Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Dr. A. B. Jadhav **Department: Mathematics**
Program: BSc FY Sem-I **Subject: Mathematics** **Course Code: CCM-1 Section A**
Paper Title: Calculus-I (Differential Calculus) **Paper No.: I**

Unit No.	Unit Name	Topics	Unit-wise Outcome
1	Differentiation	Derivability and derivative, derived function, derivability implying continuity, geometrical interpretation of a derivative, derivatives of hyperbolic functions, derivatives of inverse hyperbolic functions, Higher order derivatives, calculation of the nth derivative, determination of n^{th} derivative of rational functions, nth derivatives of the products of the powers of sines and cosines, Leibnitz theorem.	Student understands concept of limit, continuity, derivative of single variable functions. Student can find the higher order derivatives of product of functions.
2	Expansion of functions, Tangents and Normals	Maclaurin's theorem, Taylor's theorem, Equations of the tangent and normal, Angle of intersection of two curves, length of the tangent, normal, sub-tangent, sub-normal, pedal equations.	Student can expand functions in terms of infinite series. Student can find equation of tangent, normal and length of tangent, normal.
3	Mean Value Theorems	Rolle's Theorem, Lagrange's mean value theorem, Meaning of sign of derivative, Graphs of hyperbolic functions, Cauchy's mean value theorem, Generalized mean value theorems (Taylor's theorem, Maclaurin's theorem).	Student understands the concept of Mean Value Theorems. Student can use the results to solve problems.
4	Partial Differentiations	Introduction, Functions of two variables, Neighborhood of a point (a,b), Limit and Continuity, Partial derivatives, Geometrical Interpretation, Homogeneous functions, Euler's Theorem on homogeneous function and corollary, Theorems on total differentials, Equality of $f_{xy}(a, b)$ and $f_{yx}(a, b)$, Equality of f_{xy} and f_{yx}, Taylors theorem for functions of two variables.	Student understands concept of limit, continuity and differentiation of two variable functions. Student can use the results to solve problems.

Specify Course Outcome: Student learned elementary knowledge of differential calculus such as define terms, explain concepts and methods and applies to solve examples.

Specify Program Outcome: Students learned elementary knowledge of Calculus (Differential & Integral). They also learned Matrix operations, trigonometry and three dimensional geometry. Student learned iinteractive computation, Plotting of Graphs using MATLAB Software.

Signature of Teacher :

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Dr. A. B. Jadhav **Department: Mathematics**
Program: BSc FY Sem-I **Subject: Mathematics** **Course Code: CCM-1 Section B**
Paper Title: Algebra and Trigonometry **Paper No.: II**

Unit No.	Unit Name	Topics	Unit-wise Outcome
1	Matrices	Matrix, Different Types of Matrices, Equality of Matrices, Addition (Sum) of Two Matrices, Multiplication ofTwo Matrices, Properties of Matrix Multiplication, Positive Integral Powers of a Matrix, Transpose of a Matrix, Conjugate of a Matrix, Transposed Conjugate of a Matrix, Determinant of a Square Matrix, Minor of an Element, Inverse of a Square Matrix, Singular and Non-singular Matrix, OrthogonalMatrices, The Determinant of an Orthogonal Matrix, Unitary Matrix.	Student can Add, Subtract and Multiply two matrices. Student recognizes the different types of Matrices. Student will be able to find the Inverse of invertible Matrices.
2	Rank of a Matrix	Minor of Order k of a Matrix, Rank of a Matrix, elementary Row and Column Operations, The Inverse of an elementary Operation, Row and ColumnEquivalent, Equivalent Matrices, Working Procedure for Finding Rank Using Elementary Operations, Row- Echelon Matrix, Row Rank and Column Rank of a Matrix.	Student will be able to determine the rank of a matrix. Student can transform matrix to Row Echelon form.
3	Linear Equations	Linear Equations, Equivalent Systems, System of Homogeneous Equations. Characteristic Roots and Characteristic Vectors : Definitions, To Find Characteristic Vectors, Cayley-Hamilton Theorem.	Student Solves the System of Linear Equations. Student will be able to find the Characteristic Roots and Characteristic Vectors of a Matrix.
4	Trigonometry	Complex Quantities, DeMoivre's Theorem, Expansions of sines and cosines; Expansions of the sine and cosine of an Angle in Series of Ascending Powers of the Angle, Expansionsof the sines and cosines of Multiple Angles, and of Powers of sines and cosines, Exponential Series for Complex Quantities, Circular Functions for Complex Angles, HyperbolicFunctions, Inverse Circular Functions, Inverse Hyperbolic Functions.	Student can expand sines and cosines of an angle in Series of Ascending Powers of the Angle. Student can find expansionsof the sines and cosines of Multiple Angles.

