Program: B.SC.(Hons.) Mathematics

Program Specific Outcomes

PSO1: Gives you understanding of how we learn mathematics/statistics and associated different teaching approaches.

PSO2: Advances your own knowledge of mathematics with an option to include statistics.

PSO3: Develops your educational skills alongside problem-solving and reflective skills.

PSO4: Offers a choice of start points to suit your level of mathematical knowledge.

PSO5: Communicate mathematical ideas with clarity and coherence, both written and verbally.

PSO6: He is able to demonstrate basic manipulative skills in algebra, geometry, trigonometry and beginning calculus.

Course Outcomes

Semester I

Course: Calculus-I

CO1: Assimilate the notions of limit of a function and sequence, differentiability

C02: Calculate the limit and examine the continuity of a function at a point

CO3: Understand the consequences of Integration of functions, Riemann sum and definite integrals, Area and various mean value theorems for differentiable functions.

CO4: Apply the ratio, root, alternating, integral and limit comparison tests for convergence and absolute convergence of an infinite series of real numbers

CO5: Apply derivative tests in optimization problems appearing in social sciences, physical sciences, life sciences and a host of other disciplines.

Course: Coordinate Geometry

CO1: Able to understand the graph of vertical and horizontal conic

CO2: Model real-world situations by using conics For example Architects and engineers frequently use the shape of a parabola for support arches in bridges and buildings

CO3: Familiarize with use the information that we can determine from its equation and add points to establish a pattern for the curve.

CO4: Identify the condition for them to be parallel or perpendicular

CO5: Recognise line and rotational symmetries

Course: Mathematical foundation of Statistics

CO1: Understand the Notion of Probability, Random experiment, sample space, axiom of probability, elementary properties of probability, equally likely outcome problems

CO2: Familiarize the concept of cumulative distributive function, discrete and continuous random variables, expectations, mean, variance, moment generating functions

CO3: Recognize about Bernoulli, binomial, generic, Poisson, Continuous, Uniform, exponential, Gamma and normal random variable.

CO4: Analyze the concept of Conditional probability and conditional expectations, Bayes theorem, independence, computing expectation by conditioning

CO5: Know about Sum of random variables, the laws of large numbers and the Central Limit Theorem, the approximation of distributions

Course: Information Technology

CO1: Understand the meaning and basic components of a computer system

CO2: Define and distinguish Hardware and Software components of computer system

CO3:Explain the functions of a computer

CO4: Identify and discuss the functional units of a computer system

CO5: Identify the various input and output units and explain their purposes

CO6: Understand the concept and need of primary and secondary memory

Course: Computer Programming using C

CO1: Design an algorithmic solution for a given problem

CO2:Write a maintainable C program for a given algorithm.

CO3:Trace the given C program manually.

CO4: Write C program for simple applications of real life using structures and files.

Semester II

Course: Calculus-II

CO1: Understand about Vectors in the plane and spaces. Dot and cross products. Lines and planes in space, Cylindrical and Spherical co-ordinates

CO2: Familiarize with Modelling Projectile Motion. Arc length and Unit Tangent vector curvature, Torsion and the TNB Frame

CO3: Inter-relationship amongst the line and surface integral, double and triple integral formulations.

CO4: Recognize the Applications of multivariable calculus tools in physics, economics, optimization, and understanding the architecture of curves and surfaces in plane and space

CO5: Realize importance of Limits and continuity. Partial derivatives. Differentiability. The chain rule, Directional derivatives, Gradient vectors and tangent planes. Extreme values and saddle points

Course: Ordinary Differential Equation

CO1: Understand the genesis of ordinary differential equations.

CO2: Learn various techniques of getting exact solutions of solvable first order differential equations and linear differential equations of higher order

CO3: Familiarize with Linear Independence and dependence, Wronskian, Legendre's, Hermite's and Bessel's equation

CO4: Grasp the concept of a general solution of a linear differential equation of an arbitrary order and also learn a few methods to obtain the general solution of such equations

CO5: Formulate mathematical models in the form of ordinary differential equations to suggest possible solutions of the day to day problems arising in physical, chemical and biological disciplines.

Course: Linear Programmimg

CO1: Understand the theory of the simplex, Big-M and Two phase method

CO2: Provide graphical solutions of linear programming problems with two variables, and illustrate the concept of convex set and extreme points.

CO3: Know about the relationships between the primal and dual problems, and to understand sensitivity analysis.

