P.V.P. Mahavidhylaya, Kavathe Mahankal

Annual Teaching Plan : 2019-2020

Name of the Teacher : Dudhal .R. D **Designation :**

Class: B.Sc. I **Semester :- II**

Department : Mathematics **Paper: III & IV**

Paper Title :- Differential equation & Higher order Differetial equation , partial differential equation

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	Novembar	Differential Equation of first order	**Differential Equations of First Order** Differential Equations of First Order and First Degree. Exact Differential Equations. : Necessary and Sufficient condition for exactess Working Rule for solving an Exact Differential Equation. Integrating Factor. Integrating Factor by Inspection and examples.Integrating Factor by using Rules (Without Proof) and Examples. Linear Differential Equations: Definition, Method of Solution and examples. Bernoulli's Equation: Definition, Method of Solution and Examples. Differential Equations of First Order but Not of First Degree: Introduction. Equations solvable for p: Method and Problems. Equations solvable for x: Method and Problems. Equations solvable for y: Method and Problems. Clairaut's Form: Method and Problems. Equations Reducible to Clairaut's Form.	

2	Decembar	linear differential equation	**Linear Differential Equations** Linear Differential Equations with Constant Cofficients Introduction and General Solution. Determination of Complementary Function The Symbolic Function 1/f(D):Definition. Determination of Particular Integral. General Method of Particular IntegralShort Methods of Finding P.I. when X is in the form , sin ax , cos ax , (m being a positive integer), V , x V where V is a function of x. Examples. Homogeneous Linear Differential Equations (The Cauchy-Euler Equations) Introduction and Method of Solution. Legendre's Linear Equations. Method of Solution of Legendre's Linear Equations. Examples.	
3	January	Second order linear differential equation	**Second Order Linear Differential Equations and Simultaneous Differential Equations** Second Order Linear Differential Equations The General Form. Complete Solution when one Integral is known: Method and Examples. Transformation of the Equation by changing the dependent variable (Removal of First order Derivative). Transformation of the Equation by changing the independent variable. Method of Variation of Parameters. Examples. Ordinary Simultaneous Differential Equations and Total Differential Equations Simultaneous Linear Differential Equations of the Form	

4	February	Simulteneous Differential Equation	Methods of Solving Simultaneous Linear Differential Equations Total differential equations Pdx + Qdy + Rdz = 0 Necessary condition for Integrability of total differential equation The condition for exactness	
5	March	Method of solving total Differential equation	Methods of solving total differential equations a) Method of Inspection b) One variable regarding as a constant Geometrical Interpretation of Ordinary Simultaneous Differential Equations Geometrical Interpretation of Total Differential Equations Geometrical Relation between Total Differential equations and Simultaneous differential Equations.	
6	April	Partial Differential Equation	**Partial Differential Equa**tions Partial Differential Equations Introduction Order and Degree of Partial Differential Equations Linear and non-linear Partial Differential Equations Classification of first order Partial Differential Equations Formation of Partial Differential Equations by the elimination of arbitrary constants Formation of Partial Differential Equations by the elimination of arbitrary functions Ø from the equation Ø(u,v) = 0 where u and v are functions of x, y and z. Examples.	
7	May	First oOrder Partial differential equation	First Order Partial Differential First Order Linear Partial Differential Equations Lagrange's equations Pp + Qq = R Lagrange's methods of solving Pp + Qq	

			= R: Examples Charpit's method Special methods of solutions applicable to certain standard forms Only p and q present Clairaut's equations Only p, q and z present $f(x,p) = g(y,q)$ Examples	

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Department of Mathematics
P.V.P. Mahavidyalaya,
Kavathe Mahankal, Dist.-Sangli.

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Annual Teaching Plan : 2019-2020

Name of the Teacher : Dudhal .R. A

Designation :

Class: B.Sc. I

Semester :- I

Department : Mathematics

Paper: I & II

Paper Title :- Differential calculus & calculus

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	June	Introduction--	Intraduction - Hyperbolic Functions De- Moivre's Theorem. Examples. Applications of De- Moivre's Theorem , nth roots of unity Hyperbolic functions. Properties of hyperbolic function Differentiation of hyperbolic functions Inverse hyperbolic functions and their derivatives. Examples Relations between hyperbolic and circular functions. Representation of curves in Parametric and Polar co-ordinate Properties of hyperbolic function Differentiation of hyperbolic functions Inverse hyperbolic functions and their derivatives. Examples Relations between hyperbolic an circular functions. Representation of curves in Parametric and Polar co-ordinate	

2	July	Successive Differentiation	Successive Differentiation n^{th} order derivative of standard functions: $(ax+b)^m$, e^{ax}, a^{mx}, $1/(ax+b)$, $\sin(ax+b)$, $e^{ax} \cos(ax+b)$, $e^{ax} \sin(ax+b)$, $\cos(ax+b)$. Leibnitz's Theorem (with proof). Partial differentiation, Chain rule (without proof) and its examples2.4 Euler's theorem on homogenous functions. Maxima and Minima for functions of two variables. Lagrange's Method of undetermined multipliers. Mean Value Theorems and Indeterminate Forms Rolle's Theorem Geometrical interpretation of Rolle's Theorem. Examples on Rolle's Theorem Lagrange's Mean Value Theorem (LMVT) Geometrical interpretation of LMVT. Examples on LMVT. Cauchy's Mean Value Theorem (CMVT) Examples on CMVT19	
3	August	Successive Differential Equation	Taylor's Theorem with Lagrange's and Cauchy's form of remainder (without proof) Maclarin's Theorem with Lagrange's and Cauchy's form of remainder (without proof) Maclarin's series for sin x, cos x, e^x, log (1+x), $(1+x)^m$. Examples on Maclarin's series Indeterminate Forms L'Hospital Rule, the form , , and Examples. L'Hospital Rule, Indeterminate Forms L'Hospital Rule, the form , , and Examples. L'Hospital Rule, the form $0 \times \infty$, $\infty - \infty$. and Examples the form $0 \times \infty$, $\infty - \infty$. and Examples - Limits and Continuity of Real Valued Functions	10

4	septembar	Limit and continuous	∈ - δ definition of limit of function of one variable, Left hand side limits and Right hand side limits . Theorems on Limits (Statements Only) \ Continuous Functions and Their Properties If f and g are two real valued functions of a real variable which are continuous at x = c then (i) f + g (ii) f – g (iii) f.g are continuous at x = c. and (iv) f/g is continuous at x = c , g(c) ≠ 0. Composite function of two continuous functions is continuous. Classification of discontinuities (First and second kind).Types of Discontinuities :(i) Removable discontinuity(ii) Jump discontinuity of first kind (iii) Jump discontinuity of second kind Differentiability at a point, Left hand derivative, Right hand derivative, Differentiability in the interval [a,b].	
5	octombar	Continuty	Theorem: Continuity is necessary but not a sufficient condition for the existence of a derivative. If a function f is continuous in a closed interval [a, b] then it is bounded in [a, b]. If a function f is continuous in a closed interval [a, b] then it attains its bounds at least once in [a, b]. If a function f is continuous in a closed interval [a, b] and if f(a), f(b) are of opposite signs then there exists c □ [a, b] such that f(c) = 0. (Statement Only) . If a function f is continuous in aclosed interval [a, b] and if f(a) ≠ f(b) then f assumes every value between f(a) and f(b). (Statement Only)	

Head
Department of Mathematics
P.V.P. Mahavid[illegible]
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P.V.P. Mahavidhylaya, Kavathe Mahankal

Annual Teaching Plan : 2020-2021

Name of the Teacher : Dudhal .R. D

Designation :

Class: B.Sc. I

Semester :- I

Department : Mathematics

Paper: I & II

Paper Title :- Differential calculus & calculus

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	july	Introduction--	Intraduction - Hyperbolic Functions De- Moivre's Theorem. Examples. Applications of De- Moivre's Theorem , nth roots of unity Hyperbolic functions. Properties of hyperbolic function Differentiation of hyperbolic functions Inverse hyperbolic functions and their derivatives. Examples Relations between hyperbolic and circular functions. Representation of curves in Parametric and Polar co-ordinate Properties of hyperbolic function Differentiation of hyperbolic functions Inverse hyperbolic functions and their derivatives. Examples Relations between hyperbolic an circular functions. Representation of curves in Parametric and Polar co-ordinate	

2	August	Successive Differentiation	Successive Differentiation n_{th} order derivative of standard functions: $(ax+b)_m$, e_{ax}, a_{mx}, $1/(ax+b)$, $\sin(ax+b)$, $e_{ax}\cos(ax+b)$, $e_{ax}\sin(ax+b)$, $\cos(ax+b)$. Leibnitz's Theorem (with proof). Partial differentiation, Chain rule (without proof) and its examples2.4 Euler's theorem on homogenous functions. Maxima and Minima for functions of two variables. Lagrange's Method of undetermined multipliers. Mean Value Theorems and Indeterminate Forms Rolle's Theorem Geometrical interpretation of Rolle's Theorem. Examples on Rolle's Theorem Lagrange's Mean Value Theorem (LMVT) Geometrical interpretation of LMVT. Examples on LMVT. Cauchy's Mean Value Theorem (CMVT) Examples on CMVT19	
3	September		Taylor's Theorem with Lagrange's and Cauchy's form of remainder (without proof) Maclarin's Theorem with Lagrange's and Cauchy's form of remainder (without proof) Maclarin's series for sin x, cos x, e_x, log $(1+x)$, $(1+x)_m$. Examples on Maclarin's series Indeterminate Forms L'Hospital Rule, the form , , and Examples. L'Hospital Rule, Indeterminate Forms L'Hospital Rule, the form , , and Examples. L'Hospital Rule, the form $0 \times \infty$, $\infty - \infty$. and Examples the form $0 \times \infty$, $\infty - \infty$. and Examples - Limits and Continuity	10

			of Real Valued Functions	
4	octomber		∈ - δ definition of limit of function of one variable, Left hand side limits and Right hand side limits . Theorems on Limits (Statements Only) \ Continuous Functions and Their Properties If f and g are two real valued functions of a real variable which are continuous at x = c then (i) f + g (ii) f – g (iii) f.g are continuous at x = c. and (iv) f/g is continuous at x = c , g(c) ≠ 0. Composite function of two continuous functions is continuous. Classification of discontinuities (First and second kind).Types of Discontinuities :(i) Removable discontinuity(ii) Jump discontinuity of first kind (iii) Jump discontinuity of second kind Differentiability at a point, Left hand derivative, Right hand derivative, Differentiability in the interval [a,b].	
5	November		Theorem: Continuity is necessary but not a sufficient condition for the existence of a derivative. If a function f is continuous in a closed interval [a, b] then it is bounded in [a, b]. . If a function f is continuous in a closed interval [a, b] then it attains its bounds at least once in [a, b]. If a function f is continuous in a closed interval [a, b] and if f(a), f(b) are of opposite signs then there exists c □ [a, b] such that f(c) = 0. (Statement Only) . If a function f is continuous in aclosed interval [a, b] and if f(a) ≠ f(b) then f	

