INDIRA GANDHI (P.G.) MAHILA MAHAVIDYALAYA, KAITHAL

Affiliated to Kurukshetra University, Kurukshetra

Department Of Mathematics

Lesson Plan (Session 2025-2026)

Class: B.Sc.(Physical Science)/B.A. Semester: **I**

Name of the Course: Calculus Course Code: B23-MAT-101

Dates: 22 July, 2025 – 24 Nov., 2025

SYLLABUS

Maximum Marks: 100 Time: 3 hours

End Term Exam Marks: 50(T)+20(P)= 70 Marks Assessment:20(T)+10(P)=30 Marks

Note: Examiner will be required to set nine questions in all. First question will be compulsory, consisting of short type question covering the entire syllabus in addition to that eight more questions will be set, two question from each unit. Students will be required to attempt in all. In addition to the compulsory question, student will have to attempt four more questions selecting one question from each unit.

Unit	Topics	Contact Hours
Unit: I	ε-δ definition of limit and continuity of a real valued function, Basic properties of limits, Types of discontinuities, Differentiability of functions, Application of L'Hospital rule to indeterminate forms, Successive differentiation, Leibnitztheorem, Taylor's and Maclaurin's series expansion with different forms of remainder.	12
Unit: II	Asymptotes: Horizontal, vertical and oblique asymptotes for algebraic curves, Asymptotes for polar curves, Intersection of a curve and its asymptotes, Curvature and radius of curvature of curves (cartesian, parametric, polar & intrinsic forms), Newton's method, Centre of curvature and circle of curvature.	12
Unit: III	Multiple points, Node, Cusp, Conjugate point, Tests for concavity and convexity, Points of inflexion, Tracing of curves, Reduction formulae.	12
Unit: IV	Rectification, intrinsic equation of a curve, Quadrature, Area bounded by closed curves, Volumes and surfaces of solids of revolution	12
V*	Problems of curve tracing when equation is given in Cartesian coordinates, Problems of curve tracing when equation is given in Parametric form, Problems of curve tracing when equation is given in Polar coordinates, Problem of determination of length of a curve expressed in Cartesian coordinates, Problem of determination of length of a curve expressed in Polar coordinates, Problem of determination of radius of curvature expressed in Cartesian coordinates, Problem of determination of radius of curvature expressed in Polar coordinates, Problem of determination of radius of curvature expressed in Parametric form, Problem of determination of volumes and surfaces of solids of revolution for Cartesian curve, Problem of determination of volumes and surfaces of solids of revolution for Parametric curve, Problem of determination of volumes and surfaces of solids of revolution for Polar curve.The following practicals will be done using MAXIMA software and their record will be maintained in the practical note book: Learn to use basic operators and functions in Maxima software, Simplify algebraic expressions and expressions containing radicals, logarithms, exponentials and trigonometric functions, Expand algebraic, rational, trigonometric and logarithmicexpressions, Find derivatives of algebraic, trigonometric, exponential and logarithmic functions, Find derivatives of functions involving above mentioned functions, Problems of successive differentiation, Find indefinite integrals of different functions, Find definite integrals of different functions, To plot curves involving Cartesian, parametric and polar forms, To demonstrate singular points.	30

Text Books:

1. M.L. Jain, Dr. J.S. Sikka, Dr. Satyabir Mehla, Pankaj Kalra, "Elements of Calculus", Jeevansons Publications

Course Outcomes

After completing this course, the learner will be able to:

1. Gain knowledge of the concepts and theory of limit, continuity and differentiability of functions. Attain skills of calculating the limit of functions and examining the continuity and differentiability of different types of functions, and perform successive differentiation of functions. To apply the procedural knowledge to obtain the series expansions of functions which find multidisciplinary applications.

2. Understand concepts of asymptotes and curvature, the geometrical meaning of these terms and to have procedural knowledge to solve related problems.
3. Determine singular points of a curve and classify them. Understand the concept of rectification of curves andderive the reduction formulae.
4. Have theoretical knowledge and practical skills to evaluate the area bounded by the curves, and volume and surface area of solids formed by revolution of curves.