CO4: Learn about the applications to transportation, assignment and two-person zero-sum game problems, maximization case in assignment problem

CO5: Analyze and solve linear programming models of real life situations

Course: Computer System architecture

CO1: Understand the basics of computer hardware and how software interacts with computer hardware

CO2: Understand how computers represent and manipulate data

CO3: Understand computer arithmetic and convert between different number systems

CO4: Assemble a simple computer with hardware design including data format, instruction format, instruction set, addressing modes, bus structure, input/output, memory, Arithmetic/Logic unit, control unit, and data, instruction and address flow

CO5: Designing computer logic, through simple combinational and sequential logic circuits

Course: Object oriented Programming Using C++

CO1: Understand the basic components of an object-oriented program including methods and attributes.

CO2: Perform object oriented programming to develop solutions to problems demonstrating usage of control

CO3: Structures, modularity, I/O. and other standard language constructs. Demonstrate adeptness of object oriented programming in developing solutions to problems demonstrating• usage of data abstraction, encapsulation, and inheritance. Demonstrate ability to implement one or more patterns involving realization of an abstract interface and

CO4: Utilization of polymorphism in the solution of problems which can take advantage of dynamic dispatching.

Semester III

Course: Analysis-I

CO1: Learn basic facts about cardinality of sets , field axioms and order axiom

CO2: Familiarise with the decimal representation of the real numbers, some useful inequalities and the extended real number system

CO3: Recognize the concept of Euclidean spaces Rn, Open sets and their structure in Rn, Point Set Topology in Metric Spaces, Compact subsets of a metric space

CO4: Identify the continuity of a function defined on metric spaces and homeomorphisms

CO5: Explain the concept of Arcwise connectedness, compact sets, dicontinuites of the real valued functions and the Monotonic Functions.

Course: Group Theory

CO1: Recognize the mathematical objects called groups, matrix, quaternions, symmetric, cyclic groups, even and odd permutations

CO2: Link the fundamental concepts of groups and symmetries of geometrical objects

CO3: Explain the significance of the notions of cosets, normal subgroups, and factor groups, , Homomorphisms, Isomorphism and Cayley's Theorem

CO4: Analyze consequences of Lagrange's theorem including Fermat's Little theorem

CO5: Learn about structure preserving maps between groups and their consequences and Fundamental Theorem for finite Abelian groups and its applications

Course: Mathematical Methods

CO1: Know about Fourier Chebyshev Series, Bessel's functions. Strum-Liouville Problem – Orthogonality of Bessel functions

CO2: Familiarise with Orthogonal property of Legendre polynomials, Recurrence relations,Rodrigue's formula, generating function

CO3: Explain Parseval's identity, Plancherel's theorem and applications of Fourier transforms to boundary value problems

CO4: Learn Fourier series, Bessel's inequality, term by term differentiation and integration of Fourier series, piecewise continuous and Dirac delta function, Laplace transforms and its properties

CO5: Apply the concepts of the course in real life problems

Course: Optimization Techniques

CO1: Understand Inventory, Costs and variables in Inventory Models and its Classification

CO2: Familiarize about EOQ Models with no shortage, Scheduling time variable, Production Lot size model with shortages, Multi-item Inventory

CO3: Analyze Job Sequencing Introduction and its Solution.

CO4: Find Project networks; critical path methods, Project Evaluation & Review Technique

CO5: Explain the concept of Simulation an its Types,Uses and Limitation, Simulation Models, Monte Carlo Simulation, Application of Simulation

Course: Data structures

CO1: Be familiar with basic techniques of algorithm analysis

CO2: Be familiar with writing recursive methods

CO3: Master the implementation of linked data structures such as linked lists and binary trees

CO4: Be familiar with advanced data structures such as balanced search trees, hash tables, priority queues and the disjoint set union/find data structure

Semester IV

Course: Linear Algebra

CO1: Understand the concept of vector space, subspace, basis, dimension,

CO2: Know about Systems of linear equations, homogeneous equations, Linear Manifolds.

CO3: Familiarize with Linear Transformation and Matrices. The concept of symmetry, Inner Products, Gram Schmidt orthogonalization, Orthogonal Transformations

CO4: Recognize the concept of Existence and Uniqueness of determinants, Cramer's Rule, Hadamard's Inequality

CO5: Evaluate Eigenvalues, Eigenvectors, Diagonalization and the minimal polynomial, The Triangular Form, Cayley Hamilton, The Jordan Deocomposition Theorem and the Trace

Course: Analysis-II

CO1: Understand the concept of Functions of bounded Variation and Rectifiable Curves, Total variation, Additive property of total variation, Arc Length

CO2: Analyse the concept of The Riemann-Stieltjes Integral, additive and linearity properties of upper and lower integrals, Mean value theorems for Riemann-Stieltjes integrals

CO3: Recognize the concept of infinite, alternating, geometric series.