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Kavathe Mahankal Dist.-Sangli

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Annual Teaching Plan : 2020-2021

Name of the Teacher : Dudhal .R. A **Designation :**

Class: B.Sc. I **Semester :- II**

Department : Mathematics **Paper: III & IV**

Paper Title :- Differential equation & Higher order Differetial equation , partial differential equation

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	April	Differential equation and first order	**Differential Equations of First Order** Differential Equations of First Order and First Degree. Exact Differential Equations. : Necessary and Sufficient condition for exactess. Working Rule for solving an Exact Differential Equation. Integrating Factor. Integrating Factor by Inspection and examples. : Integrating Factor by using Rules (Without Proof) and Examples. Linear Differential Equations: Definition, Method of Solution and examples. Bernoulli's Equation: Definition, Method of Solution and Examples. Differential Equations of First Order but Not of First Degree: Introduction. Equations solvable for p: Method and Problems. Equations solvable for x: Method and Problems. Equations solvable for y: Method and Problems. Clairaut's Form: Method and	

			Problems. Equations Reducible to Clairaut's Form.	
2	May	Linear Differential Equation	**Linear Differential Equations** Linear Differential Equations with Constant Cofficients Introduction and General Solution. Determination of Complementary Function The Symbolic Function 1/f(D):Definition. Determination of Particular Integral. General Method of Particular IntegraShort Methods of Finding P.I. when X is in the form , sin ax , cos ax , (m being a positive integer), V , x V where V is a function of x. Examples. Homogeneous Linear Differential Equations (The Cauchy-Euler Equations) Introduction and Method of Solution. Legendre's Linear Equations. Method of Solution of Legendre's Linear Equations. Examples.	
3	June	Second order partial differential equation	**Second Order Linear Differential Equations and Simultaneous Differential Equations** Second Order Linear Differential Equations The General Form. Complete Solution when one Integral is known: Method and Examples. Transformation of the Equation by changing the dependent variable (Removal of First order Derivative). Transformation of the Equation by changing the independent variable. Method of Variation of Parameters. Examples. Ordinary Simultaneous Differential Equations and Total Differential	10

			Equations .	
4	July	Linear Diifferential Equation	Methods of Solving Simultaneous Linear Differential Equations Total differential equations Pdx + Qdy + Rdz = 0 Neccessary condition for Integrability of total differential equation The condition for exactness. Methods of solving total differential equations a) Method of Inspection b) One variable regarding as a constant Geometrical Interpretation of Ordinary Simultaneous Differential Equations Geometrical Interpretation of Total Differential Equations Geometrical Relation between Total Differential equations and Simultaneous differential Equations.	
5	August	Partial Differential Equation	**Partial Differential Equations** Partial Differential Equations Introduction Order and Degree of Partial Differential Equations Linear and non-linear Partial Differential Equations Classification of first order Partial Differential Equations Formation of Partial Differential Equations by the elimination of arbitrary constants Formation of Partial Differential Equations by the elimination of arbitrary functions Ø from the equation Ø(u,v) = 0 where u and v are functions of x, y and z. Examples. First Order Partial Differential First Order Linear Partial Differential Equations Lagrange's equations Pp + Qq = R Lagrange's methods of solving Pp + Qq	

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Annual Teaching Plan : 2020-2021

Name of the Teacher : Dudhal .R. D

Designation :

Class: B.Sc. II

Semester :- III

Department : Mathematics

Paper: III &IV

Paper Title :- Real Analysis -1

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required	
1	June	Function and countable sets	:Functions and Countable sets (16hrs) Sets. Revision of basic notions in sets. Operations on sets:-Union, Intersection, Complement, Relative complement, Cartesian product of sets, Relation. Functions Definitions: Function, Domain, Co-domain, Range, Graph of a function, Direct image and Inverse image of a subset under a function. Examples of direct image and inverse image of a subset		
2	july	Types of functions	Definitions: Injective, Surjective and Bijective functions Inverse function Proposition: If is injective and , then . Proposition: If is surjective and , then . Definition: Composite function, Restriction and Extension of a function. Theorem: Let and be functions and let be a subset of . Then . . Theorem: Composition of two bijective functions is a bijective function. Examples. Mathematical Induction		

			Principle of Mathematical Induction (without proof), Well ordering property of natural numbers Principle of Mathematical Induction (second version: Statement only), Principle of strong induction (Statement only). Examples based on 1.3.1 and 1.3.2		
3	august	Countable sets	Countable Sets Definitions: Denumerable sets, Countable sets, uncountable sets. Examples of denumerable sets: Set of Natural numbers, Set of Integers, Set of even natural numbers and odd natural numbers. Proposition: Union of two disjoint denumerable sets is denumerable. Theorem: If is a countable set for each , then the union is countable. (Countable union of countable sets is countable) . Theorem:The set of Rational numbers is denumerable. . Theorem: Any subset of countable set is countable. . Theorem: The closed interval is uncountable. Corollary: The set of all real numbers is uncountable. Examples		
4	september	Algebric and order properties	:The Real numbers Algebraic and Order Properties of . . Algebraic properties of real numbers. Theorem:Let . (a) If and , then (b) If , then (c) If and , then . If and , then		
5	octomber	THereoms	Theorem: (a) If and , then . (b) (c) If , then . Theorem: If is such that for every then .		

			Theorem: If , then either (i) and or (ii) and Corollary: If , then either (i) and or (ii) and		
6	november		Inequalities . If , , then prove that Arithmetic-Geometric mean inequality (with proof). . Bernoulli's inequality (with proof		
7	december		Absolute Value and neighbourhood . Definition: Absolute value of a real number Theorem: (a) for all (b) for all (c) If , then if and only if (d) for all Theorem (Triangle inequality):If , then .		
8	january		. Corollary:If , then (i) (ii) Corollary: If are any real numbers then Examples on inequalities Definition:· - Neighbourhood. . Theorem:Let . If belongs to thebourhood for every then . Completeness property of		
9	february		. Definitions: Lower bound, Upper bound of a subset of , Bounded set, Supremum (least upper bound), Infimum (greatest lower bound). . The completeness property of (The supremum property) Applications of the supremum property. . Theorem: (Archimedean Property) If , then there exists such that .		
10	march		. Corollary: If , then inf .. Corollary: If , then there exists such that . Corollary: If , then there exists su that		

			. Theorem: There exists a positive real number such that . Theorem: (The Density theorem)If and are any real numbers with , then there exists a rational number such that . Corollary: If and are real numbers with , then there existsan irrational number such that . Intervals . Characterization theorem: If is a subset of that contains at least two points and has the property then is an interval. Intervals		

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Annual Teaching Plan 2020-2021

Name of the Teacher : R.A.Dudhal

Designation :

Class: B.Sc. II

Semester :- IV

Department : Mathematics

Paper: VIII

Paper Title :- Real analysis II

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	March	Sequence	Sequence of real numbers Sequence and subsequence Definition and examples. Limit of sequence and examples using definition. Theorem: If is sequence of non-negative real numbers and if lim then L 0. Convergent sequences and examples. Theorem: If the sequence of real numbers is convergent to L, then can not converge to limit distinct from L. Theorem (without proof) : If the sequence of real numbers is convergent to L, then any subsequence of is also convergent to L. Theorem (without proof): All subsequences of a convergent sequence of real numbers converge to the same limit. Bounded sequences and examples. Theorem: If the sequence of real numbers is convergent, then it is	

			bounded. Monotone Sequences Definition and examples. Theorem: A non-decreasing sequence which is bounded above is convergent.	
2	April	Therorem on Sequences	Theorem: A non-increasing sequence which is bounded below is convergent. Corollary: The sequence Error! Objects cannot be created from editing field codes.{$(1 + 1/n)_n$} is convergent. Theorem (without proof): A non-decreasing sequence which is not bounded above diverges to infinity. Theorem (without proof): A non-increasing sequence which is not bounded below diverges to minus infinity. Theorem : Abounded sequence of real numbers has convergent subsequence.	
3	May	Limit of Sequence	Limit Superior and Limit Inferior of Sequences Definition and examples. Theorem: The Cauchy Sequence Definition and examples Theorem: If the sequence of real numbers converges, then is Cauchy sequence. Infinite Series Convergent and Divergent Series Definition: Infinite series, convergent and divergent series, sequence of partial sum of series and examples. A necessary condition for convergence Cauchy's General Principal of Convergence (statement only). Theorem: A series $_n$ converges iff for every > 0 there exists a positive number m such that $\|u_{n+1} + u_{n+2} + +$	

			u_{n+p}| < , for every all n m and p 1. Positive Term Series Definition and examples.Theorem: A positive term series converges iff its sequence of partial sums is bounded above. Geometric Series: The positive term geometric series Error! Objects cannot be created from editing field codes.$_n$, converges for r <1, and diverges to infinity for 1.	
4	June	theorem	Theorem: A positive term series Error! Objects cannot be created from editing field codes.$_p$ is convergent if and only if p > 1. Comparison Tests For Positive Term Series Comparison Test (First Type)): If $_n$ and $_n$ are two positive term series, and k 0, a fixed positive real number (independent of n) and there exists a positive integer m such that u_n kv_n, for every n m,then (a) $_n$ is convergent , if $_n$ is convergent, and (b) $_n$ is divergent, if $_n$ is divergent. Examples. Limit Form: If $_n$ and $_n$ are two positive term series Examples. Cauchy's Root Test: If $_n$ is a positive term series such that lim $(u_n)_{1/n}$ = L, then the series (i) converges, if L < 1, (ii) diverges, if L > 1, and (iii) the test fails to give any definite information, if L= 1. Examples. D'Alembert's Ratio Test: If $_n$ is a positive term series, such that lim (u_{n+1} / u_n) = L, then the Series (i) converges, if L < 1. (ii) diverges, if L > 1, and	

