve logarithms, exponentials, polynomials, and powers by using the Fundamental Theorem of Calculus.

Course Outcomes

After the completion of the course, Students will be able to

1. understand the relationship between the derivative and the definite integral as expressed in both parts of the Fundamental Theorem of Calculus.
2. locate the x and y intercepts, any undefined points, and any asymptotes.
3. determine asymptotes for rational expressions (we will not go into these graphs in much detail)
4. apply the techniques from the previous section to graph a fourth degree polynomial or higher
5. determine if there is any symmetry to aid in the graphing process.
6. determine the point(s) of intersection of pairs of curves.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Solid Geometry **Class: B.A. 1st Sem.**

Course Objective

1. To get basic knowledge about Circle, Cone, Parabola, Hyperbola, Ellipse etc.
2. To understand the concepts & advance topics related to two & three dimensional geometry.
3. To study the applications of conics.
4. To study the application of Sphere, cone and cylinder.
5. To study how to trace the curve.

Course Outcomes

After the completion of the course, Students will be able to

1. understand geometrical terminology for angles, triangles, quadrilaterals and circles.
2. measure angles using a protractor.
3. use geometrical results to determine unknown angles.
4. recognise line and rotational symmetries.
5. find the areas of triangles, quadrilaterals and circles and shapes based on these.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject :Number Theory And Trigonometry **Class: B.A. 2nd Sem.**

Course Objective

1. Define and interpret the concepts of divisibility, congruence, greatest common divisor, prime, and prime-factorization.
2. Apply the Law of Quadratic Reciprocity and other methods to classify numbers as primitive roots, quadratic residues, and quadratic non-residues.
3. Formulate and prove conjectures about numeric patterns.
4. 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.
5. Evaluate trigonometric and inverse trigonometric functions.
6. Solve trigonometric equations and applications.
7. Apply and prove trigonometric identities.

Course Outcomes

After the completion of the course, Students will be able to

1. Demonstrate knowledge and understanding of topics including, but not limited to divisibility, prime numbers, congruences, quadratic reciprocity, Diophantine equations.
2. Learn methods and techniques used in number theory.
3. Write programs/functions to compute number theoretic functions.
4. Use mathematical induction and other types of proof writing techniques.
5. Evaluate trigonometric and inverse trigonometric functions.
6. Solve trigonometric equations and applications.
7. Apply and prove trigonometric identities.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Ordinary Differential Equations **Class: B.A. 2nd Sem.**

Course Objective

1. Evaluate first order differential equations including separable, homogeneous, exact, and linear.
2. Show existence and uniqueness of solutions.
3. Solve second order and higher order linear differential equations.
4. Create and analyze mathematical models using higher order differential equations to solve application problems such as harmonic oscillator and circuits.
5. Solve differential equations using variation of parameters
6. Solve linear systems of ordinary differential equations

Course Outcomes

After the completion of the course, Students will be able to

1. Student will be able to solve first order differential equations utilizing the standard techniques for separable, exact, linear, homogeneous, or Bernoulli cases.
2. Student will be able to find the complete solution of a nonhomogeneous differential equation as a linear combination of the complementary function and a particular solution.
3. Student will be introduced to the complete solution of a nonhomogeneous differential equation with constant coefficients by the method of undetermined coefficients.
4. Student will be able to find the complete solution of a differential equation with constant coefficients by variation of parameters.
5. Student will have a working knowledge of basic application problems described by second order linear differential equations with constant coefficients.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject : Vector Calculus **Class: B.A. 2nd Sem.**

Course Objectives

1. Define vector fields.
2. Calculate line integrals along piecewise smooth paths; interpret such quantities as work done by a force .
3. Use the fundamental theorem of line integrals.
4. Use Green's theorem to evaluate line integrals along simple closed contours on the plane.
5. Compute the curl and the divergence of vector fields.
6. Apply Stokes' theorem to compute line integrals along the boundary of a surface.
7. Use Stokes' theorem to give a physical interpretation of the curl of a vector field.
8. Use the divergence theorem to give a physical interpretation of the divergence of a vector field.

Course Outcomes

1. Memorize definition of directional derivative and gradient and illustrate geometric meanings with the aid of sketches.
2. Memorize theorem relating directional derivative to gradient and reproduce proof.
3. Calculate directional derivatives and gradients.
4. Apply gradient to solve problems involving normal vectors to level surfaces.
5. Explain the concept of a vector integration a plane and in space.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject : Advanced Calculus **Class: B.A. 3rd Sem.**

Course Objectives

1. To understand Different indeterminate forms of limit.
2. Calculate functional value in neighbourhood of some point using expensions.
3. To understand the behaviour of curve in space.
4. Continuity and Limits - Prove convergence and divergence of limits using the ϵ-δ definition.
5. Differentiation - Identify and prove basic facts about derivatives and their properties.
6. To understand the maximum and minimum behaviour of a function of two variables.

Course Outcomes

1. The student is expected to learn about the basic principles of multi-variable calculus with proofs.
2. To have full knowledge of calculus involving the fundamental tools such as continuity and differentiability.
3. Students are able to reason rigorously in mathematical arguments. They can follow abstract mathematical arguments and write their own proofs.
4. Students are able to effectively communicate mathematics: reading, writing, listening, and speaking. Students make effective use of the library, conduct research and make oral and written presentations of their findings.
5. To know Relationship between the increasing and decreasing behavior of f and the sign of f

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Partial Differential Equation **Class: B.A. 3rd Sem.**

Course Objective

1. Introduce students to partial differential equations.
2. Introduce students to how to solve linear Partial Differential with different methods.
3. To derive heat and wave equations in 2D and 3D.
4. Find the solutions of PDEs are determined by conditions at the boundary of the spatial domain and initial conditions at time zero.
5. Technique of separation of variables to solve PDEs and analyze the behavior of solutions in terms of eigen function expansions.

Course Outcomes

After the completion of the course, Students will be able to

1. classify partial differential equations and transform into canonical form
2. solve linear partial differential equations of both first and second order
3. apply partial derivative equation techniques to predict the behaviour of certain phenomena.
4. apply specific methodologies, techniques and resources to conduct research and produce innovative results in the area of specialisation.
5. extract information from partial derivative models in order to interpret reality.
6. identify real phenomena as models of partial derivative equations.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject : Statics **Class: B.A. 3rd Sem.**

Course Objective

1. Develop an understanding of the principles of statics
2. Develop an ability to analyze problems in a systematic and logical manner, including the ability to draw free-body diagrams.
3. Ability to analyze the statics of trusses, frames and machine.
4. Ability to apply laws of statics.
5. To know the knowledge of equilibrium conditions of a static body.