CO4: Describe and Explain the concept of the integral, the ratio and the root test, Dirichlet's and Abel's test, Rearrangement of Series

CO5: Express the concept of Pointwise and uniform convergence, uniform convergence and continuity, uniform convergence and integration, uniform convergence and differentiation

Course: PDE and System of ODE

CO1: Understand the concept of ODE in more than two variables, Surfaces and curves and order and degree in three dimensions, Orthogonal trajectories

CO2: Analyze the concept of Cauchy's problem and linear equation of first order, Integral surface, Surfaces orthogonal to a given system of surfaces

CO3: Familiarize with Cauchy method of characteristics, Compatible system of first order equations, Charpit's and Jacobi's method, Special types, Solutions satisfying given conditions

CO4: Discuss the concept of PDE, separation of variables. Solution of Laplace equation, Heat and Wave equation

CO5: Express the concept of system of linear equation, an operator method, Basic Theory of linear systems in normal form, homogeneous linear systems with constant and variable coefficients

Course: Optimization Techniques-II

CO1: Understand the concept of Queueing Problems, Its Classification and Characteristics, Poisson arrivals and exponential service times

CO2: Analyze about (M/M/1)(8/FCFS) Model, Measures of (M/M/1):(8/FCFS), General Erlang Queueing model, (M/M/1):(N/FCFS) Model

CO3: Express the concept of (M/M/S):(8/FCFS) Model, (M/M/S):(N/FCFS) Queueing Model, Measures of M/M/S, Steady state Solutions and their measures of effectiveness

CO4: Explain the concept of Dynamic Programming, Solution of Multistage Optimization Problems, Backward and Forward Recursive relations

CO5: Familiarize with the concept of Applications of Dynamic Programming to Discrete systems: General problems, Reliability problems and Cargo Loading Problems

Course: Computer Graphics

CO1: Identify and explain the core concepts of computer graphics.

CO2: Apply graphics programming techniques to design and create computer graphics scenes.

CO3: Understand the basic principles of implementing computer graphics primitives

CO4: Familiarity with key algorithms for modeling and rendering graphical data

CO5: Develop design and problem solving skills with application to computer graphics

Semester V

Course: Algebra (Group and Ring Theory)

CO1: Understand the concept of Derived subgroups, Normal,Subnormal and Composition series, Solvable groups, Schereier's refinement and Jordan-Holder theorem

CO2: Deal with the rings, subrings, ideals, Integral domains, Division rings, Fields, Nilpotent and Nil ideals, Prime and Maximal ideals

CO3: Explain the concept of Quotient Rings, Homomorphism, Fundamental theorem of ring homomorphism, First and Second theorems of isomorphism, Field of quotients

CO4: Express all about Polynomial Rings, Factorization and Divisibility in integral domains ,UFD, PID, ED and relationships between them

Course: Calculus of several variables and Improper Integrals

CO1: Understand the concept of limit and continuity, Partial and directional derivatives and their elementary properties,

CO2: Calculate the higher order derivatives, Taylor Theorem for function of n-variables.

CO3: Familiarize with the consequences of Inverse and Implicit function theorem. Maxima and Minima at interior points, The method of Lagrange multipliers

CO4: Evaluate the Riemann integral of a bounded function defined on a compact interval in Rn , Sets of measure zero and Lebesgue's criterion for existence of amultiple Riemann Integral

CO5: Explain the concept of Improper and multiple integrals, tests for convergence and uniform convergence,Elementary notions of functions defined by integrals

Course: Discrete Mathematics and Graph Theory

CO1: Understand the concept of Pigeonhole principle, Basic counting principles, permutations and combinations of sets and multisets, Binomial and multinomial theorems

CO2: Analyze the concept of inclusion and exclusion principle, Generating function solution of recurrence relations using difference equations and generating functions.

CO3: Applying the concept of Graph Theory, Eulerian and Hamiltonian trails and cycles. Bipartite multigraphs,

CO4: Familiarize with Trees, Algorithms for BFS and DFS trees weighted Graphs, Greedy and Prim's Algorithm

CO5: Determine the concept of Digraphs, Planar graphs, Euler formula and Chromatic numbers

Course: Mechanics- I

CO1: Familiarize with the concept of Newton Laws of motion, system of two forces, parallelogram law of forces, resultant of two collinear forces

CO2: Understand necessary conditions for resolution and moment of a force, couple, theorem on moments of a couple, coplanar forces

CO3: Find the resolved parts, resultant of two forces acting on a rigid body, Varignon's and generalized theorem of moments.