			(iii) the test fails, if L = 1. Examples. Raabe's Test: If n is a positive term series such that Lim n{ (u_n / u_{n+1}) – 1 } = L, then the series (i) converges, if L >1. (ii) diverges, if L < 1, and (iii) the test fails, if L = 1.	
5	July	Aliternatinf series	Alternating Series Definition and examples. Leinitz Test: If the alternating series $u_1 - u_2 + u_3 - u_4 +$ ($u_n > 0$, for every n) is such that (i) u_{n+1} u_n, for every n and (ii) lim $u_n = 0$, then the series converges. Examples. Absolute and Conditional Convergence Definition and examples . Theorem: Every absolutely convergent series is convergent. Examples. Recommended Books: 1. R.R.Goldberg, Methods of Real Analysis, Oxford & IBH	

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Annual Teaching Plan : 2020-2021

Name of the Teacher : Dudhal .R. D

Designation :

Class: B.Sc. I

Semester :- I

Department : Mathematics

Paper: I & II

Paper Title :- Differential calculus & calculus

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	july	Introduction--	Intraduction - Hyperbolic Functions De- Moivre's Theorem. Examples. Applications of De- Moivre's Theorem , nth roots of unity Hyperbolic functions. Properties of hyperbolic function Differentiation of hyperbolic functions Inverse hyperbolic functions and their derivatives. Examples Relations between hyperbolic and circular functions. Representation of curves in Parametric and Polar co-ordinate Properties of hyperbolic function Differentiation of hyperbolic functions Inverse hyperbolic functions and their derivatives. Examples Relations between hyperbolic an circular functions. Representation of curves in Parametric and Polar co-ordinate	

2	August	Successive Differentiation	Successive Differentiation n_{th} order derivative of standard functions: $(ax+b)_m$, e_{ax}, a_{mx}, $1/(ax+b)$, $\sin(ax+b)$, $e_{ax}\cos(ax+b)$, $e_{ax}\sin(ax+b)$, $\cos(ax+b)$. Leibnitz's Theorem (with proof). Partial differentiation, Chain rule (without proof) and its examples2.4 Euler's theorem on homogenous functions. Maxima and Minima for functions of two variables. Lagrange's Method of undetermined multipliers. Mean Value Theorems and Indeterminate Forms Rolle's Theorem Geometrical interpretation of Rolle's Theorem. Examples on Rolle's Theorem Lagrange's Mean Value Theorem (LMVT) Geometrical interpretation of LMVT. Examples on LMVT. Cauchy's Mean Value Theorem (CMVT) Examples on CMVT19	
3	September		Taylor's Theorem with Lagrange's and Cauchy's form of remainder (without proof) Maclarin's Theorem with Lagrange's and Cauchy's form of remainder (without proof) Maclarin's series for sin x, cos x, e_x, log (1+x), $(1+x)_m$. Examples on Maclarin's series Indeterminate Forms L'Hospital Rule, the form , , and Examples. L'Hospital Rule, Indeterminate Forms L'Hospital Rule, the form , , and Examples. L'Hospital Rule, the form $0 \times \infty$, $\infty - \infty$. and Examples the form $0 \times \infty$, $\infty - \infty$. and Examples - Limits and Continuity	10

			of Real Valued Functions	
4	octomber		∈ - δ definition of limit of function of one variable, Left hand side limits and Right hand side limits . Theorems on Limits (Statements Only) \ Continuous Functions and Their Properties If f and g are two real valued functions of a real variable which are continuous at x = c then (i) f + g (ii) f – g (iii) f.g are continuous at x = c. and (iv) f/g is continuous at x = c , g(c) ≠ 0. Composite function of two continuous functions is continuous. Classification of discontinuities (First and second kind).Types of Discontinuities :(i) Removable discontinuity(ii) Jump discontinuity of first kind (iii) Jump discontinuity of second kind Differentiability at a point, Left hand derivative, Right hand derivative, Differentiability in the interval [a,b].	
5	November		Theorem: Continuity is necessary but not a sufficient condition for the existence of a derivative. If a function f is continuous in a closed interval [a, b] then it is bounded in [a, b]. . If a function f is continuous in a closed interval [a, b] then it attains its bounds at least once in [a, b]. If a function f is continuous in a closed interval [a, b] and if f(a), f(b) are of opposite signs then there exists c □ [a, b] such that f(c) = 0. (Statement Only) . If a function f is continuous in aclosed interval [a, b] and if f(a) ≠ f(b) then f	

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Annual Teaching Plan : 2020-2021

Name of the Teacher : Dudhal .R. A

Designation :

Class: B.Sc. I

Semester :- II

Department : Mathematics

Paper: III & IV

Paper Title :- Differential equation & Higher order Differetial equation , partial differential equation

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	April	Differential equation and first order	**Differential Equations of First Order** Differential Equations of First Order and First Degree. Exact Differential Equations. : Necessary and Sufficient condition for exactess. Working Rule for solving an Exact Differential Equation. Integrating Factor. Integrating Factor by Inspection and examples. : Integrating Factor by using Rules (Without Proof) and Examples. Linear Differential Equations: Definition, Method of Solution and examples. Bernoulli's Equation: Definition, Method of Solution and Examples. Differential Equations of First Order but Not of First Degree: Introduction. Equations solvable for p: Method and Problems. Equations solvable for x: Method and Problems. Equations solvable for y: Method and Problems. Clairaut's Form: Method and	

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2	May	Linear Differential Equation	**Linear Differential Equations** Linear Differential Equations with Constant Cofficients Introduction and General Solution. Determination of Complementary Function The Symbolic Function 1/f(D):Definition. Determination of Particular Integral. General Method of Particular IntegraShort Methods of Finding P.I. when X is in the form , sin ax , cos ax , (m being a positive integer), V , x V where V is a function of x. Examples. Homogeneous Linear Differential Equations (The Cauchy-Euler Equations) Introduction and Method of Solution. Legendre's Linear Equations. Method of Solution of Legendre's Linear Equations. Examples.	
3	June	Second order partial differential equation	**Second Order Linear Differential Equations and Simultaneous Differential Equations** Second Order Linear Differential Equations The General Form. Complete Solution when one Integral is known: Method and Examples. Transformation of the Equation by changing the dependent variable (Removal of First order Derivative). Transformation of the Equation by changing the independent variable. Method of Variation of Parameters. Examples. Ordinary Simultaneous Differential Equations and Total Differential	10

			Equations .	
4	July	Linear Diifferential Equation	Methods of Solving Simultaneous Linear Differential Equations Total differential equations Pdx + Qdy + Rdz = 0 Neccessary condition for Integrability of total differential equation The condition for exactness. Methods of solving total differential equations a) Method of Inspection b) One variable regarding as a constant Geometrical Interpretation of Ordinary Simultaneous Differential Equations Geometrical Interpretation of Total Differential Equations Geometrical Relation between Total Differential equations and Simultaneous differential Equations.	
5	August	Partial Differential Equation	**Partial Differential Equations** Partial Differential Equations Introduction Order and Degree of Partial Differential Equations Linear and non-linear Partial Differential Equations Classification of first order Partial Differential Equations Formation of Partial Differential Equations by the elimination of arbitrary constants Formation of Partial Differential Equations by the elimination of arbitrary functions Ø from the equation Ø(u,v) = 0 where u and v are functions of x, y and z. Examples. First Order Partial Differential First Order Linear Partial Differential Equations Lagrange's equations Pp + Qq = R Lagrange's methods of solving Pp + Qq	

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Annual Teaching Plan : 2020-2021

Name of the Teacher : Dudhal .R. D

Designation :

Class: B.Sc. II

Semester :- III

Department : Mathematics

Paper: III &IV

Paper Title :- Real Analysis -1

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required	
1	June	Function and countable sets	:Functions and Countable sets (16hrs) Sets. Revision of basic notions in sets. Operations on sets:-Union, Intersection, Complement, Relative complement, Cartesian product of sets, Relation. Functions Definitions: Function, Domain, Co-domain, Range, Graph of a function, Direct image and Inverse image of a subset under a function. Examples of direct image and inverse image of a subset		
2	july	Types of functions	Definitions: Injective, Surjective and Bijective functions Inverse function Proposition: If is injective and , then . Proposition: If is surjective and , then . Definition: Composite function, Restriction and Extension of a function. Theorem: Let and be functions and let be a subset of . Then . . Theorem: Composition of two bijective functions is a bijective function. Examples. Mathematical Induction		

			Principle of Mathematical Induction (without proof), Well ordering property of natural numbers Principle of Mathematical Induction (second version: Statement only), Principle of strong induction (Statement only). Examples based on 1.3.1 and 1.3.2		
3	august	Countable sets	Countable Sets Definitions: Denumerable sets, Countable sets, uncountable sets. Examples of denumerable sets: Set of Natural numbers, Set of Integers, Set of even natural numbers and odd natural numbers. Proposition: Union of two disjoint denumerable sets is denumerable. Theorem: If is a countable set for each , then the union is countable. (Countable union of countable sets is countable) . Theorem:The set of Rational numbers is denumerable. . Theorem: Any subset of countable set is countable. . Theorem: The closed interval is uncountable. Corollary: The set of all real numbers is uncountable. Examples		
4	september	Algebric and order properties	:The Real numbers Algebraic and Order Properties of . . Algebraic properties of real numbers. Theorem:Let . (a) If and , then (b) If , then (c) If and , then . If and , then		
5	octomber	THereoms	Theorem: (a) If and , then . (b) (c) If , then . Theorem: If is such that for every then .		

			Theorem: If , then either (i) and or (ii) and Corollary: If , then either (i) and or (ii) and		
6	november		Inequalities . If , , then prove that Arithmetic-Geometric mean inequality (with proof). . Bernoulli's inequality (with proof		
7	december		Absolute Value and neighbourhood . Definition: Absolute value of a real number Theorem: (a) for all (b) for all (c) If , then if and only if (d) for all Theorem (Triangle inequality):If , then .		
8	january		. Corollary:If , then (i) (ii) Corollary: If are any real numbers then Examples on inequalities Definition:· - Neighbourhood. . Theorem:Let . If belongs to thebourhood for every then . Completeness property of		
9	february		. Definitions: Lower bound, Upper bound of a subset of , Bounded set, Supremum (least upper bound), Infimum (greatest lower bound). . The completeness property of (The supremum property) Applications of the supremum property. . Theorem: (Archimedean Property) If , then there exists such that .		
10	march		. Corollary: If , then inf .. Corollary: If , then there exists such that . Corollary: If , then there exists su that		

			. Theorem: There exists a positive real number such that . Theorem: (The Density theorem)If and are any real numbers with , then there exists a rational number such that . Corollary: If and are real numbers with , then there existsan irrational number such that . Intervals . Characterization theorem: If is a subset of that contains at least two points and has the property then is an interval. Intervals		

Head
Department of Mathematics
P.V.P. Mahavidyalaya,
Kavathe Mahankal, Dist.-Sangli.