Course Outcomes

After the completion of the course, Students will be able to

1. An ability to construct free-body diagrams and to calculate the reactions necessary to ensure static equilibrium.
2. An understanding of the analysis of distributed loads.
3. A knowledge of internal forces and moments in members.
4. An ability to calculate centroids and moments of inertia.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject : Sequences And Series **Class: B.A. 4th Sem.**

Course Objective

1. Learn to work with logarithmic, exponential, and inverse trigonometric functions.
2. Learn to work with infinite sequences and series.
3. Learn to work with infinite sequence is bounded.
4. Learn to work with an infinite sequence is monotonic.
5. Learn to work with an infinite sequence is convergent or divergent.
6. Find the sequence of partial sums of an infinite series.
7. Determine if a geometric series is convergent or divergent.
8. Find the sum of a convergent geometric series.

Course Outcomes

After the completion of the course, Students will be able to

1. Determine if an infinite sequence is bounded.
2. Determine if an infinite sequence is monotonic.
3. Determine if an infinite sequence is convergent or divergent.
4. Find the sequence of partial sums of an infinite series.
5. Determine if a geometric series is convergent or divergent.
6. Find the sum of a convergent geometric series.
7. Determine if an infinite series is convergent or divergent by selecting the appropriate test from the following: (a) test for divergence; (b) integral test; (c) p-series test; (d) the comparison tests; (e) alternating series test; (f) absolute convergence test; (g) ratio test; and (h) root test.
8. Determine if an infinite series converges absolutely or conditionally.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Special Function & Integral Transforms **Class: B.A. 4th Sem.**

Course Objective

1. To analyze properties of special functions by their integral representations and symmetries.
2. To determine properties of Fourier Transform which may be solved by application of special functions.
3. To determine properties of Laplace Transform which may be solved by application of special functions.
4. To determine properties of Legendre Polynomial which may be solved by application of special functions.

Course Outcomes

After the completion of the course, Students will be able to

1. understand integral calculus and special functions of various engineering problem and to known the application of some basic mathematical methods via all these special functions.
2. explain the applications and the usefulness of these special functions.
3. classify and explain the functions of different types of differential equations.
4. understand purpose and functions of the gamma and beta functions, Fourier series and Transformation.
5. use the gamma function, beta function and special functions to: evaluate different types of integral calculus problems and Fourier series to solve differential equations.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Programming in C & Numerical Methods **Class: B.A. 4th Sem.**

Course Objective

1. To develop programming skills using the fundamentals and basics of C language.
2. To study the advantages of user defined data type that provides flexibility for application development.
3. To enable effective usage of arrays, structures, functions and pointers.
4. Derive appropriate numerical methods to solve algebraic and transcendental equations.
5. Derive appropriate numerical methods to solve a linear system of equations.
6. Prove results for various numerical root finding methods.

Course Outcomes

After the completion of the course, Students will be able to

1. Read, understand and trace the execution of programs written in C language.
2. Write the C code for a given algorithm.
3. Write programs that perform operations using derived data types.
4. Solve an algebraic or transcendental equation using an appropriate numerical method.
5. Solve a linear system of equations using an appropriate numerical method.
6. Perform an error analysis for a given numerical method.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Real Analysis **Class: B.A. 5th Sem.**

Course Objective

The student will:

1. Define the real numbers, least upper bounds, and the triangle inequality.
2. Define functions between sets; equivalent sets; finite, countable and uncountable sets. Recognize convergent, divergent, bounded, Cauchy and monotone sequences.
3. Calculate the limit superior, limit inferior, and the limit of a sequence.
4. Recognize alternating, convergent, conditionally and absolutely convergent series.
5. Determine if subsets of a metric space are open, closed, connected, bounded, totally bounded and/or compact.
6. Determine if a function on a metric space is discontinuous, continuous, or uniformly continuous.

Course Outcomes

After the completion of the course, Students will be able to

1. describe fundamental properties of the real numbers that lead to the formal development of real analysis.
2. comprehend rigorous arguments developing the theory underpinning real analysis.
3. demonstrate an understanding of limits and how they are used in sequences, series, differentiation and integration.
4. construct rigorous mathematical proofs of basic results in real analysis.
5. appreciate how abstract ideas and rigorous methods in mathematical analysis can be applied to important practical problems.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Groups & Rings **Class: B.A. 5th Sem.**

Course Objective

1. Present the relationships between abstract algebraic structures with familiar numbers systems such as the integers and real numbers.
2. Present concepts of and the relationships between operations satisfying various properties (e.g. commutative property).
3. Present concepts and properties of various algebraic structures.
4. Discuss the importance of algebraic properties relative to working within various number systems.
5. Develop the ability to form and evaluate conjectures.

Course Outcomes

After the completion of the course, Students will be able to

1. understand the importance of algebraic properties with regard to working within various number systems.
2. extend group structure to finite permutation groups (Cayley's Theorem).
3. understand Sylow's Theorems.
4. generate groups given specific conditions.
5. investigate symmetry using group theory.
6. understand the three major concrete models of Boolean algebra: the algebra of sets, the algebra of electrical circuits, and the algebra of logic.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject : Dynamics **Class: B.A. 5th Sem.**

Course Objective

1. Develop an understanding of the principles of dynamics.
2. Develop an ability to analyze problems in a systematic and logical manner, including the ability to draw free-body diagrams of rigid body.
3. Ability to analyze the dynamics of rigid body.
4. Discuss the motion on smooth and rough planes.
5. Discuss general motion of rigid body, Keplers laws.

Course Outcomes

After the completion of the course, Students will be able to

1. An ability to construct free-body diagrams.
2. An understanding of the analysis of distributed loads.
3. A knowledge of internal forces and moments in members.
4. Apply Keplers laws to solve the problems.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Real & Complex Analysis **Class: B.A. 6th Sem.**

Course Objective

1. Understand how complex numbers provide a satisfying extension of the real numbers;
2. Learn techniques of complex analysis that make practical problems easy (e.g. graphical rotation and scaling as an example of complex multiplication);
3. Appreciate how mathematics is used in design (e.g. conformal mapping);
4. Unlearn (if ever learned) the notion that mathematics is all about getting "the right answer";
5. To understand signals and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide.
6. Development of the mathematical skills to solve problems involving convolution, filtering, modulation and sampling.

Course Outcomes

After the completion of the course, Students will be able to

1. Students will be able to understand the concept of limit for real functions and be able to calculate limits of standard functions and construct simple proofs involving this concept;
2. Student will be introduced to the concept of continuity and be familiar with the statements and proofs of the standard results about continuous real functions;
3. Student will understand the concept of the differentiability of a real valued function and be familiar with the statements and proofs of the standard results about differentiable real functions.
4. Student will have a working knowledge of differentiability for complex functions and be familiar with the Cauchy-Riemann equations;
5. Student will evaluate integrals along a path in the complex plane and understand the statement of Cauchy's Theorem.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject :Linear Algebra **Class: B.A. 6th Sem.**

Course Objective

1. Solve systems of linear equations,
2. Analyze vectors in R^n geometrically and algebraically,
3. Recognize the concepts of the terms span, linear independence, basis, and dimension, and apply these concepts to various vector spaces and subspaces,
4. Use matrix algebra and the related matrices to linear transformations,
5. Compute and use determinants,
6. Compute and use eigenvectors and eigenvalues,
7. Determine and use orthogonality, and
8. Use technological tools such as computer algebra systems or graphing calculators for visualization and calculation of linear algebra concepts.