CO4: Express all about equilibrium condition for any number of coplanar concurrent forces, Lami's and $\lambda - \mu$ theorem, resultant of a force and a couple. Equilibrium conditions for coplanar non-concurrent forces.

CO5: Discuss all about the nature and laws of friction, Centre of gravity

Course: Linear Integral Equations

CO1: Understand the concept of Linear integral equations of first and second kind, Relation between linear differential equation and Volterra's equation

CO2: Identify The Non linear and Singular equations and evaluating the Solution by successive substitutions , Volterra's solution of Fredholm's equation

CO3: Familiarize with Fredholm's equation as limit of finite system of linear equations, Hadamard's theorem, convergence proof, Fredholm's two fundamental relations

CO4: Determine Fredholm's solution of integral equation, Dirichlet's and Neumann's problem

CO5: Understand the concept of iterations of symmetric kernel, Schwarz's inequality and its applications

Semester VI

Course: Number Theory

CO1: Define and interpret the concepts of divisibility, congruence, residue classes, g.c.d, prime, and prime-factorization

CO2: Recognize the Euler-Fermat's, Wilson's and Chinese Remainder Theorem

CO2: Familiarize with the Primitive roots, indices, Arithmetical functions, Euler's φ(n) and Mobius function μ(n), divisors functions. Mobius Inversion Formula.

CO3: Explain the concept of Quadratic residues and reciprocity, Legendre's symbol, Euler's Criterion, Gauss' Lemma, Jacobi symbol

CO4: Evaluate The Diophantine Equations x^2+y^2=z^2, x^4+y^4=z^2, Farey Sequences, Rational approximations, Continued fractions, Pell's equation

Course: Mechanics-II

CO1: Understand about Motion of a particle with constant acceleration, acceleration of falling bodies, motion under gravity and two particles connected by a string, motion and along a smooth inclined plane

CO2: Familiarize with Variable acceleration, Simple harmonic motion, elastic string, simple pendulum

CO3: Explain Projectile, Work, Power, conservative fields and potential energy, work done against gravity, potential energy of a gravitational field.

CO4: Evaluate Relative motion and displacement, velocity and acceleration, Linear and angular momentum,

CO5: Analyze conservation of angular momentum, impulsive forces, principle of impulse and momentum

Course: Partial Differential Equations

CO1: Understand ODE in two and three variables, Methods of their solution and applications, Pfaffian Differential forms and equations and its solutions in three variables

CO2: Familiarize with PDE of the first order and its solution in three variables, Cauchy's Problem for first order equations, Linear and non-linear PDE of the first order,.

CO3: Explain the concept of Integral surfaces passing through a given curve, surfaces orthogonal to a given system of surfaces

CO4: Understand about compatible system of first order equations, Charpit and Jacobi Method, Cauchy's method of characteristics.

CO5: Identify the classification into hyperbolic, elliptic and parabolic types, canonical forms

CO6: Analyze the concept of Laplace, Diffusion and Wave equations and their solutions in Cartesian, Spherical and cylindrical polar coordinates

Course: Numerical Analysis

CO1: Analyze the error number system, Floating point arithmetic, Loss of significance and propagation of errors, Error in Numerical computation, Bounds on error, Condition and Instability

CO2: Compare the variability of different approaches to the numerical solution of problems arising in roots of solution of non-linear and linear equations

CO3: Understand all about Lagrange's, Newton, Piecewise, Hermite and Spline Interpolation, Least square and Uniform approximation

CO4: Familiarize with the concept of Newton Cotes formulae, Trapezoidal, Simpson's 1/3 and 3/8-Rule, Weddle's Rule, Romberg Integration.

CO5: Explain the concept of Taylor's Series and Picard's Method, Euler's and modified Euler's methods, Runge Kutta methods

Course: Tensor Analysis

CO1: Understand the basic concepts of tensors, Dummy and free index, Summation convention, Kronecker delta Manifolds and tensors

CO2: Familiarize with the role of tensors in differential geometry,

CO3: Understand about Symmetric, skew symmetric, Pseudo, reciprocal, relative and Cartesian, The metric tensor and Associated tensors

CO4: Know the Interpretation of Co-ordinate Surfaces and curves, line element, length of a vector, Angle between two vectors, reciprocal base system, partial derivative

CO5: Apply the role of Christoffel symbols and its Properties and transformations, Gradient, Divergence, Curl, Laplacian Operator, Intrinsic derivative.