P.V.P. Mahavidyalaya, Kavathe Mahankal

Annual Teaching Plan 2020-2021

Name of the Teacher : R.A.Dudhal

Designation :

Class: B.Sc. II

Semester :- IV

Department : Mathematics

Paper: VIII

Paper Title :- Real analysis II

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	March	Sequence	Sequence of real numbers Sequence and subsequence Definition and examples. Limit of sequence and examples using definition. Theorem: If is sequence of non-negative real numbers and if lim then L 0. Convergent sequences and examples. Theorem: If the sequence of real numbers is convergent to L, then can not converge to limit distinct from L. Theorem (without proof) : If the sequence of real numbers is convergent to L, then any subsequence of is also convergent to L. Theorem (without proof): All subsequences of a convergent sequence of real numbers converge to the same limit. Bounded sequences and examples. Theorem: If the sequence of real numbers is convergent, then it is	

			bounded. Monotone Sequences Definition and examples. Theorem: A non-decreasing sequence which is bounded above is convergent.	
2	April	Therorem on Sequences	Theorem: A non-increasing sequence which is bounded below is convergent. Corollary: The sequence Error! Objects cannot be created from editing field codes.{(1 + 1/n)$_n$} is convergent. Theorem (without proof): A non-decreasing sequence which is not bounded above diverges to infinity. Theorem (without proof): A non-increasing sequence which is not bounded below diverges to minus infinity. Theorem : Abounded sequence of real numbers has convergent subsequence.	
3	May	Limit of Sequence	Limit Superior and Limit Inferior of Sequences Definition and examples. Theorem: The Cauchy Sequence Definition and examples Theorem: If the sequence of real numbers converges, then is Cauchy sequence. Infinite Series Convergent and Divergent Series Definition: Infinite series, convergent and divergent series, sequence of partial sum of series and examples. A necessary condition for convergence Cauchy's General Principal of Convergence (statement only). Theorem: A series $_n$ converges iff for every > 0 there exists a positive number m such that $\|u_{n+1} + u_{n+2} + +$	

			u_{n+p}| < , for every all n m and p 1. Positive Term Series Definition and examples.Theorem: A positive term series converges iff its sequence of partial sums is bounded above. Geometric Series: The positive term geometric series Error! Objects cannot be created from editing field codes.$_n$. converges for r <1, and diverges to infinity for 1.	
4	June	theorem	Theorem: A positive term series Error! Objects cannot be created from editing field codes.$_p$ is convergent if and only if p > 1. Comparison Tests For Positive Term Series Comparison Test (First Type)): If $_n$ and $_n$ are two positive term series, and k 0, a fixed positive real number (independent of n) and there exists a positive integer m such that u_n kv_n, for every n m,then (a) $_n$ is convergent , if $_n$ is convergent, and (b) $_n$ is divergent, if $_n$ is divergent. Examples. Limit Form: If $_n$ and $_n$ are two positive term series Examples. Cauchy's Root Test: If $_n$ is a positive term series such that lim $(u_n)_{1/n}$ = L, then the series (i) converges, if L < 1, (ii) diverges, if L > 1, and (iii) the test fails to give any definite information, if L= 1. Examples. D'Alembert's Ratio Test: If $_n$ is a positive term series, such that lim $(u_{n+1}$ / u_n) = L, then the Series (i) converges, if L < 1. (ii) diverges, if L > 1, and	

			(iii) the test fails, if L = 1. Examples. Raabe's Test: If $_n$ is a positive term series such that Lim n{ (u_n / u_{n+1}) – 1 } = L, then the series (i) converges, if L >1. (ii) diverges, if L < 1, and (iii) the test fails, if L = 1.	
5	July	Aliternatinf series	Alternating Series Definition and examples. Leinitz Test: If the alternating series $u_1 - u_2 + u_3 - u_4 +$ ($u_n > 0$, for every n) is such that (i) u_{n+1} u_n, for every n and (ii) lim $u_n = 0$, then the series converges. Examples. Absolute and Conditional Convergence Definition and examples . Theorem: Every absolutely convergent series is convergent. Examples. Recommended Books: 1. R.R.Goldberg, Methods of Real Analysis, Oxford & IBH	

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Department of Mathematics
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Shikshan Prasarak Sanstha's

Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2021-2022

Name of the Teacher : Dudhal R. D. Designation : Asso-Professor

Class: B.Sc. I Semester :- I

Department : Mathematics Paper: I & II

Paper Title :- Differential calculus & calculus

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	June	Introduction--	Intraduction - Hyperbolic Functions De- Moivre's Theorem. Examples. Applications of De- Moivre's Theorem , nth roots of unity Hyperbolic functions. Properties of hyperbolic function Differentiation of hyperbolic functions Inverse hyperbolic functions and their derivatives. Examples	
2	July		Relations between hyperbolic and circular functions. Representation of curves in Parametric and Polar co-ordinate Properties of hyperbolic function Differentiation of hyperbolic functions Inverse hyperbolic functions and their derivatives. Examples Relations between hyperbolic an circular functions. Representation of curves in Parametric and Polar co-ordinate	

			L'Hospital Rule, Indeterminate Forms L'Hospital Rule, the form , , and Examples. L'Hospital Rule, the form $0 \times \infty$, $\infty - \infty$. and Examples the form $0 \times \infty$, $\infty - \infty$. and Examples - Limits and Continuity	
6	November		Theorems on Limits (Statem$\in$ - δ definition of limit of function of one variable, Left hand side limits and Right hand side limits .	
7	December		Continuous Functions and Their Properties If f and g are two real valued functions of a real variable which are continuous at x = c then (i) f + g (ii) f – g (iii) f.g are continuous at x = c. and (iv) f/g is continuous at x = c , g(c) $\neq$ 0. Composite function of two continuous functions is continuous. Classification of discontinuities (First and second kind).Types of Discontinuities :(i) Removable discontinuity(ii) Jump discontinuity of first kind (iii) Jump discontinuity of second kind Differentiability at a point, Left hand derivative, Right hand derivative, Differentiability in the interval [a,b].	
8	January		Theorem: Continuity is necessary but not a sufficient condition for the existence of a derivative. If a function f is continuous in a closed interval [a, b] then it is bounded in [a, b]. . If a function f is continuous in a closed interval [a, b] then it attains its bounds at least once in [a, b]. If a function f is continuous in a closed interval [a, b] and if f(a), f(b) are of opposite signs then there exists c □ [a, b] such that f(c) = 0. (Statement Only)	

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Shikshan Prasarak Sanstha's

Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2020-2021

Name of the Teacher : M.N. Waghmode | Designation :

Class: B.Sc. I | Semester :- I

Department : Mathematics | Paper: I

Paper Title :- Differential Calculus (Online)

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	November	Introduction--	**Introduction and syllabus discussion**	02
2	December	Hyperbolic function	**Unit 1 Hyperbolic Functions** De- Moivre's Theorem. Examples. Applications of De- Moivre's Theorem , nth roots of unity Hyperbolic functions. Properties of hyperbolic functions.	08
3	January	Hyperbolic function	Differentiation of hyperbolic functions Inverse hyperbolic functions and their derivatives. Examples Relations between hyperbolic and circular functions. Representation of curves in Parametersand Polar co-ordinates	08
4	February	Higher order derivatives	**Unit 2 Higher Order Derivatives** Successive Differentiation nth order derivative of standard functions: $(ax+b)^m$, e^{ax}, a^{mx}, $1/(ax+b)$, $\sin(ax+b)$, $\cos(ax+b)$, $e^{ax}\sin(ax+b)$, $e^{ax}\cos(ax+b)$. Leibnitz's Theorem	10

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Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2022-2023

Name of the Teacher : Prof. R.A.Dudhal

Designation : Asso-professer

Class: B.Sc. I

Semester :- II

Department : Mathematics

Paper: IV

Paper Title :- Basic Algebra

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	February	Introduction Functions, divisibility and congruence	1.1 Set, Relations on sets, type of relations, equivalence relations, Equivalence classes and partitions of a set. 1.2 Functions: One-one, onto functions and bijections, composition of functions (Definitions and examples).	06
2	March		1.3 The induction principle and strong induction principle. 1.4 Divisibility and congruence: 1.4.1 The division algorithm: Theorem and its applications. 1.4.2 Definitions of Greatest common divisor least common multiple. 1.4.3 Euclidean Algorithm. 1.4.4 Fundamental Theorem of Arithmetic. 1.4.5 The theory of Congruence: Basic Properties of congruence.	14

Shikshan Prasarak Sanstha's

Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2022-2023

Annual Teaching Plan : 2022-2023

Name of the Teacher : Prof. R.A.Dudhal

Designation : Asso-professer

Class: B.Sc. I

Semester :- I

Department : Mathematics

Paper: I

Paper Title :- Calculus

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	October	Introduction— Limit, Continuity and Differentiability	**Introduction and syllabus discussion** 1.1 Limits: $\varepsilon - \delta$ definition, infinite limit ($\to \infty$ as $x \to c$), limit at infinity ($f \to l$ as $x \to \infty$ and $f \to \infty$ as $x \to \infty$) . 1.2 Left hand and Right hand limits: definition and examples. 1.3 Properties of limits: Theorem: If f and g are two functions defined on some neighbourhood of c such that $\lim x \to c\ f(x) = l$, $\lim x \to c\ g(x) = m$ then (i) $\lim x \to c\ (f + g)(x) = l + m$ (ii) $\lim x \to c\ (f - g)(x) = l - m$ (iii) $\lim x \to c\ (f \cdot g)(x) = lm$ (iv) $\lim x \to c\ (f/g)(x) = l/m\ if\ m \neq 0$ (without proof) 1.4 Evaluation of limit: Examples (using techniques like factorization, rationalization, Left hand and Right hand limits etc.).	06
2	November		1.5 Continuous functions: definition of Continuity at a point, definition of continuity in an interval. 1.6 Properties of continuous functions: 1.6.1 Theorem: Let f and g be two	16

			simple examples 1.10 Theorem: A function which is uniformly continuous on an interval is continuous on that interval. 1.11 Differentiability at a point and Differentiability in an interval: definitions. 1.12 Examples on 1.11 1.13 (Differentiability and continuity) Theorem: A function which is derivable at a point is necessarily continuous at that point	
3	December	Mean Value Theorems, Successive Differentiation, Expansions of functions	2.1 Mean Value Theorems 2.1.1 Rolle's Mean Value Theorem, Geometrical interpretation. 2.1.2 Lagrange's Mean Value Theorem, Geometrical interpretation. 2.1.3 Cauchy's Mean Value Theorem. 2.1.4 Examples on 2.1.1, 2.1.2, 2.1.3. 2.2 Successive Differentiation 2.2.1 Higher order derivatives: notations. 2.2.2 Calculation of nth derivative: Standard results $(ax+b)m$, $1/(ax+b)$, $\log(ax+b)$, $a\ mx$, $e\ mx$, $\sin(ax+b)$, $\cos(ax+b)$, $e\ ax\ \sin(bx+c)$, $e\ ax\ \cos(bx+c)$. 2.2.3	12
4	January		Determination of nth derivative: examples. 2.2.4 Leibnitz's Theorem. 2.2.5 Examples on 2.2.4. 2.3 Expansion of functions 2.3.1 Maclaurin's theorem (Statement only), examples using Maclaurin's theorem. 2.3.2 Taylor's theorems (Statement only), examples using Taylor's theorem.	06