Course Outcomes

After the completion of the course, Students will be able to

1. Identify and construct linear transformations of a matrix.
2. Characterize linear transformations as onto, one-to-one.
3. Solve linear systems represented as linear transforms.
4. Express linear transforms in other forms, such as as matrix equations, and vector equations.
5. Characterize a set of vectors and linear systems using the concept of linear independence.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Numerical Analysis **Class: B.A. 6th Sem.**

Course Objective

1. The course will also develop an understanding of the elements of error analysis for numerical methods and certain proofs.
2. The main objective of this course is to provide students with an introduction to the field of numerical analysis.
3. Derive appropriate numerical methods to solve interpolation based problems.
4. Derive appropriate numerical methods to solve probability based problems.
5. Prove results for various numerical root finding methods.

Course Outcomes

After the completion of the course, Students will be able to

1. understand the theoretical and practical aspects of the use of numerical analysis.
2. proficient in implementing numerical methods for a variety of multidisciplinary applications.
3. establish the limitations, advantages, and disadvantages of numerical analysis.
4. derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
5. understand of common numerical analysis and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.

DEPARTMENT OF COMMERCE
Course Objective & Outcomes

Subject : Business Mathematics I **Class: B.Com. 1st Sem.**

Course Objectives

1. To understand basics of integration and its uses in the areas of mathematics.
2. Independently solving of business problems.
3. Use percentages, ratios, and proportions for business applications such as discounts, markups, and markdowns, and be able to differentiate which math methods should be used for different problems.
4. Use simple and compound interest to do business calculations such as value of money, maturity value, promissory notes, present value, and future value and be able to differentiate which math method should be used for different problems.
5. Use business statistics for central measurements, frequency distributions, graphs, and measure of dispersion and be able to select which math method should be used for different problems.

Course Outcomes

1. To apply basic terms of integration in solving practical problems field of as of business.
2. To explain basic methods of business calculus, types and methods of interest account and their basic applications in practice.
3. To solve problems in the areas of business calculus, simple and compound interest account, use of compound interest account, loan and consumer credit.
4. To discuss effects of various types and methods of interest account.
5. connect acquired knowledge and skills with practical problems in economic practice.

DEPARTMENT OF COMMERCE
Course Objective & Outcomes

Subject : Business Mathematics **Class: B.Com. 2nd Sem.**

Course Objectives

1. Understanding basic terms in the areas of business calculus and financial mathematics.
2. Independently solving of business problems.
3. Use percentages, ratios, and proportions for business applications such as discounts, markups, and markdowns, and be able to differentiate which math methods should be used for different problems.
4. Use simple and compound interest to do business calculations such as value of money, maturity value, promissory notes, present value, and future value and be able to differentiate which math method should be used for different problems.
5. Use business statistics for central measurements, frequency distributions, graphs, and measure of dispersion and be able to select which math method should be used for different problems.

Course Outcomes

After the successful completion of the syllabus, students will be able to

1. define basic terms in the areas of business calculus and financial mathematics.
2. explain basic methods of business calculus, types and methods of interest account and their basic applications in practice.
3. solve problems in the areas of business calculus, simple and compound interest account, use of compound interest account, loan and consumer credit.
4. discern effects of various types and methods of interest account.
5. connect acquired knowledge and skills with practical problems in economic practice.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject : Algebra **Class: B.Sc. 1st Sem.**

Course Objective

1. Work with matrices and determine if a given square matrix is invertible.
2. Learn to solve systems of linear equations and application problems requiring them.
3. Learn to compute determinants and know their properties.
4. Learn to find and use eigenvalues and eigenvectors of a matrix.
5. Learn about and work with vector spaces and subspaces.

Course Outcomes

After the completion of the course, Students will be able to

1. Find the inverse of a square matrix.
2. Solve the matrix equation Ax = b using row operations and matrix operations.
3. Find the determinant of a product of square matrices, of the transpose of a square matrix, and of the inverse of an invertible matrix
4. Find the characteristic equation, eigenvalues and corresponding eigenvectors of a given matrix.
5. Determine if a given matrix is diagonalizable.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Calculus **Class: B.Sc. 1st Sem.**

Course Objective

1. Use the fact that the derivative is the slope of the tangent line to the curve at a given point to help determine the derivatives of simple linear functions.
2. Determine whether the equation of a function given is differentiable or continuous at a particular value of x.
3. Determine the information from a graph that when the second derivative is positive the graph is concave upward, when the second derivative is negative the graph is concave downward, and when there is a switch in sign there is an inflection point.
4. Understand the various forms of a line including: standard form, point slope form, and slope intercept form.
5. Calculate definite integrals that may involve logarithms, exponentials, polynomials, and powers by using the Fundamental Theorem of Calculus.

Course Outcomes

After the completion of the course, Students will be able to

1. understand the relationship between the derivative and the definite integral as expressed in both parts of the Fundamental Theorem of Calculus.
2. locate the x and y intercepts, any undefined points, and any asymptotes.
3. determine asymptotes for rational expressions (we will not go into these graphs in much detail)
4. apply the techniques from the previous section to graph a fourth degree polynomial or higher
5. determine if there is any symmetry to aid in the graphing process.
6. determine the point(s) of intersection of pairs of curves.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Solid Geometry **Class: B.Sc. 1st Sem.**

Course Objective

1. To get basic knowledge about Circle, Cone, Parabola, Hyperbola, Ellipse etc.
2. To understand the concepts & advance topics related to two & three dimensional geometry.
3. To study the applications of conics.
4. To study the application of Sphere, cone and cylinder.
5. To study how to trace the curve.

Course Outcomes

After the completion of the course, Students will be able to

1. Understand geometrical terminology for angles, triangles, quadrilaterals and circles.
2. Measure angles using a protractor.
3. Use geometrical results to determine unknown angles.
4. Recognize line and rotational symmetries.
5. Find the areas of triangles, quadrilaterals and circles and shapes based on these.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Number Theory And Trigonometry **Class: B.Sc. 2nd Sem.**

Course Objective

1. Define and interpret the concepts of divisibility, congruence, greatest common divisor, prime, and prime-factorization.
2. Apply the Law of Quadratic Reciprocity and other methods to classify numbers as primitive roots, quadratic residues, and quadratic non-residues.
3. Formulate and prove conjectures about numeric patterns.
4. 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.
5. Evaluate trigonometric and inverse trigonometric functions.
6. Solve trigonometric equations and applications.
7. Apply and prove trigonometric identities.

