DEPARTMENT OF MATHEMATICS

COURSE OUTCOMES FOR MATHEMATICS MAJOR

SEMESTER-I

COURSE 1: ESSENTIALS AND APPLICATIONS OF MATHEMATICAL, PHYSICALANDCHEMICAL SCIENCES

Course Objective:

The objective of this course is to provide students with a comprehensive understanding of theessential concepts and applications of mathematical, physical, and chemical sciences. The course aims to develop students' critical thinking, problem-solving, and analytical skills in these areas, enabling them to apply scientific principles to real-world situations.

Learning outcomes:

1. Apply critical thinking skills to solve complex problems involving complex numbers,trigonometric ratios, vectors, and statistical measures.

2. To Explain the basic principles and concepts underlying a broad range of fundamentalareas of physics and to Connect their knowledge of physics to everyday situations

3. To Explain the basic principles and concepts underlying a broad range of fundamentalareas of chemistry and to Connect their knowledge of chemistry to daily life.

4. Understand the interplay and connections between mathematics, physics, and chemistry invarious applications. Recognize how mathematical models and physical and chemical principles can be used to explain and predict phenomena in different contexts.

5 To explore the history and evolution of the Internet and to gain an understanding of network security concepts, including threats, vulnerabilities, and countermeasures.

SEMESTER-I

COURSE 2: ADVANCES IN MATHEMATICAL, PHYSICALAND CHEMICAL SCIENCES

Course Objective:

The objective of this course is to provide students with an in-depth understanding of the recent advances and cutting-edge research in mathematical, physical, and chemical sciences. The course aims to broaden students' knowledge beyond the foundational concepts and expose them to the latest developments in these disciplines, fostering critical thinking, research skills, and the ability to contribute to scientific advancements.

Learning outcomes:

1. Explore the applications of mathematics in various fields of physics and chemistry, to understand how mathematical concepts are used to model and solve real-world problems.

2. To Explain the basic principles and concepts underlying a broad range of fundamental areasof physics and to Connect their knowledge of physics to everyday situations.

3. Understand the different sources of renewable energy and their generation processes and advances in nanomaterials and their properties, with a focus on quantum dots. To study the emerging field of quantum communication and its potential applications. To gain an understanding of the principles of biophysics in studying biological systems. Explore the properties and applications of shape memory materials.

3. Understand the principles and techniques used in computer-aided drug design and drug delivery systems, to understand the fabrication techniques and working principles of nanosensors. Explore the effects of chemical pollutants on ecosystems and human health.

4. Understand the interplay and connections between mathematics, physics, and chemistry in various advanced applications. Recognize how mathematical models and physical and chemical principles can be used to explain and predict phenomena in different contexts.

5 Understand and convert between different number systems, such as binary, octal, decimal, and hexadecimal. Differentiate between analog and digital signals and understand their characteristics.Gain knowledge of different types of transmission media, such as wired (e.g., copper cables, fiber optics) and wireless (e.g., radio waves, microwave, satellite)..

SEMESTER-II

COURSE 3: DIFFERENTIAL EQUATIONS

Course Outcomes

After successful completion of this course, the student will be able to

1. solve first order first degree linear differential equations.
2. convert a non-exact homogeneous equation to exact differential equation by using anintegrating factor.
3. know the methods of finding solution of a differential equation of first order but not of firstdegree.
4. solve higher-order linear differential equations for both homogeneous and non-homogeneous,with constant coefficients.
5. understand and apply the appropriate methods for solving higher order differential equations.

SEMESTER-II

COURSE 4: ANALYTICAL SOLID GEOMETRY

Course Outcomes

After successful completion of this course, the student will be able to

1. understand planes and system of planes
2. know the detailed idea of lines
3. understand spheres and their properties
4. know system of spheres and coaxial system of spheres
5. understand various types of cones

SEMESTER-III

COURSE 5: GROUP THEORY

Course Outcomes

After successful completion of this course, the student will be able to

1. acquire the basic knowledge and structure of groups
2. get the significance of the notation of a subgroup and cosets.
3. understand the concept of normal subgroups and properties of normal subgroup
4. study the homomorphisms and isomorphisms with applications.
5. understand the properties of permutation and cyclic groups

COURSE 6: NUMERICAL METHODS

Course Outcomes

After successful completion of this course, the student will be able to

1. difference between the operators Δ, ∇, E and the relation between them
2. know about the Newton – Gregory Forward and backward interpolation 3.know the Central Difference operators δ, μ, σ and relation between them
4. solve Algebraic and Transcendental equations
5. understand the concept of Curve fitting

