As per the NEP 2020

Bachelor of Science

Mathematics

(Effective from Academic Year 2024-2025 onwards)

Pandit Deendayal Upadhyaya Shekhawati University

Sikar (Rajasthan) 302024

E-mail: registrar@shekhauni.ac.in

Website: www.shekhauni.ac.in

Dy. Registrar
Pandit Deendayal Upadhyaya
Shekhawati University,
Sikar(Rajasthan)

Semester – I

Learning Objectives

The objective of the course is to study "instantaneous" change in the fundamental idea of Calculus and apply the concept and principle to connect them with real-world problems.

Learning outcomes

By studying this course students will gain basic knowledge on

- Understand the concept of curvature and padel equations.
- Understand the concept of maxima-minima, double triple integration, and its applications.
- To understand the mathematical formulation of optimization problems and allied theoretical concepts for solution methodologies.

Course Title:	**Calculus and Optimization Techniques**	**Course Code: 24BMT5101T**
Total Lecture hours 45		**Hours**
Unit I	Taylor's theorem. Maclaurin's theorem. Power series expansion of a function. Power series expansion of sin x, cos x, e^x, $\log_e$ (1+ x), $(1+x)^n$. Derivative of the length of an arc. Pedal equations. Curvature: Various formulae, Centre of curvature, and Chord of curvature. Partial differentiation. Euler's theorem for homogeneous functions. Chain rule of partial differentiation. Total differentiation, Differentiation of implicit functions.	**12**
Unit II	Envelopes: One parameter family of curves when two parameters are connected by a relation. Maxima and Minima of functions of two variables. Lagrange's method of undetermined multipliers. Asymptotes: Definition, Parallel to coordinate axes. General rational algebraic curves, inspection method, Intersection of a curve and its asymptotes. Multiple points. Curve tracing of standard curves (Cartesian and Polar curves).	**13**
Unit III	Beta and Gamma functions, Reduction formulae (simple standard formulae), Double integrals in Cartesian and Polar Coordinates, Change of order of integration. Triple integrals. Dirichlet's integral. Rectification, Area, Volume, and Surface of solids of revolution.	**10**
Unit IV	Linear programming problems. Basic solution. Some basic properties and theorems on convex sets. Simplex algorithm. Duality, Solution of dual problems.	**10**

Reference Books:

1	Shanti Narayan, and P. K. Mittal, Integral Calculus, S. Chand & Co., N. D., 2013.
2	H. S. Dhami, Differential Calculus, Age Int. Ltd., New Delhi, 20 12.
3	M.J. Strauss, G. L Bradley, and K. J. Smith, Calculus (3rd Edition), Dorl ing Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi , 2007.
4	H. Anton, I. Bivens and S. Davis, Calculus (7th Edition), John Wiley and Sons (Asia), Pt Ltd., Singapore, 2002.
5	G.B. Thomas, R. L Finney, M. 13. Weir, Calculus and Analytic Geometry, Pearson Education Ltd, 2003.
6	G. Hadley, Linear Programming, Narosa Publishing House, New Delhi, 2002.
7	Hamdy A. Taha, Operations Research, An Introduction (9th edition), Prentice-Hall,2010.

Course Title:	**Practical I Lab Work-Optimization Techniques**	**Course Code: 24BMT5101P**
1	**Part-A** 1. Find the optimum solution of LPP by using the Simplex method. 2. Find the Optimum Solution of Dual LPP by using the Simplex method.	
2	**Part-B** 1. Find the Optimum solution to given Transportation Problems. 2. Find the Optimum solution of given Assignment Problems.	

Reference Books:	
1	G.Hadley, Linear Programming, Narosa Publishing House, NewDelhi, 2002.
2	Hamdy A. Taha, Operations Research, An Introduction (9th edition), Prentice-Hall,2010.

Semester – II

Learning Objectives

The course aims to introduce concepts and techniques of modern Mathematics which should serve as a preparation for more advanced quantitative courses.