Lesson Plan

SR. No	Date	Course Content	
		Theory (3)	**Practical (2)**
1	22 July -25July 2025	ε-δ definition of limit and continuity of a real valued function, Basic properties of limits	Problems of curve tracing when equation is given in Cartesian coordinates. Problems of curve tracing when equation is given in Parametric form.
2	28 July - 2 August	Types of discontinuities, Differentiability of functions	Problems of curve tracing when equation is given in Polar coordinates. Problem of determination of length of a curve expressed in Cartesian coordinates.
3	4 August -8 August	Application of L'Hospital rule to indeterminate forms, Successive differentiation	Problem of determination of length of a curve expressed in Polar coordinates. 30 34(954) 6. Problem of determination of radius of curvature expressed in Cartesian coordinates.
4	11 August - 14 August	Leibnitztheorem, Taylor's and Maclaurin's series expansion with different forms of remainder	Problem of determination of radius of curvature expressed in Polar coordinates. Problem of determination of radius of curvature expressed in Parametric form.
5	18 August - 23August	Asymptotes: Horizontal, vertical and oblique asymptotes for algebraic curves	Problem of determination of volumes and surfaces of solids of revolution for Cartesian curve. Problem of determination of volumes and surfaces of solids of revolution for Parametric curve. Problem of determination of volumes and surfaces of solids of revolution for Polar curve.
6	25 August -30 August	Asymptotes for polar curves, Intersection of a curve and its asymptotes	Learn to use basic operators and functions in Maxima software.
7	1 Sept. - 6 Sept.	Curvature and radius of curvature of curves (cartesian, parametric, polar & intrinsic forms)	Simplify algebraic expressions and expressions containing radicals, logarithms, exponentials and trigonometric functions
8	8 Sept. - 13 Sept.	Newton's method, Centre of curvature and circle of curvature.	Expand algebraic, rational, trigonometric and logarithmic expressions.
9	15 Sept. - 20 Sept.	Multiple points, Node	Find derivatives of algebraic, trigonometric, exponential and logarithmic functions.
10	22 Sept. - 27 Sept.	Cusp, Conjugate point, Tests for concavity and convexity	Find derivatives of functions involving above mentioned functions.
11	29 Sept.- 4 Oct.	Points of inflexion	Problems of successive differentiation.
12	6 Oct.- 11 Oct.	Tracing of curves, Reduction formulae	Find indefinite integrals of different functions.
13	13 Oct.- 18 Oct.	Rectification	Find definite integrals of different functions.
14	27 Oct. - 1 Nov.	Intrinsic equation of a curve, Quadrature	To plot curves involving Cartesian, parametric and polar forms.
15	3 Nov. - 8Nov	Area bounded by closed curves, Volumes and surfaces of solids of revolution	To demonstrate singular points.
16	10 Nov-15 Nov	Revision	Practice
17	17 Nov -22 Nov	Revision	Practice
18	24 Nov.	Revision.	Practice

Signature of Teacher **Head of Department**

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Department Of Mathematics

Lesson Plan (Session 2025-2026)

Class: B.Sc.(Physical Science)/B.A. Semester: III

Name of the Course: Differential Equation-I Course Code: B23-MAT-301

Dates: 22 July, 2025 – 24 Nov., 2025

SYLLABUS

Maximum Marks: 100 Time: 3 hours

End Term Exam Marks: 50(T)+20(P)=70 Marks Assessment: 20(T)+10(P)=30 Marks

Note: Examiner will be required to set nine questions in all. First question will be compulsory, consisting of short type question covering the entire syllabus in addition to that eight more questions will be set, two question from each unit. Students will be required to attempt in all. In addition to the compulsory question, student will have to attempt four more questions selecting one question from each unit.

Unit	Topics	Contact Hours
Unit: I	Basic concepts and genesis of ordinary differential equations, Order and degree of a differential equation, Solutions of differential equations of first order and first degree, Exact differential equations, Integrating factor, First order higher degree equations solvable for x, y and p, Lagrange's equations, Clairaut's form and singular solutions. Orthogonal trajectories of one-parameter families of curves in a plane.	12
Unit: II	Solutions of linear ordinary differential equations with constant coefficients, linear non-homogeneous differential equations. Linear differential equation of second order with variable coefficients. Method of reduction of order, method of undetermined coefficients, method of variation of parameters. Cauchy-Euler equation	12
Unit: III	Solution of simultaneous differential equations, total differential equations. Genesis of Partial differential equations (PDE), Concept of linear and non-linear PDEs. Complete solution, general solution and singular solution of a PDE. Linear PDE of first order. Lagrange's method for PDEs of the form: $P(x,y,z)\,p + Q(x,y,z)\,q = R(x,y,z)$, where $p=\partial z/\partial x$ and $q=\partial z/\partial y$.	12
Unit: IV	Integral surfaces passing through a given curve. Surfaces orthogonal to a given system of surfaces. Compatible systems of first order equations. Charpit's method, Special types of first order PDEs, Jacobi's method. Second Order Partial Differential Equations with Constant Coefficients.	12
V*	Problems solving for differential equations which are reducible to homogeneous, Problems solving for differential equations which are Exact differential equations, Problems solving for linear differential equations with constant coefficient, Problems solving for linear differential equations with variable coefficient, Problems solving for differential equations by method of variation of parameters, Problems solving for differential equations by method of undetermined coefficients, Problems solving for simultaneous differential equations, Problems solving for different PDEs using Lagrange's method, Problems solving for PDEs with Charpit's method and Jacobi'smethod.The following practicals will be done using MAXIMA software and record of those will be maintained in the practical note book: Solutions of first and second order differential equations, Plotting of family of solutions of differential equations of first, second and third order, Solution of differential equations using method of variation of parameters, Growth and decay model (exponential case only), Lake pollution model (with constant/seasonal flow and pollution concentration), Density-dependent growth model, Predatory-prey model (basic Volterra model, with density dependence, effect of DDT, two prey one predator), To find the solutions Linear differential equations of second order using built in functions of MAXIMA software, To find numerical solution of a first order ODE using plotdf builtin function of MAXIMA, To find exact solutions of first and second order ODEs using ode2 and ic1/ic2 built in functions of MAXIMA, To find exact solutions of first and second order ODEs using desolve and atvalue built in functions of MAXIMA.	30