Course Outcomes

After the completion of the course, Students will be able to

1. Demonstrate knowledge and understanding of topics including, but not limited to divisibility, prime numbers, congruences, quadratic reciprocity, Diophantine equations.
2. Learn methods and techniques used in number theory.
3. Write programs/functions to compute number theoretic functions.
4. Use mathematical induction and other types of proof writing techniques.
5. Evaluate trigonometric and inverse trigonometric functions.
6. Solve trigonometric equations and applications.
7. Apply and prove trigonometric identities.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Ordinary Differential Equations **Class: B.Sc. 2nd Sem.**

Course Objective

1. Evaluate first order differential equations including separable, homogeneous, exact, and linear.
2. Show existence and uniqueness of solutions.
3. Solve second order and higher order linear differential equations.
4. Create and analyze mathematical models using higher order differential equations to solve application problems such as harmonic oscillator and circuits.
5. Solve differential equations using variation of parameters
6. Solve linear systems of ordinary differential equations

Course Outcomes

After the completion of the course, Students will be able to

1. Student will be able to solve first order differential equations utilizing the standard techniques for separable, exact, linear, homogeneous, or Bernoulli cases.
2. Student will be able to find the complete solution of a nonhomogeneous differential equation as a linear combination of the complementary function and a particular solution.
3. Student will be introduced to the complete solution of a nonhomogeneous differential equation with constant coefficients by the method of undetermined coefficients.
4. Student will be able to find the complete solution of a differential equation with constant coefficients by variation of parameters.
5. Student will have a working knowledge of basic application problems described by second order linear differential equations with constant coefficients.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject : Vector Calculus **Class: B.Sc. 2nd Sem.**

Course Objectives

1. Define vector fields.
2. Calculate line integrals along piecewise smooth paths; interpret such quantities as work done by a force .
3. Use the fundamental theorem of line integrals.
4. Use Green's theorem to evaluate line integrals along simple closed contours on the plane.
5. Compute the curl and the divergence of vector fields.
6. Apply Stokes' theorem to compute line integrals along the boundary of a surface.
7. Use Stokes' theorem to give a physical interpretation of the curl of a vector field.
8. Use the divergence theorem to give a physical interpretation of the divergence of a vector field.

Course Outcomes

1. Memorize definition of directional derivative and gradient and illustrate geometric meanings with the aid of sketches.
2. Memorize theorem relating directional derivative to gradient and reproduce proof.
3. Calculate directional derivatives and gradients.
4. Apply gradient to solve problems involving normal vectors to level surfaces.
5. Explain the concept of a vector integration a plane and in space.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject : Advanced Calculus **Class: B.Sc. 3rd Sem.**

Course Objectives

1. To understand Different indeterminate forms of limit.
2. Calculate functional value in neighbourhood of some point using expensions.
3. To understand the behaviour of curve in space.
4. Continuity and Limits - Prove convergence and divergence of limits using the ϵ-δ definition.
5. Differentiation - Identify and prove basic facts about derivatives and their properties.
6. To understand the maximum and minimum behaviour of a function of two variables.

Course Outcomes

1. The student is expected to learn about the basic principles of multi-variable calculus with proofs.
2. To have full knowledge of calculus involving the fundamental tools such as continuity and differentiability.
3. Students are able to reason rigorously in mathematical arguments. They can follow abstract mathematical arguments and write their own proofs.
4. Students are able to effectively communicate mathematics: reading, writing, listening, and speaking. Students make effective use of the library, conduct research and make oral and written presentations of their findings.
5. To know Relationship between the increasing and decreasing behavior of f and the sign of f

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Partial Differential Equation **Class: B.Sc. 3rd Sem.**

Course Objective

1. Introduce students to partial differential equations.
2. Introduce students to how to solve linear Partial Differential with different methods.
3. To derive heat and wave equations in 2D and 3D.
4. Find the solutions of PDEs are determined by conditions at the boundary of the spatial domain and initial conditions at time zero.
5. Technique of separation of variables to solve PDEs and analyze the behavior of solutions in terms of eigen function expansions.

Course Outcomes

After the completion of the course, Students will be able to

1. classify partial differential equations and transform into canonical form
2. solve linear partial differential equations of both first and second order
3. apply partial derivative equation techniques to predict the behaviour of certain phenomena.
4. apply specific methodologies, techniques and resources to conduct research and produce innovative results in the area of specialisation.
5. extract information from partial derivative models in order to interpret reality.
6. identify real phenomena as models of partial derivative equations.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject : Statics **Class: B.Sc. 3rd Sem.**

Course Objective

1. Develop an understanding of the principles of statics
2. Develop an ability to analyze problems in a systematic and logical manner, including the ability to draw free-body diagrams.
3. Ability to analyze the statics of trusses, frames and machine.
4. Ability to apply laws of statics.
5. To know the knowledge of equilibrium conditions of a static body.

Course Outcomes

After the completion of the course, Students will be able to

1. An ability to construct free-body diagrams and to calculate the reactions necessary to ensure static equilibrium.
2. An understanding of the analysis of distributed loads.
3. A knowledge of internal forces and moments in members.
4. An ability to calculate centroids and moments of inertia.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject : Sequences And Series **Class: B.Sc. 4th Sem.**

Course Objective

1. Learn to work with logarithmic, exponential, and inverse trigonometric functions.
2. Learn to work with infinite sequences and series.
3. Learn to work with infinite sequence is bounded.
4. Learn to work with an infinite sequence is monotonic.
5. Learn to work with an infinite sequence is convergent or divergent.
6. Find the sequence of partial sums of an infinite series.
7. Determine if a geometric series is convergent or divergent.
8. Find the sum of a convergent geometric series.

Course Outcomes

After the completion of the course, Students will be able to

1. Determine if an infinite sequence is bounded.
2. Determine if an infinite sequence is monotonic.
3. Determine if an infinite sequence is convergent or divergent.
4. Find the sequence of partial sums of an infinite series.
5. Determine if a geometric series is convergent or divergent.
6. Find the sum of a convergent geometric series.
7. Determine if an infinite series is convergent or divergent by selecting the appropriate test from the following: (a) test for divergence; (b) integral test; (c) p-series test; (d) the comparison tests; (e) alternating series test; (f) absolute convergence test; (g) ratio test; and (h) root test.
8. Determine if an infinite series converges absolutely or conditionally.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Special Function & Integral Transforms **Class: B.Sc. 4th Sem.**

Course Objective

1. To analyze properties of special functions by their integral representations and symmetries.
2. To determine properties of Fourier Transform which may be solved by application of special functions.
3. To determine properties of Laplace Transform which may be solved by application of special functions.
4. To determine properties of Legendre Polynomial which may be solved by application of special functions.

Course Outcomes

After the completion of the course, Students will be able to

1. Understand integral calculus and special functions of various engineering problem and to known the application of some basic mathematical methods via all these special functions.

2. Explain the applications and the usefulness of these special functions.

3. Classify and explain the functions of different types of differential equations.

4. Understand purpose and functions of the gamma and beta functions, Fourier series and Transformation.

5. Use the gamma function, beta function and special functions to: evaluate different types of integral calculus problems and Fourier series to solve differential equations.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Programming in C & Numerical Methods **Class: B.Sc. 4th Sem.**

Course Objective

1. To develop programming skills using the fundamentals and basics of C language.
2. To study the advantages of user defined data type that provides flexibility for application development.
3. To enable effective usage of arrays, structures, functions and pointers.
4. Derive appropriate numerical methods to solve algebraic and transcendental equations.
5. Derive appropriate numerical methods to solve a linear system of equations.
6. Prove results for various numerical root finding methods.