Learning outcomes

Upon completion of the course, students should be able to:

- To understand the ideas in discrete structures viz. partially ordered sets, Lattices, Graphs, etc., and allied conceptual intricacies with applications.
- Understand the concept of vector calculus viz. operators, and vector integration.

Course Title:	Discrete Mathematics & Vector Calculus	Course Code: 24BMT5201T
Total Lecture hours 45		Hours
Unit I	Relations on a set, Equivalence class, partial order relations, Chains, and Anti-chains. Lattices, Distributive and Complemented Lattices. Boolean algebra, conjunctive normal form, disjunctive normal form. Pigeon hole principle. Principle of inclusion and exclusion. Propositional calculus, Basic logical operations, Truth tables, Tautologies, and contradictions.	12
Unit II	Discrete numeric functions, Generating functions, Recurrence relations, linear recurrence relation with constant coefficients and their solutions, Total solutions, and Solutions by the method of generating functions. Basic concepts of graph theory, Types of graphs, Planar graphs, Walks, Paths & Circuits, Shortest path problems.	11
Unit III	Planar graphs, Operations on graphs (union, join, products). Matrix representation of graphs, Adjacency matrices, Incidence matrices. Hamiltonian and Eulerian graphs. Tree, Spanning tree, Minimum spanning tree, Distance between vertices, Center of tree, Binary tree, Rooted tree.	11
Unit IV	Scalar and Vector point functions. Differentiation of vector point functions Directional derivative. Differential operators. Gradient, Divergence, and Curl. Integration of vector point functions. Line, Surface, and Volume integral, Theorems of Gauss, Green, and Stokes (without proof) and problems based on these theorems.	11

Reference Books:	
1	V. K. Bala Krishnan, Introductory Discrete Mathematics, Prentice-Hall, 1996.
2	N. Deo, Graph Theory with Applications to Computer Science, Prentice-Hall of India.
3	C.L. Liu, Elements of Discrete Mathematics, (Second Edition), McGraw Hill, International Edition, 1986.
4	Kenneth H. Rosen, Discrete Mathematics and Its Applications, Tata Mc-Graw Hills, New Delhi, 2003.

Course Title:	Practical I Lab Work-Discrete Mathematics	Course Code: 24BMT5201P
Total Lecture hours 26		
1	**Part-A** 1. Find the vertices, even vertices, odd vertices, and number of edges in the graphs & Directed graphs. 2. Find the union, intersection, ring sum, Product, and Cartesian product of two graphs. 3. Find the solution to the Travelling salesman problem.	
2	**Part-B** 1. Find the shortest path between two vertices using the Dijkstra Algorithm.	

	2. Find the minimum spanning tree using Prim's Algorithm. 3. Find a minimum spanning tree using Kruskal's Algorithm.
Reference Books:	
1	N. Deo, Graph Theory with Applications to Computer Science, Prentice-Hall of India.
2	C.L. Liu, Elements of Discrete Mathematics, (Second Edition), McGraw Hill, International Edition, 1986.

Semester – III

Learning Objectives

The course aims to

- Study the fundamental concepts of analysis.
- Introduce the concept of the sequence and series of real no. and convergence.

Learning Outcomes

Upon completion of the course, students should be able to:

- Understand basic concepts of continuity and important theorems.
- Understand the concepts of real numbers and analyze their properties.
- Study sequence, series, and their applications.
- Apply Riemann integrals in the evaluation of some integrals.
- Understand the concept of uniform convergence and study their application.