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Shikshan Prasarak Sanstha's

Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2022-2023

Name of the Teacher : Prof. R.A.Dudhal

Designation : Asso-professer

Class: B.Sc. I

Semester :- I

Department : Mathematics

Paper: II

Paper Title :- Differential Equation

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	October	Introduction Ordinary differential equations of first order and first degree	Definition, Order and Degree, Exact differential equations, Necessary and sufficient condition for exactness, Differential equations reducible to exact, Integrating factors with rules	06
2	November		Linear differential equations, Differential equations reducible to linear differential equation, Bernoulli's differential equations. Orthogonal trajectories, orthogonal trajectories to Cartesian and polar curves. Differential equations of first order but not of first degree: Equations that can be factorized, Equations solvable for p, Equations that cannot be factorized, Equations solvable for x, Equations solvable for y and Clairaut's form.	12

Shikshan Prasarak Sanstha's

Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2022-2023

Name of the Teacher : Prof. R.A.Dudhal **Designation : Asso-professer**

Class: B.Sc. I **Semester :- I**

Department : Mathematics **Paper: II**

Paper Title :- Differential Equation

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	October	Introduction Ordinary differential equations of first order and first degree	Definition, Order and Degree, Exact differential equations, Necessary and sufficient condition for exactness, Differential equations reducible to exact, Integrating factors with rules	06
2	November		Linear differential equations, Differential equations reducible to linear differential equation, Bernoulli's differential equations. Orthogonal trajectories, orthogonal trajectories to Cartesian and polar curves. Differential equations of first order but not of first degree: Equations that can be factorized, Equations solvable for p, Equations that cannot be factorized, Equations solvable for x, Equations solvable for y and Clairaut's form.	12

Shikshan Prasarak Sanstha's

Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2022-2023

Name of the Teacher : Prof. R.A.Dudhal

Designation : Asso-professer

Class: B.Sc. I

Semester :- II

Department : Mathematics

Paper: III

Paper Title :- Multivariable Calculus

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	February	Introduction : Partial differentiation	Functions of two variables: domain, Neighbourhood of a point, Continuity of functions of two variables (at a point), Limit of functions of two variables, Partial derivatives: first order partial derivatives, partial derivatives of higher order, Geometrical interpretation of partial derivatives, examples	06
2	March		Homogeneous functions: definition, Euler's theorem on homogeneous functions (Case of two and three variables), examples using Euler's theorem. Total Differentials, Differentiation of composite functions, examples, Implicit function: first and second order derivative of implicit functions and its examples. Taylor's theorem for a function of two variables, its examples.	12

Shikshan Prasarak Sanstha's

Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2022-2023

Name of the Teacher : Prof. R.A.Dudhal

Designation : Asso-professer

Class: B.Sc. II

Semester :- IV

Department : Mathematics

Paper: VIII

Paper Title :- Algebra II

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	February	Groups	1.1 Lagrange's theorem and its Consequences 1.1.1 Definitionof Index of a subgroup 1.1.2 Theorem(Lagrange): If G is any finite group and H is any subgroup of G, then O(H) divides O(G). 1.1.3 Corollary: The index of any subgroup of a finite group is a divisor of the order of the group. 1.1.4 Corollary: If G is a finite group and a G, then O(a) divides O(G). 1.1.5 Corollary: If G is a finite group of order n then for all a G, an = e, where e is the identity element of G. 1.1.6 Theorem(Euler's theorem): If n is any positive integer and a is relatively prime to n, then 1(mod n) 1.1.7 Theorem(Fermat's theorem): If a is any integer and p is any positive prime, then ap a(mod p	08
2	March		1.2 Normal subgroups and its Properties 1.2.1 Definition of Normal subgroup and examples 1.2.2 Theorem: A subgroup H of a group G is normal if and only if gHg- 1 = H for all g G. 1.2.3 Theorem: A subgroup H of a group G is normal if and only if every right coset of H in G is a left coset of H in G. 1.2.4	12

			group G into a group G', then the range f(G) = {f(g) | for all g G} is a subgroup of G'. 1.4.4 Theorem: The homomorphic image of the group G in the group G' is a subgroup of G'. 1.4.5 Theorem: Let f : G G' be a homomorphism from the group G into the group G' and H is a subgroup of G, then f(H) is also a subgroup of G'. 1.4.6 Theorem:Let f : G G be a homomorphism of the group G into itself and H is a cyclic subgroup of G, then f(H) is again a cyclic subgroup of G	
3	April	Normal subgroups	2.1. Kernel of a Homomorphism 2.1.1. Definitionof Kernel of a Homomorphism and examples. 2.1.2. Theorem: Let f : G G' be a homomorphism of a group G into G' with Kernel K. Then K is a normal subgroup of G. 2.1.3. Theorem: Let f : G G' be a homomorphism of a group G into G' with Kernel K. Then f is one – one if and only if K = {e}, where e is the identity element of G. 2.1.4. Corollary: A homomorphism f from the group G onto the group G' is an isomorphism if and only if Ker f = {e}. 2.1.5. Theorem: Let G be a group and H be a normal subgroup of G. Then G/H is a homomorphic image of G with H as its Kernel. 2.1.6. Theorem(Fundamental Homomorphism Theorem): Let f be a homomorphism of a group G into a group G', with kernel K. Then f(G) is isomorphic to factor group G/K. 2.1.7. Results related to Isomorphism (i) If f : G G' be an isomorphism of a group G onto a group G' and a is any element of G then the order of f(a) equals the order of a. (ii) If f : G G' be an isomorphism and G is an abelian group then G' is also abelian. (iii) Any infinite cyclic group is isomorphic to the group Z of integers, under addition. (iv) Any finite cyclic group of order n is isomorphic to additive group of integers modulo n.	12

Shikshan Prasarak Sanstha's

Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2022-2023

Name of the Teacher : Prof. R.A.Dudhal

Designation : Asso-professer

Class: B.Sc. II

Semester :- III

Department : Mathematics

Paper: VI

Paper Title :- Algebra - I

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	October	Matrices and Relations	1.5. Definitions: Hermitian and Skew Hermitian matrices. 1.6. Properties of Hermitian and Skew Hermitian matrices. 1.7. Rank of a matrix, Row-echelon form and reduced row echelon form. 1.8. System of linear homogeneous equations and linear non-homogeneous equations. 1.8.1.Condition for consistency 1.8.2.Nature of the general solution 1.8.3.Gaussian elimination and Gauss Jordon method (Using row-echelon form and reduced row echelon form). 1.8.4.Examples on 1.4.1 and 1.4.3 1.9. The characteristic equation of a matrix, Eigen values, Eigen vectors of a matrix.	06
2	November		1.10. Cayley Hamilton theorem 1.11. Applications of Cayley Hamilton theorem (Examples). 1.12. Relations: Definition, Types of relations, Equivalence relation, Partial ordering relation 1.13. Examples of equivalence relations and Partial ordering relations. 1.14. Digraphs of relations, matrix representation. 1.15. Composition of	10

4	January		2.4. Cyclic Groups and its Properties 2.4.1. Definition of Cyclic group generated by an element, Cyclic subgroup of a group and examples 2.4.2.Theorem: If G is a group and a G is a fixed element of G, then the set H = { an | n Z } is a subgroup of G. 2.4.3. Definition of Order of an element of a group and its properties. 2.4.4. Theorem: Every cyclic group is abelian. 2.4.5. Theorem: If a is a generator of a cyclic group G, so is a- 1 . 2.4.6. Theorem: If a is a generator of a cyclic group G, then O(a) = O(G). 2.4.7. Theorem: If G is a finite group of order n containing an element of order n, then G is cyclic. 2.4.8. Theorem: If in a cyclic group of order k, am = an (m n), then m n(mod k). 2.4.9. Theorem: Every subgroup of a cyclic group is cyclic. 2.4.10. Theorem: A cyclic group of order d has (d) generators. 2.5. Cosets 2.5.1. Definition of Left and Right Cosets in group G and examples 2.5.2. Theorem: If H is a subgroup of G, then (i) Ha = H if and only if a H (ii) Ha = Hb if and only if ab- 1 H (iii) Ha is a subgroup of G if and only if a H 2.5.3. Theorem: If H is a subgroup of G, then for all a G Ha = {x G | x a mod H}. 2.5.4.Theorem: If H is a subgroup of G then there exists a one to one correspondence between any two right (left) cosets of H in G.	06