Specify Course Outcome: Student got elementary knowledge of Matrices, Complex Numbers, and Trigonometry such as obtaining inverse, solving simultaneous equations, evaluating expansions of sines and cosine series.

Specify Program Outcome: Students learned elementary knowledge of Calculus (Differential & Integral). They also learned Matrix operations, trigonometry and three dimensional geometry. Student learned iinteractive computation, Plotting of Graphs using MATLAB Software.

Signature of Teacher :

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Dr. A. B. Jadhav **Department: Mathematics**
Program: BSc FY Sem-II **Subject: Mathematics** **Course Code: CCM-2 Section A**
Paper Title: Calculus-II (Integral Calculus) **Paper No.: III**

Unit No.	Unit Name	Topics	Unit-wise Outcome
1	Integration of Algebraic Rational Functions	Methods of Integration, Partial Fractions, Non-repeated linear factors only in the denominator, Linear or quadratic non-repeated linear factor, Reduction formula, Integration of algebraic rational functions by substitution.	Can understand concept of integration of algebraic rational functions. Student is able to apply method of integration to find the integral of function.
2	Integration of Irrational Algebraic Functions	Integration of $1/(ax^2+bx+c)^{1/2}$, Integration of $(ax^2 + bx + c)^{1/2}$, Integration of $(px+q) / (ax^2 + bx + c)^{1/2}$, etc. Integration by Rationalisation, Integration of $x^m(a+bx^n)^p$, where m, n and p are not necessarily integers, Reduction formulae	Can understand concept of integration of algebraic irrational functions. Will be able to solve problems using reduction formulae.
3	Integration of Transcendental Functions	Reduction formulae, Integration of $\sin^m x \cos^n x$; Reduction formulae, Definite Integrals, Definition, Properties of definite integral, Definite Integral as the Limit of a Sum.	Student Solve examples of definite integrals using Properties definite integrals. Student obtains the area and volume of given shape.
4	Beta, Gamma Functions and Multiple Integrals	Gamma Function, A Fundamental Property of Gamma Function, Product of two Integrals, Beta Function, Relation between beta and gamma function, Integrationof $\sin^{2m-1}t \cos^{2m-1}t$, Double integrals, Area bydouble integration, Volume under a surface, Polar coordinates , Evaluation of double integral (statement only), Change from cartesian to Polar Coordinates.	Student understands concept of Gamma and Beta Functions. Student Solves problems on Multiple Integrals.

Specify Course Outcome: Student apply methods finding Integration ofAlgebraic Rational & Irrational Functions, Transcendental Functions for solving examples. Students also analyze Gamma and Beta Functions, Multiple Integral and Apply integration to find Area and Volume.

Specify Program Outcome: Students learned elementary knowledge of Calculus (Differential & Integral). They also learned Matrix operations, trigonometry and three dimensional geometry. Student learned iinteractive computation, Plotting of Graphs using MATLAB Software.

Signature of Teacher :

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: V. A. Kalyan **Department: Mathematics**
Program: BSc FY Sem-II **Subject: Mathematics** **Course Code: CCM-2 Section B**
Paper Title: Geometry **Paper No.: IV**