Course Title:	**Real Analysis and Numerical Analysis - I**	**Course Code: 24BMT5301T**
Total Lecture hours 45		**Hours**
Unit I	Real numbers as a complete ordered field, Limit point, Bolzano-Weierstrass theorem, closed and Open sets. Concept of compactness and connectedness. Heine-Borel theorem. Holder inequality & Minkowski inequality, Real sequences- Limit and Convergence of a sequence, Monotonic sequences. Cauchy's sequences, Subsequences, Cauchy's general principle of convergence. Properties of continuous functions on closed intervals.	**12**
Unit II	Properties of derivable functions, Darboux's and Rolle's theorem. The notion of limit, continuity, and differentiability for functions of several variables. The directional derivative, the total derivative, expression of the total derivative in terms of partial derivatives. Riemann integration - Lower and Upper Riemann integrals, Riemann integrability, Mean value theorem of integral calculus, Fundamental theorem of integral calculus. Functions of bounded variations. Introduction, properties of functions of bounded variations, total variation.	**13**
Unit III	Sequence and series of functions - Pointwise and Uniform convergence, Cauchy's criterion, Weierstrass M-test, Abel's test, Dirichlet's test for uniform convergence of series of functions, Uniform convergence and Continuity of series of functions, Term by term differentiation and integration. Differences. Relation between differences and derivatives. Differences of a polynomial. Newton's formulae for forward and backward interpolation.	**10**
Unit IV	Numerical integration, Derivations of general quadrature formulas, Trapazoidal rule. Simpson's one-third, Simpson's three-eighth, and Gauss's quadrature formulae.Numerical solution of Algebraic and Transcendental equations, Bisection method, Secant method, Regula-Falsi method, Iteration method, Newton-Raphson Method (derivation of formulae and rate of convergence only).	**10**
Reference Books:		
1	K.A. Ross, Elementary Analysis: The Theory of Calculus, Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.	
2	R.G. Bartle D.R. Sherbert, Introduction to Real Analysis (3rd edition), John Wiley and Sons (Asia) Pvt. Ltd.., Singapore, 2002.	

3	Charles G. Denlinger, Elements of Real Analysis, Jones and Bartlett (Student Edition),2011.

Course Title:	Practical I Lab Work-Numerical Analysis – I	Course Code: 24BMT5301P
1	**Part-A** Find the Numerical integration, Derivatives of general quadrature formulas, and Trapezoidal rule. Simpson's one-third, Simpson's three-eighth, and Gauss's quadrature formulae.	
2	**Part-B** Find the Numerical Solution of Algebraic and Transcendental equations using the Bisection method, Secant method, Regula-Falsi method, Iteration method, and Newton-Raphson Method.	
Reference Books:		
1	B. Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007.	
2	C.F. Gerald, P.O. Wheatley, Applied Numerical Analysis, Addison-Wesley, 1998.	

Semester – IV

Learning Objectives

The course aims to

- Introduce the exciting world of differential equations.
- Familiarize with the concept of Differential Equations which is essential for higher-order Differential Equations and its applications in Mathematics and other subjects.

Learning Outcomes

- Understand the concept of differential equation and their types and analyze their applications.
- Understand the concept of exact, simultaneous, and total differential equations and analyze their applications.
- Solve linear differential equations with variable coefficients by various approaches. Classify the partial differential equation and evaluate their solution using different approaches.

Course Title:	Differential Equations and Numerical Analysis-II	Course Code: 24BMT5401T
Total Lecture hours 45		**Hours**
Unit I	First-order but higher degree differential equations solvable for x, y, and p. Clairaut's form and singular solutions with Extraneous Loci. Linear differential equations with constant coefficients, Complimentary functions, and Particular integrals.Homogeneous linear differential equations.	**11**
Unit II	Simultaneous differential equations. Exact linear differential equations of nth order. Existence and uniqueness theorem. Linear differential equations of second order. Linear independence of solutions. Solution by transformation of the equation by changing the dependent variable/the independent variable, Factorization of operators, Method of variation of parameters, and Method of undetermined coefficients.	**12**
Unit III	Partial differential equations of the first order. Lagrange's linear equation. Charpit's general method of solution. Homogeneous and non-homogeneous linear partial differential equations with constant coefficients. Equations reducible to equations with constant coefficients.	**11**
Unit IV	Gauss elimination and Iterative methods (Jacobi and Gauss-Seidel) for solving systems of linear algebraic equations. Partial Pivoting method, ill-conditioned systems, Numerical solutions of ordinary differential equations of first order with initial condition using Picard's, Euler, and modified Euler's method.	**11**