Course Outcomes

After the completion of the course, Students will be able to

1. Read, understand and trace the execution of programs written in C language.
2. Write the C code for a given algorithm.
3. Write programs that perform operations using derived data types.
4. Solve an algebraic or transcendental equation using an appropriate numerical method.
5. Solve a linear system of equations using an appropriate numerical method.
6. Perform an error analysis for a given numerical method.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Real Analysis **Class: B.Sc. 5th Sem.**

Course Objective

The student will:

1. Define the real numbers, least upper bounds, and the triangle inequality.
2. Define functions between sets; equivalent sets; finite, countable and uncountable sets. Recognize convergent, divergent, bounded, Cauchy and monotone sequences.
3. Calculate the limit superior, limit inferior, and the limit of a sequence.
4. Recognize alternating, convergent, conditionally and absolutely convergent series.
5. Determine if subsets of a metric space are open, closed, connected, bounded, totally bounded and/or compact.
6. Determine if a function on a metric space is discontinuous, continuous, or uniformly continuous.

Course Outcomes

After the completion of the course, Students will be able to

1. Describe fundamental properties of the real numbers that lead to the formal development of real analysis.
2. Comprehend rigorous arguments developing the theory underpinning real analysis.
3. Demonstrate an understanding of limits and how they are used in sequences, series, differentiation and integration.
4. Construct rigorous mathematical proofs of basic results in real analysis.
5. Appreciate how abstract ideas and rigorous methods in mathematical analysis can be applied to important practical problems.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Groups & Rings **Class: B.Sc. 5th Sem.**

Course Objective

1. Present the relationships between abstract algebraic structures with familiar numbers systems such as the integers and real numbers.
2. Present concepts of and the relationships between operations satisfying various properties (e.g. commutative property).
3. Present concepts and properties of various algebraic structures.
4. Discuss the importance of algebraic properties relative to working within various number systems.
5. Develop the ability to form and evaluate conjectures.

Course Outcomes

After the completion of the course, Students will be able to

1. Understand the importance of algebraic properties with regard to working within various number systems.
2. Extend group structure to finite permutation groups (Cayley's Theorem).
3. Understand Sylow's Theorems.
4. Generate groups given specific conditions.
5. Investigate symmetry using group theory.
6. Understand the three major concrete models of Boolean algebra: the algebra of sets, the algebra of electrical circuits, and the algebra of logic.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject : Dynamics **Class: B.Sc. 5th Sem.**

Course Objective

1. Develop an understanding of the principles of dynamics.
2. Develop an ability to analyze problems in a systematic and logical manner, including the ability to draw free-body diagrams of rigid body.
3. Ability to analyze the dynamics of rigid body.
4. Discuss the motion on smooth and rough planes.
5. Discuss general motion of rigid body, Keplers laws.

Course Outcomes

After the completion of the course, Students will be able to

1. An ability to construct free-body diagrams.
2. An understanding of the analysis of distributed loads.
3. A knowledge of internal forces and moments in members.
4. Apply Keplers laws to solve the problems.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Real & Complex Analysis **Class: B.Sc. 6th Sem.**

Course Objective

1. Understand how complex numbers provide a satisfying extension of the real numbers;
2. Learn techniques of complex analysis that make practical problems easy (e.g. graphical rotation and scaling as an example of complex multiplication);
3. Appreciate how mathematics is used in design (e.g. conformal mapping);
4. Unlearn (if ever learned) the notion that mathematics is all about getting "the right answer";
5. To understand signals and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide.
6. Development of the mathematical skills to solve problems involving convolution, filtering, modulation and sampling.

Course Outcomes

After the completion of the course, Students will be able to

1. Students will be able to understand the concept of limit for real functions and be able to calculate limits of standard functions and construct simple proofs involving this concept;
2. Student will be introduced to the concept of continuity and be familiar with the statements and proofs of the standard results about continuous real functions;
3. Student will understand the concept of the differentiability of a real valued function and be familiar with the statements and proofs of the standard results about differentiable real functions.
4. Student will have a working knowledge of differentiability for complex functions and be familiar with the Cauchy-Riemann equations;
5. Student will evaluate integrals along a path in the complex plane and understand the statement of Cauchy's Theorem.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject :Linear Algebra **Class: B.Sc. 6th Sem.**

Course Objective

1. Solve systems of linear equations,
2. Analyze vectors in R^n geometrically and algebraically,
3. Recognize the concepts of the terms span, linear independence, basis, and dimension, and apply these concepts to various vector spaces and subspaces,
4. Use matrix algebra and the related matrices to linear transformations,
5. Compute and use determinants,
6. Compute and use eigenvectors and eigenvalues,
7. Determine and use orthogonality, and
8. Use technological tools such as computer algebra systems or graphing calculators for visualization and calculation of linear algebra concepts.

Course Outcomes

After the completion of the course, Students will be able to

1. Identify and construct linear transformations of a matrix.
2. Characterize linear transformations as onto, one-to-one.
3. Solve linear systems represented as linear transforms.
4. Express linear transforms in other forms, such as as matrix equations, and vector equations.
5. Characterize a set of vectors and linear systems using the concept of linear independence.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Numerical Analysis **Class: B.Sc. 6th Sem.**

Course Objective

1. The course will also develop an understanding of the elements of error analysis for numerical methods and certain proofs.
2. The main objective of this course is to provide students with an introduction to the field of numerical analysis.
3. Derive appropriate numerical methods to solve interpolation based problems.
4. Derive appropriate numerical methods to solve probability based problems.
5. Prove results for various numerical root finding methods.

Course Outcomes

After the completion of the course, Students will be able to

1. Understand the theoretical and practical aspects of the use of numerical analysis.
2. Proficient in implementing numerical methods for a variety of multidisciplinary applications.
3. Establish the limitations, advantages, and disadvantages of numerical analysis.
4. Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
5. Understand of common numerical analysis and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Abstract Algebra-I **Class: M.Sc. Maths 1st Sem.**

Course Objective

1. Present the relationships between abstract algebraic structures with familiar numbers systems such as the integers and real numbers.
2. Present concepts of and the relationships between operations satisfying various properties (e.g. commutative property).
3. Present concepts and properties of various algebraic structures.
4. Discuss the importance of algebraic properties relative to working within various number systems.
5. Develop the ability to form and evaluate conjectures.