Unit No.	Unit Name	Topics	Unit-wise Outcome
1	Co-ordinates and Transformation of Co-ordinates	Direction cosines of a line, relation between direction cosines, Projectionon a straight line, projection of a segment on another line,projection of the join of two lines. Angle between two lines.Change of origin, change of the direction of a axes, relation between direction cosines of three mutual Perpendicular lines.	Student understands concepts on Three Dimensional Geometry. Student can find the Direction cosines of any line under the different given conditions.
2	The Plane	General equation of first degree, Transformation tothe normal form, angle between two planes,determination of plane under given conditions,plane through three points, system of planes, two sides of a plane, length of perpendicularfrom a point to a plane, bisectors of angle between two planes.	Student is able to find equations of Planes. Student transforms the equation of a plane to the normal form.
3	Right line	Representation of line, equation of line through a given point drawn in a given direction,two forms of the equation of line, Transformationfrom the unsymmetrical to the symmetrical form, angle between a line and a plane, coplanar lines, condition for coplanarity of lines, the shortest distance between two lines, length of the perpendicular from a point to a line.	Student finds equations of Right lines. Student transforms equation of line from the unsymmetrical to the symmetrical form.
4	Sphere, Cones and Cylinders	General equation of a sphere, The sphere through fourgiven points, plane section of a sphere, intersection of two spheres, sphere with agiven diameter, equation of a circle, equation of a tangent plane, planeof contact, angleof intersection of two spheres. Cones, cylinders: Definition, equation of a cone,the right circularcone, definition, the cylinder, equation of a cylinder, the right circular cylinder.	Student can find equations of Spheres, Cones and Cylinders. Student is able to find the angle of intersection of two spheres.

Specify Course Outcome: Student understands concepts on Three Dimensional Geometry.Student applies methods to solve examples on obtaining equations of plane, right line, cylinder, cone and sphere.

Specify Program Outcome: Students learned elementary knowledge of Calculus (Differential & Integral). They also learned Matrix operations, trigonometry and three dimensional geometry. Student learned iinteractive computation, Plotting of Graphs using MATLAB Software.

Signature of Teacher :

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: V. A. Kalyan **Department: Mathematics**
Program: BSc FY Sem- I &II Subject: Mathematics **Course Code: CCMP-1**
Paper Title: Practical **Paper No.: V**

Unit No.	Unit Name	Topics	Unit-wise Outcome
1	Introduction to MATLAB	MATLAB Programming language, Built-in Functions, Graphics, computations, External interface and Tool boxes. Basics of MATLAB, MATLAB windows, desktop, command window, workspace, Figure and Editor Windows, Input-output, File types, platform dependence, Printing. Programming in MATLAB: Scripts and14 functions. Script files, function files, Executing of function, writing good functions, sub functions, compiled functions.	Student learns basics of MATLAB language. Student learns various MATLAB commands.
2	Interactive computation :	Matrices and Vectors, input, indexing, matrix manipulation, creating vectors. Matrix and Array operations, Arithmetic operations, Relational operations, logical operations, Elementary math functions, matrix functions, character string. Command-line Functions, Inline functions, Anonymous functions. Built-in functions, finding the determinant of matrix, finding eigen-values and eigenvectors. Saving and loading Data, Importing data tales, recording a session. Applications: - Linear Algebra. Solving a linear system, Gaussian elimination, Finding eigenvalues and eigenvectors, matrix factorization, advanced topics.	Student verifies associativity of matrix addition, left distributive law and right distributive law of matrices. Student finds determinant, eigen values, eigen vectors, inverse, powers and characteristics polynomial of a square matrix.
3	Plotting of Graphs	Plotting simple Graphs. Graphics: - Plotting of 2D graphs, Using subplot for multiple graphs, 3DPlots (Drawing of different Geometrical objects), saving and Printing.	Student plots the graph of different functions with the help of MATLAB software. Student draws 3D objects using MATLAB software.

Specify Course Outcome: Student studied MATLAB software and itsapplication to solve problems in matrices and to plot the graphs of different functions.

Specify Program Outcome: Students learned elementary knowledge of Calculus (Differential & Integral). They also learned Matrix operations, trigonometry and three dimensional geometry. Student learned iinteractive computation, Plotting of Graphs using MATLAB Software.