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Shikshan Prasarak Sanstha's

Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2022-2023

Name of the Teacher : Prof. R.A.Dudhal

Designation : Asso-professer

Class: B.Sc. II

Semester :- III

Department : Mathematics

Paper: V

Paper Title :- Real Analysis - I

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	October	Introduction— Functions and Countable sets	1.1. Sets. 1.1.1. Revision of basic notions in sets. 1.1.21.2. Functions 1.2.1. Definitions: Function, Domain, Co-domain, Range, Graph of a function, Direct image and Inverse image of a subset under a function. Examples of direct image and inverse image of a subset. 1.2.2. Theorem: If andif , ,then 1.2.3. Theorem: If andif , ,then 1.2.4. Theorem: If andif , ,then 1.2.5. Theorem: If andif , ,then 1.2.6. Definitions: Injective, Surjective and Bijective functions (1-1 correspondance) Inverse function. 1.2.7. Proposition: If is injective and , then . 1.2.8. Proposition: If is surjective and , then . 1.2.9. Definition: Composite function, Restriction and Extension of a function. 1.2.10. Theorem: Let and be functions and let be a subset of . Then . 1.2.11. Theorem: Composition of two bijective functions is a bijective function. 1.2.12. Examples. Operations on sets:-Union, Intersection, Complement, Relative complement, Cartesian product of sets, Relation.	08

			then (i) (ii) 2.3.5. Corollary: If are any real numbers then 2.3.6. Examples on inequalities 2.3.7. Definition:ε - Neighbourhood. 2.3.8. Theorem:Let . If belongs to the neighbourhood for every then . 2.4. Completeness property of 2.4.1. Definitions: Lower bound, Upper bound of a subset of , Bounded set, Supremum (least upper bound), Infimum (greatest lower bound). 2.4.2. The completeness property of (The supremum property) 2.4.3. Applications of the supremum property. 2.4.4. Theorem: (Archimedean Property) If , then there exists such that .	
4	January		2.4.5. Corollary: If , then inf . 2.4.6. Corollary: If , then there exists such that . 2.4.7. Corollary: If , then there exists such that . 2.4.8. Theorem: There exists a positive real number such that . 2.4.9. Theorem: (The Density theorem)If and are any real numbers with , then there exists a rational number such that . 2.4.10. Corollary: If and are real numbers with , then there existsan irrational number such that . 2.5. Intervals 2.5.1. Characterization theorem: If is a subset of that contains at least two points and has the property then is an interval.	06

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Shikshan Prasarak Sanstha's

Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2022-2023

Name of the Teacher : Prof. R.A.Dudhal **Designation : Asso-professer**

Class: B.Sc. II **Semester :- IV**

Department : Mathematics **Paper: VII**

Paper Title :- Real Analysis - II

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	February	Sequence of real numbers	1.1 Sequence and subsequence 1.1.1 Definition and examples. 1.1.2 Limit of sequence and examples using definition. 1.1.3 Theorem: If is sequence of non-negative real numbers and if lim then L 0. 1.1.4 Convergent sequences and examples. 1.1.5 Theorem: If the sequence of real numbers is convergent to L, then can not converge to limit distinct from L. 1.1.6 Theorem (without proof) : If the sequence of real numbers is convergent to L, then any subsequence of is also convergent to L. 1.1.7 Theorem (without proof): All subsequences of a convergent sequence of real numbers converge to the same limit. 1.1.8 Bounded sequences and examples. 1.1.9 Theorem: If the sequence of real numbers is convergent, then it is bounded. 1.2 Monotone Sequences 1.2.1 Definition and examples. 1.2.2 Theorem: A non-decreasing sequence which is bounded above is convergent. 1.2.3 Theorem: A non-increasing sequence which is bounded below is convergent. 1.2.4 Corollary: The	10

			numbers then is bounded. 1.5.4 Theorem: If is the Cauchy sequence of real numbers then is convergent. 1.5.5 Definition and examples of (C , 1) summability of sequence.	
3	April	Infinite Series	2.1 Convergent and Divergent Series 2.1.1 Definition: Infinite series, convergent and divergent series, sequence of partial sum of series and examples. 2.1.2 A necessary condition for convergence: A necessary condition for convergence of an infinite series n is that lim un= 0. 2.1.3 Cauchy's General Principal of Convergence (statement only). 2.1.3 Theorem: A series n converges iff for every > 0 there exists a positive number m such that |un+1 + un+2 + + un+p| < , for every all n m and p 1. 2.2 Positive Term Series 2.2.1 Definition and examples. 2.2.2 Theorem: A positive term series converges iff its sequence of partial sums is bounded above. 2.2.3 Geometric Series: The positive term geometric series Error! Objects cannot be created from editing field codes.n , converges for r 1. 2.3 Comparison Tests For Positive Term Series 2.3.1 Comparison Test (First Type)): If n and n are two positive term series, and k 0, a fixed positive real number (independent of n) and there exists a positive integer m such that un kvn, for every n m,then (a) n is convergent , If n is convergent, and (b) n is divergent, if n is divergent. 2.3.2 Examples.	10
4	May		2.3.3 Limit Form: If n and n are two positive term series such that lim (un / vn) = L, where L is a non zero finite number, then the two series converge or diverge together. 2.3.4 Comparison Test (Second Type): If nand n are two positive term series, and there exists a positive number m such that (un /un+1 (vn /vn+1) , for every n m, then (a) n is convergent, if n is convergent, and (b) n is divergent , if n is divergent. 2.3.5 Examples. 2.3.6 Cauchy's Root Test: If n is a positive term series such that lim (un) 1/n = L, then the series (i) converges, if L < 1, (ii) diverges, if L > 1, and	10

Shikshan Prasarak Sanstha's

Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2022-2023

Name of the Teacher : Prof. A. A. Bandgar **Designation :**

Class: B.Sc. III **Semester :- V**

Department : Mathematics **Paper: DSE – E10**

Paper Title :- Abstract Algebra

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	October	Introduction--	**Introduction and syllabus discussion**	04
2	November	**Groups**	Groups: Definition and examples of groups, group S3 and Dihedral group D4,Commutator subgroups and its properties, Conjugacy in group and class equation. Rings: Definition and example of Rings, Ring with unity. Zero divisor, Integral Domain, Division Ring, Field, Boolean ring, Subring, Characteristic of a ring: Nilpotent and Idempotent elements. Ideals, Sum of two ideals, Examples. Simple Ring.	12
3	December	**Rings**	Quotient Rings, Homomorphism, Kernel of Homomorphism ,Isomorphism theorems,imbedding of Ring. Maximal Ideals. Polynomial Rings, degree of Polynomial, addition and multiplication of Polynomials and their properties, UFD, Gauss' Lemma.	16

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Shikshan Prasarak Sanstha's

Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2022-2023

Name of the Teacher : Prof. A. A. Bandgar   Designation :

Class: B.Sc. III   Semester :- VI

Department : Mathematics   Paper: DSE – F11

Paper Title :- Complex Analysis

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	February	**Analytic functions and Complex Integration**	Basic algebraic and geometric properties of complex numbers, Function of complex variable, Limits, continuity and differentiation, Cauchy Riemann equations, Analytic functions and examples of analytic functions, Exponential function, Logarithmic function, Trigonometric function	06
2	March		Definite integrals of functions, Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals, Cauchy-Goursat theorem and examples, Cauchy integral formula and examples, Liouville's theorem and the fundamental theorem of algebra.	10
3	April	**Sequences, Series and Residue Calculus**	Convergence of sequences and series of complex variables, Taylor series and its examples, Laurent series and its examples, absolute and uniform convergence of power series, Isolated singular points, Residues, Cauchy's residue theorem, Residue at infinity, The three types of isolated singularities, Residues at poles and examples, Zeros of analytic functions, Zeros and poles, Application of residue theorem to	16

Shikshan Prasarak Sanstha's

Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2022-2023

Name of the Teacher : Prof. A. A. Bandgar **Designation :**

Class: B.Sc. III **Semester :- VI**

Department : Mathematics **Paper: DSE – F12**

Paper Title :- Discrete Mathematics

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	February	**Mathematical Logic**	The logic of compound statements: Statements, compound statements, truth values, logical equivalence, tautologies and contradictions, Conditional statements: Logical equivalences involving implication, negation.	06
2	March		The contrapositive of a conditional statements, converse, inverse of a conditional statements, biconditional statements.Valid and invalid arguments: Modus Ponens and modus Tollens, Additional valid argument forms, rules of inferences, contradictions and valid arguments, Number system: Addition and subtraction of Binary, decimal, quintal, octal, hexadecimal number systems and their conversions.	10
3	April	**Graphs And Trees**	Graphs :Definitions, basic properties,examples, special graphs, directed and undirected graphs, concept of degree, Trails, Paths and Circuits: connectedness, Euler circuits, Hamiltoniancircuits, Matrixrepresentation of graphs,Isomorphism	16

Shikshan Prasarak Sanstha's

Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2022-2023

Name of the Teacher : Prof. R. A. Dudhal

Designation :

Class: B.Sc. III

Semester :- V

Department : Mathematics

Paper: DSE – E12

Paper Title :- Integral Transform

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	October	**Laplace and Inverse Laplace Transform.**	**Introduction and syllabus discussion** Laplace Transform : Definitions; Piecewise continuity, Function of exponential order, Function of class A ,Existence theorem of Laplace transform. Laplace transform of standard functions.First shifting theorem and Second shifting theoremand examples,Change of scale propertyand examples, Laplace transform of derivativesand examples, Laplace transform of integralsand examples.Multiplication by power of tand examples	06
2	November		.Division by tand examples.Laplace transform of periodic functions and examples.Laplace transform of Heaviside's unit step function. Inverse Laplace Transform: Definition Standard results of inverse Laplace transform, Examples , First shifting theorem and Second shifting theoremand examples.Change of scale propertyand Inverse Laplace of derivatives, examples.The Convolution theorem and Multiplication by S, examples.Division by S,inverse Laplace by partial fractions ,examples, Solving linear. differential equations with constant	10

Shikshan Prasarak Sanstha's

Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2022-2023

Name of the Teacher : Prof. R.A. Dudhal

Designation :

Class: B.Sc. III

Semester :- VI

Department : Mathematics

Paper: DSE – F10

Paper Title :- Linear Algebra

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	February	**Vector Spaces and Linear Transformations**	**Introduction and syllabus discussion** Vector space: Subspace, Sum of subspaces, direct sum, Quotient space, Homomorphism or Linear transformation, Kernel and Range of homomorphism, Fundamental Theorem of homomorphism, Isomorphism theorems, Linear Span, Finite dimensional vector space, Linear dependence and independence, basis, dimension of vector space and subspaces.	06
2	March		Linear Transformation: Rank and nullity of a linear transformation, Sylvester's Law, Algebra of Linear Transformations , Sum and scalar multiple of Linear Transformations. The vector space of Homomorphisms, Product (composition) of Linear Transformations, Linear operator, Linear functional, Invertible and non-singular Linear Transformation, Matrix of Linear Transformations and its examples.	10

Shikshan Prasarak Sanstha's

Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2022-2023

Name of the Teacher : Prof. A. A. Bandgar | Designation :

Class: B.Sc. III | Semester :- V

Department : Mathematics | Paper: DSE – E9

Paper Title :- Mathematical Analysis

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	October	**Riemann Integration**	**Introduction and syllabus discussion** Definition of Riemann integration, Inequalities for lower and upper Darboux sums, Necessary and sufficient conditions for Riemann integrability, Definition of Riemann integration by Riemann sum and equivalence of the two definitions,	06
2	November		Riemann integrability of monotonic functions and continuous functions, Algebra and properties of Riemann integrable functions, First and second fundamental theorems of integral calculus, and the integration by parts.	10
3	December	**Improper Integrals and Fourier Series**	Improper Integrals: Definition of improper integral of first kind, Comparison test, – test for Convergence, Absolute and conditional convergence, Integral test for convergence of series, Definition of improper integral of second kind and some tests for their convergence, Cauchy principle value. Fourier Series: Definition of Fourier series and examples on the expansion of functions in Fourier series, Fourier series corresponding to even and odd functions, half range Fourier	16