Course Outcomes

After the completion of the course, Students will be able to

1. Generate groups given specific conditions.
2. Investigate symmetry using group theory.
3. Identify plane periodic patterns (lattices).
4. Understand the base of the coding theory as an application of finite fields.
5. Demonstrate knowledge that the rational numbers and real numbers can be ordered and that the complex numbers cannot be ordered, but that any polynomial equation with real coefficients can be solved in the complex field.
6. Discuss the three major concrete models of Boolean algebra: the algebra of sets, the algebra of electrical circuits, and the algebra of logic.
7. Describe other applications of abstract algebra such as in avoiding problems of round off in computations

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Measure & Integration **Class: M.Sc. Maths 1st Sem.**

Course Objective

1. Revision of basic tools, including in particular the concept of countable/uncountable sets.
2. Be able to describe at least one approach to the construction of Lebesgue measure, the Lebesgue integral of a function and measure spaces.
3. Know the principal theorems as treated and their proofs and be able to use them in the investigation of examples.
4. Be able to prove simple unseen propositions concerning measure spaces, Lebesgue measure and integration.
5. To gain understanding of the abstract measure theory and definition and main properties of the integral.
6. To construct Lebesgue's measure on the real line and in n-dimensional Euclidean space.
7. To explain the basic advanced directions of the theory.

Course Outcomes

After the completion of the course, Student will be able to

1. understand σ-algebras, measurable sets, measures, outer measures, Lebesgue measure and its properties, completion of measures.
2. understand measurable functions, approximation by simple functions.
3. understand Lebesgue integral, Monotone Convergence Theorem, Dominated Convergence Theorem, coincidence of Lebesgue and Riemann integral for Riemann integrable functions.
4. develop an appreciation of the basic concepts of measure theory. These methods will be useful for further study in a range of other fields, e.g. Stochastic calculus, Quantum Theory and Harmonic analysis.
5. establish relation to graduate attributes: The above outcomes are related to the development of the Science Faculty Graduate Attributes, in particular: Research, inquiry and analytical thinking abilities, Communication, and Information literacy

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject : Mechanics **Class: M.Sc. Maths 1st Sem.**

Course Objective

1. To demonstrate knowledge and understanding of the following fundamental concepts in the dynamics of system of particles,
2. To demonstrate knowledge and understanding of the following fundamental concepts in motion of rigid body,
3. To demonstrate knowledge and understanding of the following fundamental concepts in Lagrangian and Hamiltonian formulation of mechanics
4. To represent the equations of motion for complicated mechanical systems using the Lagrangian and Hamiltonian formulation of classical mechanics.
5. To develop math skills.

Course Outcomes

After the completion of the course, Students will be able to

1. define and understand basic mechanical concepts related to discrete and continuous mechanical systems,
2. describe and understand the vibrations of discrete and continuous mechanical systems,
3. describe and understand planar and spatial motion of a rigid body,
4. describe and understand the motion of a mechanical system using Lagrange-Hamilton formalism.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject : Ordinary Differential Equation **Class: M.Sc. Maths 1st Sem.**

Course Objective

1. To aware the students about initial value and boundary value problems and their corresponding equivalent integral equations.
2. To aware the students about concepts of approximate solution and existence theorem.
3. To familiarize the students about Adjoint system in detail.
4. Detailed study of Fundamental Set and matrix.
5. To demonstrate knowledge and understanding of Critical points in Autonomous system and their stability.

Course Outcomes

After the completion of the course, Students will be able to

1. Solve problems in ordinary differential equations, dynamical systems, stability theory, and a number of applications to scientific and engineering problems.
2. Demonstrate their ability to write coherent mathematical proofs and scientific arguments needed to communicate the results obtained from differential equation models.
3. Demonstrate their understanding of how physical phenomena are modelled by differential equations and dynamical systems.
4. Implement solution methods using appropriate technology, and
5. Investigate the qualitative behavior of solutions of systems of differential equations

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Communication Skills **Class: M.Sc. Maths 1st Sem.**

Course Objectives

1. Students will demonstrate competency in research skills related to the use of the field's professional literature and in systematic research design and implementation.
2. Students will demonstrate an understanding of multiple theoretical perspectives and diverse intellectual traditions in Communication.
3. Students will demonstrate competency in human relational interaction.
4. Students will demonstrate competency in the analysis and practice of ethical communication.
5. Students will demonstrate an understanding of the importance of free expression and the responsibilities it entails.
6. Students will demonstrate competency in effective communication with diverse others and an understanding of the impact of culture on communication

Course outcomes

After completion of the course Students will be able to

1. Demonstrate critical and innovative thinking
2. Display competence in oral, written, and visual communication.
3. Apply communication theories.
4. Show an understanding of opportunities in the field of communication.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Abstract Algebra-II **Class: M.Sc. Maths 2nd Sem.**

Course Objective

1. Present the relationships between abstract algebraic structures with familiar numbers systems such as the integers and real numbers.
2. Present concepts of and the relationships between operations satisfying various properties (e.g. commutative property).
3. Present concepts and properties of various algebraic structures.
4. Discuss the importance of algebraic properties relative to working within various number systems.
5. Develop the ability to form and evaluate conjectures.

Course Outcomes

After the completion of the course,

1. Student will be able to understand the relationships between abstract algebraic structures with familiar numbers systems such as the integers and real numbers.
2. Student will be able to verify relationships between operations satisfying various properties (e.g. commutative property).
3. Student will be able to work within various algebraic structures.
4. Students will have a working knowledge of important mathematical concepts in abstract algebra such as definition of a module, properties of module and application of module.
5. Students will be knowledgeable of different types of modules such as noetherian module, artinian module and understand the structure and characteristics of these modules.
6. Students will be introduced to and have knowledge of many mathematical concepts studied in abstract mathematics such as Nil ideal and Nilpotent ideal.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Complex Analysis **Class: M.Sc. Maths 2nd Sem.**

Course Objective

1. To provide an introduction to the theories for functions of a complex variable.
2. To explore algebraic, geometric and topological structures of the complex number field.
3. To introduce the concepts of analyticity, Cauchy-Riemann relations and harmonic functions.
4. To present Complex integration and complex power series.
5. To discuss the classification of isolated singularities and examine the theory and illustrate the applications of the calculus of residues in the evaluation of integrals.

Course Outcomes

After the completion of the course,

1. Student will have introduced to the fundamental concepts of complex analysis and their role in modern mathematics and applied contexts.
2. Student will demonstrate to accurate and efficient use of complex analysis techniques.
3. Student will be able to understand capacity for mathematical reasoning through analyzing, proving and explaining concepts from complex analysis
4. Student will be able to apply problem-solving using complex analysis techniques applied to diverse situations in physics, engineering and other mathematical contexts.
5. Student will be able to apply problem-solving using evaluation of improper integral by Cauchy Residue Theorem.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject : Partial Differential Equation. **Class: M.Sc. Maths 2nd Sem.**

Course Objectives

1. Introduce students to partial differential equations.
2. Introduce students to how to solve linear Partial Differential with different methods.
3. Introduce students to some physical problems in Engineering and Biological models that results in partial differential equations. Partial differential equations allow deterministic mathematical formulations of phenomena in physics and engineering as well as biological processes among many other scenarios.
4. The objective of this course is to present the main results in the context of partial differential equations that allow Course about these models and to study numerical methods for the approximation of their solution.
5. To discuss some methods to solve Laplace Heat and Wave Equations.

