As per the NEP 2020

Bachelor of Science

(Effective from Academic Year 2024-2025 onwards)

Faculty of Science

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As per the NEP 2020

Mathematics

(Effective from Academic Year 2024-2025 onwards)

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Bachelor of Science

(CBCS) As per the NEP 2020 (Semester I to IV)
w.e.f. the Academic Session 2024-25
Discipline: Mathematics
Faculty: Science

Semester – I

Note: Continuous assessment (internal) will be done by the teacher concerned based on test papers, regularity in the class, and performance of the candidate. The maximum marks in continuous assessment of the paper are 100 (Theory 70 Marks + Internal Assessment 30 Marks). Minor paper is offered as an additional subject for bio students.

Semester	Course title			Credit distribution of the course			Eligibility criteria
		Credits	Course Code	Lecture	Tutorial	Practical/ Practice	
I	Calculus And Optimization Techniques	DSC (3)	24BMT5101 T	3	0	0	10+2 from any recognized Board
I	Practical I Lab Work- Optimization Techniques	DSC (1)	24BMT5101P	2	0	0	
II	Discrete Mathematics & Vector Calculus	DSC (3)	24BMT5201 T	3	0	0	
II	Practical I Lab Work- Discrete Mathematics	DSC(1)	24BMT5201P	2	0	0	
III	Real Analysis And Numerical Analysis - I	DSC(3)	24BMT6301 T	3	0	0	
III	Practical I Lab Work- Numerical Analysis - I	DSC(1)	24BMT6301P	2	0	0	
IV	Differential Equations And Numerical Analysis-II	DSC (3)	24BMT6401 T	3	0	0	
IV	Practical I Lab Work- Numerical Analysis-Ii	DSC8 (1)	24BMT6401P	2	0	0	

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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.

Semester -I
Paper – I

Course Title:	Calculus and Optimization Techniques	Course Code: BMS5101T
Total Lecture hours 40		
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.	Hours: 10
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).	10
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	J. P. Saini, S. K. Sharma & Rakesh Kumar, Calculus & Optimization Techniques, N.K. Publication Jaipur.
2	S.K. Sharma, Rakesh Kumar, K. K. Saini & R.S.A. Sharma, Calculus & Optimization Techniques N.K. Publication Jaipur.
3	Pranjali Sharma, Rakesh Kumar, D. Meena & M. Meena, Calculus, N.K. Publication Jaipur.
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.

Paper – II

Duration of Examination: 2 hours **Max Marks:50**

Course Title:	Practical / Lab Work-Optimization Techniques	Course Code: BMS5101P
Total Lecture hours 26		
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.	13
2	**Part-B** 1. Find the Optimum solution to given Transportation Problems. 2. Find the Optimum solution of given Assignment Problems.	13
Reference Books:		
1	G. Hadley, Linear Programming, Narosa Publishing House, New Delhi, 2002.	
2	Hamdy A. Taha, Operations Research, An Introduction (9th edition), Prentice-Hall,2010.	

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Semester – II

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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.

Paper – III

Course Title:	**Discrete Mathematics & Vector Calculus**	**Course Code: BMS5201T**
Total Lecture hours 40		
Unit I		**Hours**
	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.	**10**
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.	**10**
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.	**10**

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.	**10**

Reference Books:

1	J. P. Saini, S. K. Sharma & Rakesh Kumar, Discrete Mathematics & Vector Calculus, N.K. Publication Jaipur.
2	V. K. Bala Krishnan, Introductory Discrete Mathematics, Prentice-Hall, 1996.
3	N. Deo, Graph Theory with Applications to Computer Science, Prentice-Hall of India.
4	C.L. Liu, Elements of Discrete Mathematics, (Second Edition), McGraw Hill, International Edition, 1986.
5	Kenneth H. Rosen, Discrete Mathematics and Its Applications, Tata Mc-Graw Hills, New Delhi, 2003.

Paper – IV

Course Title:	**Practical / Lab Work-Discrete Mathematics**	**Course Code: BMS5201P**
Total Lecture hours 26		
1	**Note:-** The Practical / Lab Work is to be performed by using computer Language C & C+. **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	**Note:-** The Practical / Lab Work is to be performed by using computer Language C & C+. **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

Note: Continuous assessment (internal) will be done by the teacher concerned based on test papers, regularity in the class, and performance of the candidate. The maximum marks in continuous assessment of the paper are 100 (Theory 70 Marks + Internal Assessment 30 Marks). Minor paper is offered as an additional subject for bio students.

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.

Paper – V

Course Title:	**Real Analysis and Numerical Analysis - I**	**Course Code: BMS5301T**
Total Lecture hours 40		
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.	**Hours** **10**
Unit II	Properties of continuous functions on closed intervals, Properties of derivable functions, Darboux's and Rolle's theorem. Riemann integration - Lower and Upper Riemann integrals, Riemann integrability, Mean value theorem of integral calculus, Fundamental theorem of integral calculus.	**10**

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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, Trapazoidal rule. Simpson's one-third, Simpson's three-eighth, and Gauss's quadrature formulla. Numerical solution of Algebraic and Transcendental equations, Bisection method, Regula-Falsi 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.

Paper – VI

Course Title:	**Practical / Lab Work-Numerical Analysis - I**	**Course Code: BMS5301P**
Total Lecture hours 26		
1	**Part-A** Find the Numerical integration by 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, Regula-Falsi 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
Paper - VII

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 andanalyze 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: BMS5401T**
Total Lecture hours 40		
Unit I		**Hours**
	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.	**10**
Unit II	Homogeneous linear differential equations.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.	**10**
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.	**10**

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Unit IV	Gauss elimination and Iterative methods (Jacobi and Gauss-Seidel) for solving systems of linear algebraic equations. Partial Pivoting method, Numerical solutions of ordinary differential equations of first order with initial condition using Picard's, Euler, and modified Euler's method.	**10**

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.

Paper – VIII

Course Title:	**Practical / Lab Work-Numerical Analysis-II**	**Course Code: BMS5401P**
Total Lecture hours 26		
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.	
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.

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