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Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2022-2023

Name of the Teacher : Prof. A. A. Bandgar **Designation :**

Class: B.Sc. III **Semester :- VI**

Department : Mathematics **Paper: DSE – F9**

Paper Title :- Metric Spaces

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	February	**Limits and Continuous Functions on Metric Spaces**	Limit of a function on the real line, Metric Spaces, Limitsin Metric Spaces	06
2	March		Functions continuous at a point on the real line, Reformulation, Functions continuous on a metric space, Open Sets, Closed Sets, More about open sets.	10
3	April	**Connectedness, Completeness and Compactness**	Connected Sets, Bounded sets and totally bounded sets,Complete metric spaces, Compact metric spaces, Continuous functions on compact metric spaces.	16

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Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2022-2023

Name of the Teacher : Prof. A. A. Bandgar **Designation :**

Class: B.Sc. III **Semester :- V**

Department : Mathematics **Paper: DSE – E11**

Paper Title :- Optimization Techniques

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	October	**Network optimization models**	**Introduction and syllabus discussion** Introduction ,Formulation of Linear Programming Problems., Graphical methods for Linear Programming problems. General formulation of Linear Programming problems, Slack and surplus variables,Canonical form, Standard form of Linear Programmingproblems.	06
2	November		Transportation problem:Introduction, Mathematical formulation ,Matrix form of Transportation problem.Feasible solution, Basic feasible solution and optimal solution, Balanced and unbalanced transportation problems. Methods of Initial basic feasible solutions: North west corner rule [Stepping stone method], Lowest cost entry method [Matrix minima method], Vogel's Approximation method [Unit Cost Penalty method] ,The optimality test.[MODI method], Assignment Models :Introduction ,Mathematical formulation of assignment problem, Hungarian method for assignment problem. Unbalanced assignment problem.Travelling	10

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Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2023-2024

Name of the Teacher : Prof. R.A.Dudhal **Designation : Asso-professer**

Class: B.Sc. I **Semester :- II**

Department : Mathematics **Paper: IV**

Paper Title :- Basic Algebra

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	December	Introduction Functions, divisibility and congruence	1.1 Set, Relations on sets, type of relations, equivalence relations, Equivalence classes and partitions of a set. 1.2 Functions: One-one, onto functions and bijections, composition of functions (Definitions and examples). 1.3 The induction principle and strong induction principle. 1.4 Divisibility and congruence: 1.4.1 The division algorithm: Theorem and its applications. 1.4.2 Definitions of Greatest common divisor least common multiple.	12
2	January		1.4.3 Euclidean Algorithm. 1.4.4 Fundamental Theorem of Arithmetic. 1.4.5 The theory of Congruence: Basic Properties of congruence. 2.1 Complex numbers (Revision): Sums and Products, Basic Algebraic Properties, Moduli, complex conjugates and polar representation of complex numbers. 2.2 Theorem: De Moivre's theorem. 2.2.1 $n\,th$ roots of unity. 2.2.2 Examples	12

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Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2023-2024

Name of the Teacher : Prof. R.A.Dudhal **Designation : Asso-professer**

Class: B.Sc. I **Semester :- I**

Department : Mathematics **Paper: I**

Paper Title :- Calculus

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	July	Introduction— Limit, Continuity and Differentiability	**Introduction and syllabus discussion** 1.1 Limits: $\varepsilon-\delta$ definition, infinite limit ($\rightarrow \infty$ as $x \rightarrow c$), limit at infinity ($f \rightarrow l$ as $x \rightarrow \infty$ and $f \rightarrow \infty$ as $x \rightarrow \infty$) . 1.2 Left hand and Right hand limits: definition and examples. 1.3 Properties of limits: Theorem: If f and g are two functions defined on some neighbourhood of c such that $\lim x \rightarrow c\, f(x) = l$, $\lim x \rightarrow c\, g(x) = m$ then (i) $\lim x \rightarrow c\,(f+g)(x) = l+m$ (ii) $\lim x \rightarrow c\,(f-g)(x) = l-m$ (iii) $\lim x \rightarrow c\,(f \cdot g)(x) = lm$ (iv) $\lim x \rightarrow c\,(f/g)(x) = l/m$ $if\ m \neq 0$ (without proof) 1.4 Evaluation of limit: Examples (using techniques like factorization, rationalization, Left hand and Right hand limits etc.).	04
2	August		1.5 Continuous functions: definition of Continuity at a point, definition of continuity in an interval. 1.6 Properties of continuous functions: 1.6.1 Theorem: Let f and g be two	16

			simple examples 1.10 Theorem: A function which is uniformly continuous on an interval is continuous on that interval. 1.11 Differentiability at a point and Differentiability in an interval: definitions. 1.12 Examples on 1.11 1.13 (Differentiability and continuity) Theorem: A function which is derivable at a point is necessarily continuous at that point	
3	September	Mean Value Theorems, Successive Differentiation, Expansions of functions	2.1 Mean Value Theorems 2.1.1 Rolle's Mean Value Theorem, Geometrical interpretation. 2.1.2 Lagrange's Mean Value Theorem, Geometrical interpretation. 2.1.3 Cauchy's Mean Value Theorem. 2.1.4 Examples on 2.1.1, 2.1.2, 2.1.3. 2.2 Successive Differentiation 2.2.1 Higher order derivatives: notations. 2.2.2 Calculation of nth derivative: Standard results $(ax + b)m$, $1/(ax + b)$, $\log(ax + b)$, a mx , e mx , $\sin(ax + b)$, $\cos(ax + b)$, e ax $\sin(bx + c)$, e ax $\cos(bx + c)$. 2.2.3	14
4	October		Determination of nth derivative: examples. 2.2.4 Leibnitz's Theorem. 2.2.5 Examples on 2.2.4. 2.3 Expansion of functions 2.3.1 Maclaurin's theorem (Statement only), examples using Maclaurin's theorem. 2.3.2 Taylor's theorems (Statement only), examples using Taylor's theorem.	06

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Shikshan Prasarak Sanstha's

Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2023-2024

Name of the Teacher : Prof. R.A.Dudhal **Designation : Asso-professer**

Class: B.Sc. I **Semester :- I**

Department : Mathematics **Paper: II**

Paper Title :- Differential Equation

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	July	Introduction Ordinary differential equations of first order and first degree	Definition, Order and Degree, Exact differential equations, Necessary and sufficient condition for exactness, Differential equations reducible to exact, Integrating factors with rules	04
2	August		Linear differential equations, Differential equations reducible to linear differential equation, Bernoulli's differential equations. Orthogonal trajectories, orthogonal trajectories to Cartesian and polar curves. Differential equations of first order but not of first degree: Equations that can be factorized, Equations solvable for p, Equations that cannot be factorized, Equations solvable for x, Equations solvable for y and Clairaut's form.	16

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Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2023-2024

Name of the Teacher : Prof. R.A.Dudhal

Designation : Asso-professer

Class: B.Sc. I

Semester :- II

Department : Mathematics

Paper: III

Paper Title :- Multivariable Calculus

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1.	December	Introduction Partial differentiation	Functions of two variables: domain, Neighbourhood of a point, Continuity of functions of two variables (at a point), Limit of functions of two variables, Partial derivatives: first order partial derivatives, partial derivatives of higher order, Geometrical interpretation of partial derivatives, examplesHomogeneous functions: definition, Euler's theorem on homogeneous functions (Case of two and three variables), examples using Euler's theorem. Total Differentials, Differentiation of composite functions, examples, Implicit function: first and second order derivative of implicit functions and its examples	12
2	January		. Taylor's theorem for a function of two variables, its examples. Maxima and minima of functions of two variables: Condition for existence of maxima or minima, stationary and extreme points, Sign of quadratic expression, Lagrange's condition for maximum and minimum	12

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Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2023-2024

Name of the Teacher : Prof. R.A.Dudhal

Designation :

Class: B.Sc. II

Semester :- III

Department : Mathematics

Paper: V

Paper Title :- Differential Equation

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	July	Introduction--	**Introduction and syllabus discussion**	02
2	August	Homogeneous Linear Differential Equation	**Unit 1 Homogeneous Linear Differential Equation** Definition: Homogeneous linear differential equation (Cauchy - Euler differential equation). Method of solution and examples. Definition: Legendre's linear differential equation. Method of solution of Legendre's linear differential equation and examples.Second order linear differential equations Definition (general form): Second order linear differential equation. Methods of solution of Second order linear differential equation. Complete solution when one integral is known: method and examples. Transformation of the equation by changing the dependent variable (removal of first order derivative) and examples. . Transformation of the equation	18

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Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2023-2024

Name of the Teacher : Prof. R.A.Dudhal **Designation :**

Class: B.Sc. II **Semester :- IV**

Department : Mathematics **Paper: VIII**

Paper Title :- Integral Calculus

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	January	Gamma and Beta Function	**Unit 1. Gamma and Beta Function.** 1.1 Gamma function. 1.1.1 Definition of Gamma function and examples. 1.1.2 Properties of Gamma function1.1.2.7 Examples based on article 1.1.2 1.2 Beta function. 1.2.1 Definition of Beta function and examples. 1.2.2 Properties of Beta function. 1.2.2.8 Duplication formula of Gamma function. 1.2.2.9 Examples based on article 1.2.2	21
2	February	Differentiation under integral sign	**Unit 2. Differentiation under integral sign,** Error functions and Multiple integrals . 2.1 Differentiation under integral sign 2.1.1 Leibnitz first rule of differentiation under integral sign. 2.1.2 Leibnitz second rule of differentiation under integral sign. 2.1.3 Examples based on articles 2.1.1 and 2.1.2 2.2 Error functions 2.2.1 Definition of erf(xx) , erfc (x) and examples. 2.2.2 Properties of error functions. 2.2.2.1 erf(0) = 0, erf (∞) = 1 2.2.2.2 erf(xx) + erfc (x) = 1	20

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Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2023-2024

Name of the Teacher : Prof. R.A.Dudhal

Designation :