Reference Books:	
1	R.S. Senger, Ordinary Differential Equations with Integration, Prayal Publ. 2000.
2	D.A. Murray, Introductory Course in Differential Equations, Orient Longman (India), 1967.
3	B. Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007.
4	C. F. Gerald and P. O. Wheatley, Applied Numerical Analysis, Pearson Education, India,7th edition, 2008.
5	C.F. Gerald, P.O. Wheatley, Applied Numerical Analysis, Addison-Wesley, 1998.

Course Title:	Practical I Lab Work-Numerical Analysis-II	Course Code: 24BMT5401P
1	**Part-A** Find the solution by Gauss elimination and Iterative methods (Jacobi and Gauss-Seidel) to solve the systems of linear algebraic equations. Partial Pivoting method, ill-conditioned systems	
2	**Part-B** Find the Numerical solutions of ordinary differential equations of first order with initial condition using Picard's, Euler's, modified Euler's, and Runge Kutta methods (up to fourth order).	
Reference Books:		
1	C. F. Gerald and P. O. Wheatley, Applied Numerical Analysis, Pearson Education, India,7th edition, 2008.	
2	C.F. Gerald, P.O. Wheatley, Applied Numerical Analysis, Addison-Wesley, 1998.	

Dy. Registrar
Pandit Deendayal Upadhyaya
Shekhawati University,
Sikar(Rajasthan)

Semester- V

Complex Analysis

Course Objective:

A Complex analysis course aims to introduce the fundamentals of complex numbers, functions and their applications, including analytic functions, contour integration and series expansions. Students will learn to apply these concepts to solve problems and demonstrate their understanding through proofs, applications and communication of mathematical ideas.

Course outcomes:

After completion of the course a student can:

1. Understand the concept of Limit, Continuity and Differentiability of Complex Functions. Analytic Functions and its various properties. Relate the algebraic and geometric properties of conformal mappings.
2. Grasped the concepts of Convergence, Power series, Complex Integral. Taylor's and Laurent's theorems as they apply to complex functions.
3. Conduct analysis on the singularities of analytic functions, including branch points, meromorphic functions, entire functions, and residues at singularities using the Cauchy residue theorem.

Course Title:	**Complex Analysis**	**Course Code: 24BMT7501T**
Total Lecture hour: 45		**Hours**
Unit I	Complex valued functions - limit, Continuity and differentiability of complex functions, Analytic functions, Cauchy-Riemann equations (Cartesian & Polar forms), Harmonic functions, Construction of an analytic function.	**12**
Unit II	Translation, Rotation, Magnification, Inversion, Linear transformation, Conformal mapping, Bilinear (fractional) transformation, cross-ratio, fixed or invariant points of a bilinear transformation, Normal form of a bilinear transformation, Elementary mappings z^2, e^z, sinz, cosz, $\frac{1}{2}(z+z^{-1})$ and logz.	**11**
Unit III	Power series- Abel's theorem, Cauchy-Hadamard theorem, Circle and radius of convergence, Complex Integration- complex line integrals, Cauchy's integral theorem, Fundamental theorem of integral calculus, Cauchy's integral formula, Cauchy's inequality, Poisson integral formula for a circle, Morera theorem, Liouville's theorem.	**11**
Unit IV	Taylor's and Laurent's series, Singularities, Isolated and non-isolated singularities, Removable Singularity, Pole, Essential singularity, Reimann theorem, Casorati- Weierstrass theorem, Calculus of Residues- Residue at a finite point, Residue at the point at infinity, Residue theorem.	**11**