COURSE 7: LAPLACE TRANSFORMS

Course Outcomes

After successful completion of this course, the student will be able to

1. understand the definition and properties of Laplace transformations
2. get an idea about first and second shifting theorems and change of scale property
3. understand Laplace transforms of standard functions like Bessel, Error function etc
4. know the reverse transformation of Laplace and properties
5. get the knowledge of application of convolution theorem

COURSE 8: FUNCTIONS OF A COMPLEX VARIABLE

Course Outcomes

After successful completion of this course, the student will be able to

1. determine a Bilinear transformation under given condition
2. know about continuity, compactness and connectedness of sets in complex plane
3. know the necessary condition and sufficient condition for f(z)to be analytic
4. know about the inverse of an analytic function
5. know about the convergence of sequences and the necessary & sufficient condition for asequence to be convergent
6. know the power series expansion of elementary functions

SEMESTER-IV

COURSE 9 : RING THEORY

Course Outcomes

After successful completion of this course, the student will be able to

1. acquire the basic knowledge of rings, fields and integral domains
2. get the knowledge of subrings and ideals
3. construct composition tables for finite quotient rings
4. study the homomorphisms and isomorphisms with applications.
5. get the idea of division algorithm of polynomials over a field.

COURSE 10: INTRODUCTION TO REAL ANALYSIS

CourseOutcomes

After successful completion of this course, the student will be able to

1. get clear idea about the real numbers and real valued functions.
2. Obtain the skills of analysing the concepts and applying appropriate methods for testing convergence of a sequence/ series.
3. Test the continuity and differentiability and Riemann integration of a function.
4. Know the geometrical interpretation of mean value theorems.
5. know about the fundamental theorem of integral calculus

COURSE 11: INTEGRAL TRANSFORMS WITH APPLICATIONS

LearningOutcomes

Students after successful completion of the course will be able to

1. understand the application of Laplace transforms to solve ODEs
2. understand the application of Laplace transforms to solve Simultaneous DEs
3. understand the application of Laplace transforms to Integral equations
4. basic knowledge of Fourier-Transformations
5. Comprehend the properties of Fourier transforms and solve problems related to finiteFourier transforms.

SEMESTER-V

COURSE 12: LINEAR ALGEBRA

Course Outcomes

After successful completion of this course, the student will be able to

1. understand the concepts of vector spaces, subspaces
2. understand the concepts of basis, dimension and their properties
3. understand the concept of linear transformation and its properties
4. apply Cayley- Hamilton theorem to problems for finding the inverse of a matrix and higherpowers of matrices without using routine methods
5. learn the properties of inner product spaces and determine orthogonality in inner productspaces.

COURSE 13: VECTOR CALCULUS

Course Outcomes

Students after successful completion of the course will be able to

1. Learn multiple integrals as a natural extension of definite integral to a function of two variables in the case of double integral/three variables in the case of triple integral.
2. Learn applications interms of finding surface area by double integral and volume by triple integral
3. Determine the gradient,divergence andcurlofavector and vector identities.
4. Evaluate line,surface and volume integrals.
5. understand relation between surface and volume integrals (Gauss divergence theorem),relationbetweenlineintegralandvolumeintegral(Green'stheorem), relationbetween line and surface integral(Stokestheorem)

COURSE 14 A: SPECIAL FUNCTIONS

Learning Outcomes

After successful completion of the course will be able to

1. Understand the Beta and Gamma functions,their properties and relation between these two functions, understand the orthogonal properties of Chebyshev polynomials and recurrencerelations.
2. Find powerseries solutions of ordinary differential equations.
3. solveHermiteequationandwritetheHermitePolynomialoforder(degree)n,also findthe generating function for Hermite Polynomials, study the orthogonal propertiesof Hermite Polynomials and recurrence relations.
4. Solve Legendre equation and write the Legendre equation of first kind, also find thegenerating function for Legendre Polynomials,understand the orthogonal properties of Legendre Polynomials.
5. Solve Bessel equation and write the Bessel equation of first kind of ordern,also find the generating function for Bessel function understand the orthogonal properties of Besselunction.

COURSE 14 B: ADVANCED NUMERICAL METHODS

Course Outcomes

After successful completion of this course, the student will be able to

1. find derivatives using various difference formulae
2. understand the process of Numerical Integration
3. solveSimultaneous Linear systems of Equations
4. understand Iterative methods
5. find Numerical Solution of Ordinary Differential Equations

COURSE 15 A: NUMBER THEORY

Learning Outcomes

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

1. understand the fundamental theorem of arithmetic
2. understand Mobius function, Euler quotient function, The Mangoldt function , Liouville'sfunction, The divisor functions and the generalized convolutions.
3. understand Euler's summation formula, application to the distribution of lattice points andthe applications to $\mu(n)$ and $\Lambda(n)$
4. understand the concepts of congruencies, residue classes and complete residues systems.
5. Comprehend the concept of quadratic residues mod p and quadratic non residues mod p.