Class: B.Sc. II

Semester :- III

Department : Mathematics

Paper: VI

Paper Title :- Numerical Methods

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	September	Solutions of Algebraic and Transcendental Equations	**Unit 1 Solutions of Algebraic and Transcendental Equations** Introduction .Mathematical Preliminaries Bisection Method .Method of False position. Newton- Raphson method Examples based on art.	12
2	Octomber	Numerical Integration	Interpolation. Introduction . Finite differences. Forward differences Backward differences Symbolic relations and Separation of symbols. Newton's formulae for Interpolation .Newton's forward difference interpolation formula. Newton's backward difference interpolation formula . Interpolation with Unevenly Spaced Points . Lagrange's Interpolation Formula . Examples based on art. **Unit 2 Numerical Integration** . General formula. Trapezoidal rule .Simpson's 1/3- rule. Simpson's 3/8- rule. Examples based on art. Solutions of Linear system of	20

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Department Of Mathematics

Annual Teaching Plan : 2023-2024

Name of the Teacher : Prof. R.A.Dudhal **Designation :**

Class: B.Sc. II **Semester :- IV**

Department : Mathematics **Paper: VII**

Paper Title :- Vector Calculus

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	November	Introduction--	**Introduction and syllabus discussion**	04
2	December	Differential Operators	**Unit 1 Differential Operators**1.1 Scalar and Vector valued Point functions 1.2 Limit and continuity of a scalar and vector point functions 1.3 Directional Derivatives of scalar and vector Point Functions & examples 1.4 The Operator ∇ 1.5 Gradient of a Scalar Point Function & examples 1.6 Geometrical Interpretation of grad Ø, where Ø is a scalar point function 1.7 Divergence and Curl of vector point function 1.7.1 Definition of where f is a vector point function 1.7.2 Expressions of in terms of components of f 1.7.3 Characters of div f and curl f as point functions 1.7.4 Problems based on 1.7 1.8 Gradient, Divergence and Curl of Sums 1.9 Gradient, Divergence and Curl of Product 1.10 Second Order Differential Operators 1 1.11 The Laplacian Operator, ∇2 and	24

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Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2023-2024

Name of the Teacher : Prof. A. A. Bandgar **Designation :**

Class: B.Sc. III **Semester :- V**

Department : Mathematics **Paper: DSE – E10**

Paper Title :- Abstract Algebra

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	July	Introduction--	**Introduction and syllabus discussion** Groups: Definition and examples of groups, group S3 and Dihedral group D4,Commutator subgroups and its properties	04
2	August	**Groups**	Conjugacy in group and class equation. Rings: Definition and example of Rings, Ring with unity. Zero divisor, Integral Domain, Division Ring, Field,	10
3	September	**Rings**	Boolean ring, Subring, Characteristic of a ring: Nilpotent and Idempotent elements. Ideals, Sum of two ideals, Examples. Simple Ring.Quotient Rings, Homomorphism, Kernel of Homomorphism ,Isomorphism theorems,imbedding of Ring. Maximal Ideals..	10
4	October		Polynomial Rings, degree of Polynomial, addition and multiplication of Polynomials and their properties, UFD, Gauss' Lemma	08

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Department Of Mathematics

Annual Teaching Plan : 2023-2024

Name of the Teacher : Prof. A. A. Bandgar

Designation :

Class: B.Sc. III

Semester :- VI

Department : Mathematics

Paper: DSE – F11

Paper Title :- Complex Analysis

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	December	**Analytic functions and Complex Integration**	Basic algebraic and geometric properties of complex numbers, Function of complex variable, Limits, continuity and differentiation, Cauchy Riemann equations, Analytic functions and examples of analytic functions, Exponential function, Logarithmic function, Trigonometric function	06
2	January		Definite integrals of functions, Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals, Cauchy-Goursat theorem and examples, Cauchy integral formula and examples, Liouville's theorem and the fundamental theorem of algebra.	10
3	February	**Sequences, Series and Residue Calculus**	Convergence of sequences and series of complex variables, Taylor series and its examples, Laurent series and its examples, absolute and uniform convergence of power series, Isolated singular points, Residues, Cauchy's residue theorem, Residue at infinity, The three types of isolated singularities	10

Shikshan Prasarak Sanstha's

Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2023-2024

Name of the Teacher : Prof. A. A. Bandgar

Designation :

Class: B.Sc. III

Semester :- VI

Department : Mathematics

Paper: DSE – F12

Paper Title :- Discrete Mathematics

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	December	**Mathematical Logic**	The logic of compound statements: Statements, compound statements, truth values, logical equivalence, tautologies and contradictions, Conditional statements: Logical equivalences involving implication, negation.	06
2	January		The contrapositive of a conditional statements, converse, inverse of a conditional statements, biconditional statements.Valid and invalid arguments: Modus Ponens and modus Tollens, Additional valid argument forms, rules of inferences, contradictions and valid arguments, Number system: Addition and subtraction of Binary, decimal, quintal, octal, hexadecimal number systems and their conversions.	10

Shikshan Prasarak Sanstha's

Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2023-2024

Name of the Teacher : Prof. R. A. Dudhal

Designation :

Class: B.Sc. III

Semester :- V

Department : Mathematics

Paper: DSE – E12

Paper Title :- Integral Transform

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	July	**Laplace and Inverse Laplace Transform.**	**Introduction and syllabus discussion** Laplace Transform : Definitions; Piecewise continuity, Function of exponential order, Function of class A ,Existence theorem of Laplace transform. Laplace transform of standard functions.First shifting theorem and Second shifting theoremand examples,Change of scale propertyand examples, Laplace transform of derivativesand examples, Laplace transform of integralsand examples.Multiplication by power of tand examples	04
2	August		.Division by tand examples.Laplace transform of periodic functions and examples.Laplace transform of Heaviside's unit step function. Inverse Laplace Transform: Definition Standard results of inverse Laplace transform, Examples , First shifting theorem and Second shifting theoremand examples.Change of scale propertyand Inverse Laplace of derivatives, examples.The Convolution theorem and Multiplication by S, examples.Division by S,inverse Laplace by partial fractions ,examples, Solving linear differential equations with constant	10

Shikshan Prasarak Sanstha's

Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2023-2024

Name of the Teacher : Prof. R.A. Dudhal

Designation : Asso-professor

Class: B.Sc. III

Semester :- VI

Department : Mathematics

Paper: DSE – F10

Paper Title :- Linear Algebra

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	December	**Vector Spaces and Linear Transformations**	**Introduction and syllabus discussion** Vector space: Subspace, Sum of subspaces, direct sum, Quotient space, Homomorphism or Linear transformation, Kernel and Range of homomorphism, Fundamental Theorem of homomorphism, Isomorphism theorems, Linear Span, Finite dimensional vector space, Linear dependence and independence, basis, dimension of vector space and subspaces.	06
2	January		Linear Transformation: Rank and nullity of a linear transformation, Sylvester's Law, Algebra of Linear Transformations , Sum and scalar multiple of Linear Transformations. The vector space of Homomorphisms, Product (composition) of Linear Transformations, Linear operator, Linear functional, Invertible and non-singular Linear Transformation, Matrix of Linear Transformations and its examples.	10
3	February	**Inner Product Spaces, Eigen values and Eigen vectors**	Inner product spaces: Norm of a vector, Cauchy- Schwarz inequality, Orthogonality, Generalized Pythagoras Theorem, orthonormal set, Gram-Schmidt orthogonalization process, Bessel's	12

Shikshan Prasarak Sanstha's

Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2023-2024

Name of the Teacher : Prof. A. A. Bandgar

Designation :

Class: B.Sc. III

Semester :- V

Department : Mathematics

Paper: DSE – E9

Paper Title :- Mathematical Analysis

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	July	Introduction--	**Introduction and syllabus discussion** Definition of Riemann integration, Inequalities for lower and upper Darboux sums, Necessary and sufficient conditions for Riemann integrability	04
2	August	**Riemann Integration**	Definition of Riemann integration by Riemann sum and equivalence of the two definitions, Riemann integrability of monotonic functions and continuous functions, Algebra and properties of Riemann integrable functions, First and second fundamental theorems of integral calculus, and the integration by parts	10
3	September		Improper Integrals: Definition of improper integral of first kind, Comparison test, – test for Convergence, Absolute and conditional convergence, Integral test for convergence of series, Definition of improper integral of second kind and some tests for their convergence	10
4	October	**Improper Integrals and Fourier Series**	Cauchy principle value. Fourier Series: Definition of Fourier series and examples on the expansion of functions in Fourier series, Fourier series corresponding to even and odd functions, half range Fourier series, half range sine and cosine series	08

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Padmabhushan Vasantraodada Patil Mahavidyalaya , Kavathe Mahankal

Department Of Mathematics

Annual Teaching Plan : 2023-2024

Name of the Teacher : Prof. A. A. Bandgar

Designation :

Class: B.Sc. III

Semester :- VI

Department : Mathematics

Paper: DSE – F9

Paper Title :- Metric Spaces

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	December	**Limits and Continuous Functions on Metric Spaces**	Limit of a function on the real line, Metric Spaces, Limitsin Metric Spaces	06
2	January		Functions continuous at a point on the real line, Reformulation, Functions continuous on a metric space, Open Sets, Closed Sets, More about open sets.	10
3	February	**Connectedness, Completeness and Compactness**	Connected Sets, Bounded sets and totally bounded sets,Complete metric spaces,	10
4	March		Compact metric spaces, Continuous functions on compact metric spaces.	06

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Department Of Mathematics

Annual Teaching Plan : 2023-2024

Name of the Teacher : Prof. A. A. Bandgar **Designation :**

Class: B.Sc. III **Semester :- V**

Department : Mathematics **Paper: DSE – E11**

Paper Title :- Optimization Techniques

Sr. No.	Month	Main Topic/Unit	Subtopic	No. of Periods required
1	July	**Network optimization models**	**Introduction and syllabus discussion** Introduction ,Formulation of Linear Programming Problems., Graphical methods for Linear Programming problems. General formulation of Linear Programming problems, Slack and surplus variables,Canonical form, Standard form of Linear Programmingproblems.	04
2	August		Transportation problem:Introduction, Mathematical formulation ,Matrix form of Transportation problem.Feasible solution, Basic feasible solution and optimal solution, Balanced and unbalanced transportation problems. Methods of Initial basic feasible solutions: North west corner rule [Stepping stone method], Lowest cost entry method [Matrix minima method], Vogel's Approximation method [Unit Cost Penalty method] ,The optimality test.[MODI method], Assignment Models :Introduction ,Mathematical formulation of assignment problem, Hungarian method for assignment problem. Unbalanced assignment problem.Travelling	10