Course Outcomes

After the completion of the course, Students will be able to

1. classify partial differential equations and transform into canonical form.
2. Solve linear partial differential equations of both first and second order.
3. Apply specific methodologies, techniques and resources to conduct research and produce innovative results in the area of specialisation.
4. Extract information from partial derivative models in order to interpret reality. Identify real phenomena as models of partial derivative equations.
5. Solve complex problems of Heat, Wave and Laplace Equations by applying the knowledge acquired to areas that are different to the original ones. Solve real problems by identifying them appropriately from the perspective of partial derivative equations.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject : Numerical Analysis **Class: M.Sc. Maths 2nd Sem.**

Course Objective

The objectives of this course are to:

1. Derive appropriate numerical methods to solve algebraic and transcendental equations & approximating the solution of problems.
2. Analyze the error incumbent in any such numerical approximation.
3. Study different techniques of interpolation.
4. Derive appropriate numerical methods to evaluate a derivative at a value.
5. Derive appropriate numerical methods to solve a linear system of equations.
6. Perform an error analysis for various numerical methods.
7. Study various concepts of difference equations.
8. Derive appropriate numerical methods to calculate a definite integral.

Course Outcomes

After the completion of the course, Students will be able to

1. Solve an algebraic or transcendental equation using an appropriate numerical method.
2. Approximate a function using an appropriate numerical method.
3. Solve a differential equation using an appropriate numerical method.
4. Evaluate a derivative at a value using an appropriate numerical method.
5. Solve a linear system of equations using an appropriate numerical method.
6. Perform an error analysis for a given numerical method.
7. Prove results for numerical root finding methods.
8. Calculate a definite integral using an appropriate numerical method.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject : Mathematical Statistics **Class: M.Sc. Maths 2nd Sem.**

Course Objective

The objectives of this course are to:

1. Understand the theory of statistics and their applications.
2. Understand the concepts of Probability.
3. To analyse different distributions along with their properties.
4. Aware the students about mathematical expectation, variance, moment generating function and moment about mean & about origin.
5. To understand the concepts of testing hypothesis.

Course Outcomes

After the completion of the course, Students will be able to

1. Differentiate between discrete and continuous random variables.
2. Solve the problems related to Bay's theorem.
3. Calculate mean, variance, Standard deviation of different types of theoretical distribution.
4. Apply different types of tests of significance.
5. Differentiate between types of error.
6. Understand Null & alternative hypothesis for testing.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Functional Analysis **Class: M.Sc. Maths 3rd Sem.**

Course Objective

1. To know and be able to use the elementary properties of normed and inner product spaces.
2. To be able to check whether a linear operator is bounded, to find its adjoint and determine whether operators are normal, self adjoint, unitary or positive.
3. To determine whether a bounded operator is invertible and understand the importance of the spectrum of a bounded linear operator.
4. To study normed linear spaces and some of the linear operators between them and give some applications of their use.
5. To introduce the theory of Lebesgue integration with the aim of providing examples of complete normed linear spaces of integrable functions.

Course Outcomes

After the completion of the course, Students will be able to

1. improve abilities in mathematical reasoning and in expressing themselves accurately in writing by producing correct mathematical proofs.
2. use logical reasoning to prove theorems.
3. introduced to the concept of continuity and be familiar with the statements and proofs of the standard results about continuous real functions;
4. understand the concept of the differentiability of a real valued function and be familiar with the statements and proofs of the standard results about differentiable real functions.
5. understand the concept of Signed measure, Baire measure and continuous function with compact support.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject : Elementary Topology **Class: M.Sc. Maths 3rd Sem.**

Course Objective

1. Students will learn the fundamentals of point-set topology
2. Students will learn the fundamentals of algebraic topology
3. Students will be prepared to begin thesis research.
4. Have the knowledge of basic properties of the field of real numbers.
5. Studying Bolzano –Weirstrass theorem and Cauchy criteria.
6. Studying the basic topological properties of the real numbers
7. Studying the notion of continuous functions and their properties

Course Outcomes

After the completion of the course, Students will be able to

1. Define and recognize the basic topological properties of R
2. Students will know the definitions of standard terms in topology.
3. Students will know how to read and write proofs in topology.
4. Students will know a variety of examples and counter examples in topology.
5. Students will know about the fundamental group and covering spaces.
6. Define and recognize the continuity of real functions.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject : Fluid Dynamics **Class: M.Sc. Maths 3rd Sem.**

Course Objectives

1. The student will learn analytical solution techniques for diverse fluid problems, including lubrication flows, boundary layers, and Stokes flow, in steady and unsteady conditions.
2. learn analytical techniques required to solve fluid flow equations for different geometries and flow conditions.
3. learn the fundamentals physics involved in modelling fluids and hydrodynamic phenomena .
4. Through learned analytical methods and basic numerical techniques presented in this course the students will be able to determine volumetric flow rates, shear and pressure drag, and lift forces for different geometric configurations.
5. The course provides fundamental tools for professional engineers working in fluid mechanics.

Course Outcomes

1. Identify the relevant parameters that govern a fluid system and use dimensional analysis to identify the fundamental variables that define flow [SO1].
2. Analyze microscopic continuum fluid mechanics where flow is governed by the continuity equation and Navier-Stokes equation (differential forms of conservation equations). Evaluate a problem and arrive at reasonable approximations to put the equations in a more soluble form [SO1].
3. Analyze systems using macroscopic fluid mechanics, using the integral form of the conservation equations (Bernoulli's equation) [SO1,SO3].
4. Explain the fundamental properties of fluids, including viscosity, Newtonian and non Newtonian rheology, and viscoelasticity [SO1].
5. Evaluate pressure distributions in a static fluid, taking account of hydrostatic pressure, buoyancy force, and interfacial tension (Laplace pressure and capillary action) [SO1].

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject : Mech. Of Solids **Class: M.Sc. Maths 3rd Sem.**

Course Objectives

1. The main objective of the course will be to show how to determine the stress, strain, and deflection suffered by bi-dimensional (and simple tridimensional) structural elements when subjected to different loads (e.g. normal, shear, torsion, bending and combined loads).
2. Once the state of stresses and strains has been established for a particular structure type, the student will be able to evaluate the allowable loads and associated allowable stresses before mechanical failure.
3. Understanding the adequacy of mechanical and structural elements under different loads is essential for the design and safe evaluation of any kind of structure.
4. This course is a major subject in many different engineering careers (Aeronautics, civil engineering, antennas, etc.).