COURSE 15 B: MATHEMATICAL STATISTICS

Course Outcomes

After completion of the course, student will be able to

1. understandthe probability set function and conditional probability
2. understand about random variables, discrete and continuous type distributions
3. understand the distribution of two random variables and expectation of a random variables
4. know binomial and related distributions
5. normal distributions and the applications of normal distributions

SEMESTER-VII

COURSE 16 A: ALGEBRA

Learning Outcomes

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

1. understand the direct product of groups and application of Sylow's theorems
2. understand the homomorphic relation between the groups, sum and direct sum of ideals
3. know factorizing the domains and factorization of polynomials
4. know about submodules and direct sums
5. about Free modules and Representation of linear mappings

COURSE 16 B: CLASSICAL MECHANICS

Learning Outcomes

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

1. identify the basic concepts of mechanics and also learn applications of Lagrangian formulation.
2. Understandderivation of Lagrange's equations from Hamilton's principle and advantages ofvariational principle formulation
3. Understand the simplistic approach to canonical transformations,
4. UnderstandPoisson and Lagrange brackets and their invariance and the Hamilton JacobiEquations for Hamilton's principal function
5. Understand special theory of relativity, Lorentz transformation and contractions and Lorentztransformations

COURSE 17 A: REAL ANALYSIS

Learning Outcomes

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

1. understand to form a metric space from any non-empty set, compact sets and connected sets
2. understand continuity of functions, compactness and connectedness
3. know the derivative of a real valued function and the applications of Mean value theorems
4. know the conditions for existence of integrals and some applications of integrals
5. know the vector valued functions, differentiation and integration of vector valued functions andtheir applications

COURSE 17 B: DISCRETE MATHEMATICS

Learning Outcomes

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

1. learn the applications of graph theory in other subjects.
2. understand representations of different problems by means of graphs.
3. learn the relation between bipartite graphs and odd cycles.
4. learn the concepts of forest, binary trees, eccentricity of a vertex and radius ofconnected graphs.
5. learn the importance of multi graphs in other subjects like physics and chemistry.
6. learn different characterizations of modular and distributive lattices.

COURSE 18 A: BASIC TOPOLOGY

Learning Outcomes

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

1. handle operations on sets and functions and their properties
2. understand the concepts of Metric spaces, open sets, closed sets, convergence, someimportant theorems like Cantor's intersection theorem and Baire's theorem
3. familiar with the concept of Topological spaces, continuous functions in more general andcharacterize continuous functions in terms of open sets, closed sets etc.

explain the concept of compactness in topological spaces characterize compactness inmetric spaces and their properties

COURSE 18 B: CRYPTOGRAPHY

Learning Outcomes

After successful completion this course, the student will be able to

1. understand Divisibility and Euclidean algorithm and congruences
2. understand about Enciphering matrices
3. understand finite fields and quadratic residues
4. understandthe idea of public key cryptography
5. understand pseudo-primes and Fermat's factorization

COURSE 19 A: LATTICE THEORY & BOOLEAN ALGEBRA

Learning Outcomes

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

1. understand the concept of partially ordered set and properties of partial ordered sets
2. understand the concept of lattice, semilattice and their properties
3. understand the concept of ideals and homomorphisms in lattices
4. understand the distributive and the modular lattices
5. understand the concept of Boolean algebra and properties of Boolean algebra

COURSE 19 A: LATTICE THEORY & BOOLEAN ALGEBRA

Learning Outcomes

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

6. understand the concept of partially ordered set and properties of partial ordered sets
7. understand the concept of lattice, semilattice and their properties
8. understand the concept of ideals and homomorphisms in lattices
9. understand the distributive and the modular lattices
10. understand the concept of Boolean algebra and properties of Boolean algebra

COURSE 19 B: FINITE ELEMENT ANALYSIS

Learning Outcomes

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

1. understand the concepts behind formulation methods in FEM.
2. identify the application and characteristics of FEA elements such as bars, beams, plane and iso-parametric elements.
3. develop element characteristic equation and generation of global equation.
4. apply suitable boundary conditions to a global equation for bars, trusses, beams, circular shafts, heat transfer, fluid flow, axisymmetric and dynamic problems and solve them displacements, stress and strains induced.
5. Know the Finite element modeling, stress calculation and temperature effects

COURSE 20 A: GRAPH THEORY

Learning Outcomes

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

1.Be familiar with the definitions and basic theory of graphs

2. Be able to implement standard algorithms of graph theory

3. Be able to prove simple results
in graph theory.

4. 4.Identify trees and obtain
spanning trees of graphs.