Text Books

Recommended Books/e-resources:

1. M.L. Jain, Dr. Poonam K. Dhaonchak, Dr. Sanjay Garg, Dr. Arpana Garg, Kanika Goyal, “Elements of Differential Equations-I ”, Jeevansons Publications
2. Dr. M.D. Raisinghania, “Differential equations”, S. Chand Publishing house
3. Shepley L.Ross, “Differential Equations”, Wiley Student Edition, Third Edition
4. Vakeel A.Khan, Ayhan Esi, Ayaz Ahmad, “Basics of Differential Equations”, Narosa Publishing house
5. Dr. M.D. Raisinghania, “Advanced Differential equations”, S. Chand Publishing house
6. D. Somasundaram, “ Ordinary Differential Equations”, Narosa Publishing house

Course Outcomes

After completing this course, the learner will be able to:

1. Gain knowledge of the basic concepts of ordinary differential equations and learn various techniques of finding exact solutions of certain solvable first order differential equations.
2. Have procedural knowledge and cognitive and technical skills of solving homogeneous and non-homogeneous second order linear ordinary differential equations with constant coefficients and with variable coefficients.
3. Gain knowledge of theory of total differential equations and basic concepts of partial differential equations. To learn methods and techniques for solving linear PDEs of first order and to acquire technical skills34(993) CLO 5 is related to the practical component. for accomplishing assigned tasks relating to formulation and solution of PDEs in broad multidisciplinary contexts.

Lesson Plan

SR. No	Date	Course Content	
		Theory (3)	**Practical(2)**
1	22 July -25July 2025	Basic concepts and genesis of ordinary differential equations,	Problems solving for differential equations which are reducible to homogeneous. Problems solving for differential equations which are Exact differential equations
2	28 July - 2 August	Order and degree of a differential equation, Solutions of differential equations of first order and first degree	Problems solving for linear differential equations with constant coefficient. Problems solving for linear differential equations with variable coefficient
3	4 August -8 August	Exact differential equations, Integrating factor, First order higher degree equations solvable for x, y and p,	Problems solving for differential equations by method of variation of parameters. Problems solving for differential equations by method of undetermined coefficients
4	11 August - 14 August	Lagrange's equations, Clairaut's form and singular solutions. Orthogonal trajectories of one-parameter families of curves in a plane.	Problems solving for simultaneous differential equations. Problems solving for different PDEs using Lagrange's method.
5	18 August - 23August	Solutions of linear ordinary differential equations with constant coefficients, linear non-homogeneous differential equations	Problems solving for PDEs with Charpit's method and Jacobi's method
6	25 August -30 August	Linear differential equation of second order with variable coefficients.	Solutions of first and second order differential equations
7	1 Sept. - 6 Sept.	Method of reduction of order, method of undetermined coefficients, method of variation of parameters. Cauchy-Euler equation	Plotting of family of solutions of differential equations of first, second and third order.
8	8 Sept. - 13 Sept.	Solution of simultaneous differential equations, total differential equations.	Solution of differential equations using method of variation of parameters.
9	15 Sept. - 20 Sept.	Genesis of Partial differential equations (PDE), Concept of linear and non-linear PDEs	Growth and decay model (exponential case only).
10	22 Sept. - 27 Sept.	Complete solution, general solution and singular solution of a PDE. Linear PDE of first order. Lagrange's method for PDEs of the form: $P(x,y,z)\,p + Q(x,y,z)\,q = R(x,y,z)$, where $p=\partial z/\partial x$ and $q=\partial z/\partial y$.	Lake pollution model (with constant/seasonal flow and pollution concentration).
11	29 Sept.- 4 Oct.	Integral surfaces passing through a given curve.	Density-dependent growth model.
12	6 Oct.- 11 Oct.	Surfaces orthogonal to a given system of surfaces	Predatory-prey model (basic Volterra model, with density dependence, effect of DDT, two prey one predator).
13	13 Oct.- 18 Oct.	Compatible systems of first order equations	To find the solutions Linear differential equations of second order using built in functions of MAXIMA software.
14	27 Oct. - 1 Nov.	Charpit's method, Special types of first order PDEs, Jacobi's method	To find numerical solution of a first order ODE using plot df built in function of MAXIMA.
15	3 Nov. - 8Nov	Second Order Partial Differential Equations with Constant Coefficients	To find exact solutions of first and second order ODEs using ode2 and ic1/ic2 built in functions of MAXIMA.
16	10 Nov-15 Nov	Revision	To find exact solutions of first and second order ODEs using desolve and atvalue built in functions of MAXIMA.
17	17 Nov -22 Nov	Revision	Practice
18	24 Nov.	Revision.	Practice