Course Outcomes

1. Understand the fundamental concepts of stress and strain and the relationship between both through the strain-stress equations in order to solve problems for simple tridimensional elastic solids.
2. Calculate and represent the stress diagrams in bars and simple structures.
3. Solve problems relating to pure and non-uniform bending of beams and other simple structures .
4. Solve problems relating to torsional deformation of bars and other simple tri-dimensional structures.
5. Understand the concept of buckling and be able to solve the problems related to isolated bars.
6. Distinguish between isostatic and hiperstatic problems and be able to use various methods for the resolution of both.
7. Be familiar with at least one software program for the evaluation of structures

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Advance Complex Analysis **Class: M.Sc. Maths 3rd Sem.**

Course Objective

1. To provide an introduction to the theories for functions of a complex variable.
2. To explore algebraic, geometric and topological structures of the complex number field.
3. To introduce the concepts of integral function, Gamma function and its properties.
4. To present analytic continuation, Germ of an analytic function.
5. To discuss the classification of canonical product, growth and order of an entire function, an estimate of number of zeros.
6. To discuss the range of an analytic function.

Course Outcomes

After the completion of the course,

1. Student will have introduced to the fundamental concepts of complex analysis and their role in modern mathematics and applied contexts.
2. Student will demonstrate to accurate and efficient use of complex analysis techniques.
3. Student will be able to understand capacity for mathematical reasoning through analyzing, proving and explaining concepts from complex analysis
4. Student will be able to apply problem-solving using complex analysis techniques applied to diverse situations in physics, engineering and other mathematical contexts.
5. Student will be able to solve application of Green function, Poisson-Jensen formula and Borel Theorem.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Inner Product Space & Measure Theory **Class: M.Sc. Maths 4th Sem.**

Course Objective

1. To know and be able to use the elementary properties of normed and inner product spaces.
2. To be able to check whether a linear operator is bounded, to find its adjoint and determine whether operators are normal, self adjoint, unitary or positive.
3. To determine whether a bounded operator is invertible and understand the importance of the spectrum of a bounded linear operator.
4. To study normed linear spaces and some of the linear operators between them and give some applications of their use.
5. To introduce the theory of Lebesgue integration with the aim of providing examples of complete normed linear spaces of integrable functions.

Course Outcomes

After the completion of the course, Students will be able to

1. improve abilities in mathematical reasoning and in expressing themselves accurately in writing by producing correct mathematical proofs.
2. use logical reasoning to prove theorems.
3. introduced to the concept of continuity and be familiar with the statements and proofs of the standard results about continuous real functions;
4. understand the concept of the differentiability of a real valued function and be familiar with the statements and proofs of the standard results about differentiable real functions.
5. understand the concept of Signed measure, Baire measure and continuous function with compact support.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject : Classical Mechanics **Class: M.Sc. Maths 4th Sem.**

Course Objective

1. To demonstrate knowledge and understanding of the following fundamental concepts in the dynamics of system of particles,
2. To demonstrate knowledge and understanding of the following fundamental concepts in motion of rigid body,
3. To demonstrate knowledge and understanding of the following fundamental concepts in Lagrangian and Hamiltonian formulation of mechanics
4. To represent the equations of motion for complicated mechanical systems using the Lagrangian and Hamiltonian formulation of classical mechanics.
5. To develop math skills.

Course Outcomes

After the completion of the course, Students will be able to

1. define and understand basic mechanical concepts related to discrete and continuous mechanical systems,
2. describe and understand the vibrations of discrete and continuous mechanical systems,
3. describe and understand planar and spatial motion of a rigid body,
4. describe and understand the motion of a mechanical system using Lagrange-Hamilton formalism.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject : Viscous Fluid Dynamics **Class: M.Sc. Maths 4th Sem.**

Course Objectives:

1. Learn the fundamentals physics involved in modelling fluids and hydrodynamic phenomena.
2. Learn analytical techniques required to solve fluid flow equations for different geometries and flow conditions.
3. The student will learn analytical solution techniques for diverse fluid problems, including lubrication flows, boundary layers, and Stokes flow, in steady and unsteady conditions.
4. Through learned analytical methods and basic numerical techniques presented in this course the students will be able to determine volumetric flow rates, shear and pressure drag, and lift forces for different geometric configurations.
5. The course provides fundamental tools for professional engineers working in fluid mechanics.

Course Outcomes

1. Explain the fundamental properties of fluids, including viscosity, Newtonian and non Newtonian rheology, and viscoelasticity [SO1].
2. Analyze microscopic continuum fluid mechanics where flow is governed by the continuity equation and Navier-Stokes equation (differential forms of conservation equations). Evaluate a problem and arrive at reasonable approximations to put the equations in a more soluble form [SO1].
3. Analyze systems using macroscopic fluid mechanics, using the integral form of the conservation equations (Bernoulli's equation) [SO1,SO3].
4. Identify the relevant parameters that govern a fluid system and use dimensional analysis to identify the fundamental variables that define flow [SO1].
5. Evaluate pressure distributions in a static fluid, taking account of hydrostatic pressure, buoyancy force, and interfacial tension (Laplace pressure and capillary action) [SO1].
6. Identify conditions under which flows are turbulent and derive equations that approximate its properties (time averages and fluctuations). Compare turbulent flow with those of laminar flow [SO1].

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject : Graph Theory **Class: M.Sc. Maths 4th Sem.**

Course Objective

The objectives of this course are to:

1. Introduce the concepts of Graph and their different types as well as the isomorphism between them.
2. Introduce the classes of Eulerian and Hamiltonian graphs, trees and weighted graphs.
3. Illustrate how to find minimal walks in graphs.
4. Introduce vertex and edge colourings of graphs.
5. Find out the different methods of searching tree.

Course Outcomes

After the completion of the course, Students will be able to

1. Understand the theoretical base of the subject.
2. Identify different types of the graphs and be able to apply different operations on them.
3. Identify Eulerian and Hamiltonian graphs.
4. Apply special algorithms to find minimal walks in weighted graphs.
5. Apply special algorithms to find spanning trees in graphs.
6. Find chromatic numbers and be able to find out planer graphs.

DEPARTMENT OF MATHEMATICS
Course Objective & Outcomes

Subject: Information and Communication Technology Class: M.Sc. Maths 4th Sem.

Course Objective

This paper's scope is to propose one possible set of objectives that could realize above defined aim. For each objective a set of applications, change drivers, requirements and possible leaders will be identified.

Education processes differ among themselves because of the subject of Course, required Course outcomes, previous knowledge, Course styles, culture, industry and many other factors. On the other hand, ICT can be used in a variety of ways in any traditional or new activity.

These two factors combined derive numerous activities in educational process in which ICT is or can be implemented. In order to streamline them and to try to identify some common points and shared resources, it is proposed to group them in three sets of objectives:

- Support functions: administrative, technical and supportive functions ,
- Course assistance: assistance and support for Course and teaching,
- New Course: new teaching and Course methods, techniques and tools.

Course Outcomes

After the completion of the course, Students will be able to

1. understand the meaning of all the terms highlighted in the text
2. demonstrate an awareness of the main processes in an ICT system (sending, receiving, storing, retrieving, manipulating, conveying)
3. demonstrate an awareness of some of the hardware, software and communication components used in ICT systems
4. use a system map or a block diagram to identify the components of an ICT system