5. Find Euler and Hamiltonian paths and circuits in a graph

COURSE 20 B: MATHEMATICAL FINANCE

Learning Outcomes

Upon successful completion of this course student should be able to:

1. Understand the that interest calculations and methods of calculations
2. Understand the annuities and types of Annuities and calculation interest and values of annuities
3. Understand the concept of Mathematics of Capital Budgeting and Depreciation and some methods ofcalculations
4. know the Comparison onthe Discount Rate to the Interest Rate
5. know the net present value, profitability index and other capital budgeting methods

SEMESTER-VIII

COURSE 21 A: ADVANCED ALGEBRA

Learning Outcomes

After successful completion this course, the student will be able to
1. define modules, submodules and give some examples of them.
2.understand reducible modules, free modules and be able to find the rank of a linearmapping
3.understand Einstein's criteria for irreducible polynomials and algebraic extensions4.understand splitting fields and finite fields
5.understand the Fundamental theorem of Galois theory

COURSE 21 B: ELEMENTS OF ELASTICITY AND FLUID DYNAMICS

Learning Outcomes

After successful completion of the course, students will be able to
1. understand the equation of continuity and general analysis of fluid motion.
2. understand the equation of motion of a fluid, Bernoulli's equation and circulation theorem.3.understand the two dimensional fluid flows and their properties.
4 .understand the various deformations and equation of compatibility.
5.understand the properties of the stress, Mohr's Diagram and certain examples of stress.

COURSE 22 A: ADVANCED ANALYSIS

Learning Outcomes

After successful completion this course, the student will be able to
1. solve the problems on convergence of Sequences and Series of functions
2.understand the Stone – Weierstras theorem
3.knowExponential and Logarithmic functions and Fourier Series
4. Linear transformations and differentiation
5. understand the contraction principle, the rank theorem

COURSE 22 B: ADVANCED LINEAR ALGEBRA

Learning Outcomes

Upon successful completion of this course student should be able to
1. understand the basic to the analysis of a single linear transformation on a finite-dimensional vector space and the analysis of characteristic values and the rational and Jordancanonical forms.
2. understand concept of finite-dimensional inner product spaces and basic geometry,relating orthogonalization and unitary operators and normal operators.
3. know the Jordan form, computation of invariant factors
4. know the inner product spaces and their properties

6. know about unitary operators and Normal operators

COURSE 23 A: ADVANCED TOPOLOGY

Learning Outcomes

After successful completion this course, the student will be able to1.define T_1-space, T_2 – space
2.understandUrysohn's Lemma, and the Tietz's extension theorem3.understand the Stone – Chech compactification,
4.understand and can define the Connectedness of a topological space
5.understand the Weierstrass approximation theorem and Stone-Weierstrass theorems

COURSE 23 B: DIFFERENTIAL GEOMETRY

Course Outcomes

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

1. to know about space curves, planar curves
2. to calculate Torsion and Curvature
3. to know parametric curves on surfaces Rodrigue's formula
4. to know about minimal surfaces
5. to know contravariant and covariant

COURSE 24 A: ORDINARY DIFFERENTIALEQUATIONS

Learning outcomes

After successful completion of the course, students will be able to
1. comprehend the bridge between the real function theory and theory of ordinary differentialequations
2. understand the basic theory behind existence, uniqueness, continuity of solutions of ordinarydifferential equations
3. realize the dependence of solutions on various parameters involved in the differential equations
4. recognize the significance studying differential systems and its utility in understanding higher orderdifferential equations
5. figure out qualitative behavior of solutions of differential equations of various orders.

COURSE 24 B: APPLICATIONS OF ALGEBRA

Course Outcomes

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

1. understand Boolean polynomials and Boolean functions
2. understand designing and simplification of circuits
3. understand incidence matrix of a BIBD and construction of BIBD from finite fields
4. know the concept of coding theory
5. generating Functions for non-isomorphic Graphs

COURSE 25 A: OPERATIONS RESEARCH

Learning Outcomes

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

1. study on LPP enables to arrive at an optimal decision/solutions in difficult decision making.
2. study on LPP applied to problems pertaining to both profit making and low cost related realworld situation.
3. study on Post optimal analysis enables into manage and control resource allocation.
4. study of Transportation problem and Assignment problem introduces to implementing simplexprocedure for more variables using Modi method stepping stone method and hungary method
5. study on games and strategies helps in decision making for problems with competitivesituationslike candidates for elections, marketing campaigns by different companies etc.

COURSE 25 B: MATHEMATICAL MODELLING

Learning Outcomes

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

1. understand concept of modelling and simulation
2. construct mathematical models of real world problems
3. solve the mathematical models using mathematical techniques
4. know the need for mathematical modelling through difference equations
5. to know Harrod Model and cobweb application model to Actuarial science

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