Signature of Teacher **Head of Department**

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Lesson Plan (Session 2025-2026)

Class: B.Sc.(Physical Science)/B.A. Semester: **V**

Name of the Course: Sequence and Series Course Code: B23-MAT-501

Dates: 22 July, 2025 – 24 Nov., 2025

SYLLABUS

Maximum Marks: 100 Time: 3 hours

End Term Exam Marks: 50(T)+20(P)=70 Marks Assessment:20(T)+10(P)= 30 Marks

Note: Examiner will be required to set nine questions in all. First question will be compulsory, consisting of short type question covering the entire syllabus in addition to that eight more questions will be set, two question from each unit. Students will be required to attempt in all. In addition to the compulsory question, student will have to attempt four more questions selecting one question from each unit.

Unit	Topics	Contact Hours
Unit: I	Boundedness of the set of real numbers, Least upper bound and Greatest lower bound of a set. Archimedean, algebraic and ordered properties in $\mathbb{R}$. The real number system as a complete ordered field. Neighbourhoods, interior points, isolated points, limit points, Open sets, closed sets, interior of a set, closure of a set in real numbers and their properties. Bolzano-Weierstrass theorem. Open covers, compact sets and Heine-Borel theorem.	12
Unit: II	Denumerable and non-denumerable sets, Denumerability of integers, rationals and non-denumerability of real numbers. Sequences: Real sequences and their convergence, Theorems on limit of sequence, Bounded and monotonic sequences, Cauchy's sequence, Cauchy general principle of convergence, Subsequences and subsequential limits, Limit superior and limit inferior.	12
Unit: III	Infinite series: Convergence and divergence of Infinite Series, Comparison tests of positive terms infinite series, Cauchy's general principle of Convergence of series, Convergence and divergence of geometric series, Hyper Harmonic series or pseries, D-Alembert's ratio test, Raabe's test, Logarithmic test, Cauchy's nth root test, De-Morgan and Bertrand's test, GaussTest, Cauchy's integral test, Cauchy's condensation test.	12
Unit: IV	Alternating series, Absolute and conditional convergence, Leibnitz test. Arbitrary series, Abel's and Dirichlet's test, Insertion and removal of parenthesis, Re-arrangement of terms in a series, Riemann's re-arrangement theorem and Pringsheim's theorem (statement only). Cauchy product of series (definitions and examples only).	12
V*	Problem demonstrating that the set of rational numbers is not order complete, Practical problems on finding lub and glb of a set, Problem solving to find limit point of a set using Bolzano Weierstrass Theorem, Problems solving using monotone convergence theorem, Practical problems demonstrating the use of Cauchy's first 30 and second theorems for convergence of sequences, Problem solving on limit inferior and limit superior of a sequence.Problem solving on limit inferior and limit superior of a sequence, Practical problems on convergence/divergence of positive term series demonstrating the application of various convergence tests, Problem solving on (a) conditional convergence and (b) absolute convergence of an alternating series, Practical problems to demonstrate, Cauchy product of two convergent series need not be convergent, Cauchy product of two divergent series need not be divergent, Practical problems demonstrating the denumerability of the cartesian product of denumerable sets, Demonstrate the non-denumerability of the set of irrationals.The following practicals will be done using Mathematica/ Matlab/Maple/Scilab/ Maxima etc.software and also verify results by applying various convergencetests. Their record will be maintained in the practical note book:Testing the convergence of infinite series of positive terms by the use of sequence of partial sums, Testing the convergence of an infinite positive term series, Testing the absolute convergence of an alternating series and comment about conditional convergence, Practical problems on the convergence of series with arbitrary terms, Testing the convergence/divergence/oscillation behavior of sequences of real numbers, Determine the lub and glb of the subset of real numbers and observe whether they belong	30

	to the set or not.	