Reference and Reading Books:

1. Brown JW, Churchill RV. Complex variables and applications. McGraw-Hill,; 2009.
2. G.N. Purohit & Goyal, Complex Analysis, Jaipur Pub. House, Jaipur
3. Guthro, Saini, Complex Analysis, Navkar Prakashan, Ajmer
4. J.N. Sharma, Functions of a Complex Variable, Krishna Prakashan, Meerut

Dy. Registrar
Pandit Deendayal Upadhyaya
Shekhawati University,
Sikar(Rajasthan)

Practical

Course Title:	Practical	Course Code: 24BMT7501P
Total Practice hour: Two period per week per batch		
Group A	Solution of Initial value problem by Picard's method, Euler's method, Modified Euler's method and Runge-Kutta method upto fourth order.	
Group B	Numerical integration by Trapezoidal Rule, Simpson's $\frac{1}{3}$ and $\frac{3}{8}$ Rule and Weddle's Rule.	
Note: Perform Practical / Lab work by C-Programming		
Reference and Reading Books: 1. C- Programming: A Practical approach, JPH, Jaipur		

Semester- VI
Algebra

Course Objective:

The aim of course is to develop a deep understanding of fundamental algebraic structures like groups, rings, fields and Vector Spaces enhancing mathematical maturity and logical thinking skills. Students will learn to define and explore these structures, understand their properties and apply these concepts to solve problems.

Course outcomes:

After finishing the course, the student is expected to be familiar with the following:

1. Identify the basic idioms in abstract & Linear algebra.
2. Development of student logical and abstract thinking.
3. Development of the student's ability to deal with abstract proofs.
4. Training students to solve exercises and applications.

Course Title:	Algebra	Course Code: 24BMT7601T
Total Lecture hour: 45		**Hours**
Unit I	Group- Definition, examples and simple properties of group, Order of an element of a group and theorem based on the order of an element of a group, Cyclic group, Permutation group.	**12**
Unit II	Subgroups- Definition, examples and properties of subgroups, center of the group, Normaliser of a group, Cosets, example and theorems based on Cosets, Lagrange's theorem, Index of a subgroup, Subgroups of cyclic group. Normal subgroup and Quotient Group, Examples and properties of Normal subgroup and Quotient Group.	**11**
Unit III	Group Homomorphism, Automorphism, Isomorphism, Kernel of homomorphism and related theorems. Basic properties of Ring, Subring, Integral domain, Ideals and Field.	**11**
Unit IV	Vector Space, Subspace, Linear Combination, Linearly independent and dependent vectors, Linear Span, Linear Sum, Direct Sum, Quotient Space, Basis, Dimension of a Vector Space and its properties, Linear Transformation.	**11**
Reference and Reading Books:: 1. I. N. Herstein , Topics in Algebra , John Wiley and Sons,1975 . 2. J. B. Fraleigh, A First Course in Abstract Algebra, 6th Ed. Addison – Wesley Publishing Co. London, 1998. 3. G.C.Sharma, Modern Algebra, Shivlal Agrawal & Co., Agra,1998. 4. G.N.Purohit, Linear Algebra , Jaipur Pub. House, Jaipur.		

Practical

Course Title:	Practical	Course Code: 24BMT7601P
Total Practice hour: Two period per week per batch		
Group A	Solution of Algebraic and Transcendental Equations by Bisection method, Regula-falsi method, Newton-Raphson method and Iteration method.	
Group B	Solution of system of linear algebraic equations by- Direct method: Gauss Elimination method, Gauss-Jordan method, Iterative Methods: Gauss-Seidel method, Jacobi iterative method.	
Note: Perform Practical / Lab work by C-Programming		
Reference and Reading Books:		
1. C- Programming: A Practical approach, JPH, Jaipur		

Dy. Registrar
Pandit Deendayal Upadhyaya
Shekhawati University,
Sikar(Rajasthan)