Text Books :

1. M.L. Jain, Sarita Ganotra, Dr. Raj Kamal Pilania, “Elements of Sequence and Series”, Jeevansons Publications

Course Outcomes

After completing this course, the learner will be able to:

1. Understand basic concepts of real number system, set theory and preliminary results on neighbourhood of a point, interior and limit points, open sets, closed sets etc.
2. Learn about denumerability of subsets of real numbers, sequences, their limits, boundedness and convergence. Determine the convergence and divergence of a sequence. Understand Cauchy sequence and Cauchy general principle of convergence of sequence.
3. Attain skills to determine convergence of a series of real numbers by applying various tests.
4. To know absolute and conditional convergence of alternating series and apply theory to check the convergence of arbitrary series.

Lesson Plan

SR. No	Date	Course Content	
		Theory (3)	**Practical(2)**
1	22 July -25July 2025	Students doing their Internship	--
2	28 July - 2 August	Students doing their Internship	--
3	4 August -8 August	Boundedness of the set of real numbers, Least upper bound and Greatest lower bound of a set	Problem demonstrating that the set of rational numbers is not order complete. Practical problems on finding lub and glb of a set.
4	11 August - 14 August	Archimedean, algebraic and ordered properties in $\mathbb{R}$. The real number system as a complete ordered field.	Problem solving to find limit point of a set using Bolzano Weierstrass Theorem
5	18 August - 23August	Neighbourhoods, interior points, isolated points, limit points, Open sets, closed sets, interior of a set	Problems solving using monotone convergence theorem.
6	25 August -30 August	Closure of a set in real numbers and their properties. Bolzano-Weierstrass theorem. Open covers, compact sets and Heine-Borel theorem.	Practical problems demonstrating the use of Cauchy's first 30 and second theorems for convergence of sequences.
7	1 Sept. - 6 Sept.	Denumerable and non-denumerable sets, Denumerability of integers, rationals and non-denumerability of real numbers	Problem solving on limit inferior and limit superior of a sequence. Practical problems on convergence/divergence of positive term series demonstrating the application of various convergence tests.
8	8 Sept. - 13 Sept.	Sequences: Real sequences and their convergence, Theorems on limit of sequence, Bounded and monotonic sequences, Cauchy's sequence	Problem solving on (a) conditional convergence and (b) absolute convergence of an alternating series. Practical problems to demonstrate
9	15 Sept. - 20 Sept.	Cauchy general principle of convergence, Subsequences and subsequential limits, Limit superior and limit inferior.	Cauchy product of two convergent series need not be convergent. Cauchy product of two divergent series need not be divergent.
10	22 Sept. - 27 Sept.	Infinite series: Convergence and divergence of Infinite Series, Comparison tests of positive terms infinite series	Practical problems demonstrating the denumerability of the cartesian product of denumerable sets. Demonstrate the non-denumerability of the set of irrationals.
11	29 Sept.- 4 Oct.	Cauchy's general principle of Convergence of series, Convergence and divergence of geometric series, Hyper Harmonic series or pseries, D-Alembert's ratio test	Testing the convergence of infinite series of positive terms by the use of sequence of partial sums.
12	6 Oct.- 11 Oct.	Raabe's test, Logarithmic test, Cauchy's nth root test, De-Morgan and Bertrand's test, GaussTest, Cauchy's integral test, Cauchy's condensation test	Testing the convergence of an infinite positive term series.
13	13 Oct.- 18 Oct.	Alternating series	Testing the absolute convergence of an alternating series and comment about conditional convergence.
14	27 Oct. - 1 Nov.	Absolute and conditional convergence, Leibnitz test	Practical problems on the convergence of series with arbitrary terms.
15	3 Nov. - 8Nov	Arbitrary series, Abel's and Dirichlet's test	Testing the convergence/divergence/oscillation behavior of sequences of real numbers.
16	10 Nov-15 Nov	Insertion and removal of parenthesis, Re-arrangement of terms in a series	Determine the lub and glb of the subset of real numbers and observe whether they belong to the set or not
17	17 Nov -22 Nov	Riemann's re-arrangement theorem and Pringsheim's theorem (statement only). Cauchy product of series (definitions and examples only).	Practice
18	24 Nov.	Revision.	Practice

Signature of Teacher **Head of Department**