Signature of Teacher :

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: V. A. Kalyan **Department: Mathematics**
Program: BSc SY Sem-III **Subject: Mathematics** **Course Code: CCM-3 Section A**
Paper Title: Real Analysis-I **Paper No.: VI**

Unit No.	Unit Name	Topics	Unit-wise Outcome
1	Sets and Properties	Field structure and order structure, Bounded and unbounded sets, Supremum, Infimum, Order completeness in R, Archimedean property of real numbers, Dedekind's Property, Complete-ordered field, Representation of real numbers as points of a straight line, Neighbourhood of a point, Interior point of a set, Open set, Limit point of a set, Bolzano-Weierstrass theorem, Closed sets, Closure of a set, Dense sets, Some important theorems, Countable and uncountable sets.	Student understands the basic concept of sets and their properties. Student can find supremum, infimum and limit points of given sets. Student
2	Real Sequences	Sequence, Range set, Bounds of a sequence, Convergence of sequences, Some theorem, Limit point of a sequence, Existence of limit points, Convergent sequences, Cauchy's general principle of convergence, Cauchy's sequence, Algebra of sequences, Some important theorem, Monotonic sequences, Subsequences.	Student will be able to prove Cauchy's general principle of convergence. Student uses various results to check the behavior of given sequences.
3	Infinite Series	Introduction, Definitions, Necessary condition for convergence, Cauchy's general principle of convergence for series, Some preliminary theorems, Positive term series, Necessary condition for convergence of positive term series, Geometric series, Comparison series, Series with arbitrary terms, Alternating series, Absolute convergence, Rearrangement of terms, Fourier series.	Student understands the concept of convergence of infinite series. Student uses comparison tests to check the behavior of given series.
4	Comparison Test for Series	Comparison test (first and second type), Cauchy's root test, D `Alembert's root test, Raabe's test, logarithmic test, Test for series of arbitrary term.	Student will be able to prove Cauchy's root test, Rabbe's test. Student can solve problems on convergence of series.

Specify Course Outcome: Student understands concept of open set, closed set, real sequences, subsequences, convergence of sequences, infinite series, convergence of series, comparison tests for series.

Specify Program Outcome: Student learned elementary knowledge of real sequences, infinite series, various algebraic structures, group theory and ordinary differential equations.

Signature of Teacher :

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: V. A. Kalyan **Department: Mathematics**
Program: BSc SY Sem-III **Subject: Mathematics** **Course Code: CCM-3 Section B**
Paper Title: Group Theory **Paper No.: VII**

Unit No.	Unit Name	Topics	Unit-wise Outcome
1	Set theory & elementary concepts of Group	Cartesian product of two sets, Functions or mappings, Types of functions, Inverse image of an element, Inverse function, Intervals defined as sets of real numbers, Product or Composite of functions, Some properties of composite of mappings, Binary operation, Relations, Equivalence relations, Equivalence classes, Properties of equivalence classes. Groups: Binary operation on a set, Algebraic structure, definition of group, abelian group, finite and infinite groups, order of an infinite group, General properties of a group.	Student understands the concepts on an equivalence relation. Student checks whether the given set, is a group for the given operation or not.
2	Group of Permutations, Cyclic permutations, Subgroups	Composition table for finite sets, Addition modulo n, Multiplication modulo p; Residue classes of the set of integers, Permutations, Group of permutations, cyclic permutations, Integral powers of an element of a group, Order of an element of a group, Complexes and subgroups of a group. Criterion for a complex to be a subgroup.	Student understands the general properties of groups. Student solves problems on groups.
3	Cosets and Cyclic groups	Cosets, Relation of congruence modulo, Lagrange's theorem, Euler's theorem, Fermat's theorem, Caleys's theorem, Cyclic groups, Some properties of cyclic group, Subgroup generated by a subset of a group.	Student understands the concepts of the cyclic group. Student uses Lagrange's theorem to solve the problems in number theory.
4	Normal groups, homomorphism & automorphism	Normal subgroups, quotient group, homomorphisms of a groups, Kernal of homomophism, Fundamental theorem on homomorphism of groups, Automorphisms of a group, Inner automorphisms.	Student forms a quotient group. Student finds the kernel of a group homomorphism.

Specify Course Outcome: Student understands concept of group of permutations, cyclic permutations, subgroups, cosets, cyclic groups, normal groups, homomorphism & automorphism. Student uses Lagrange's theorem to solve the problems in number theory.

Specify Program Outcome: Student learned elementary knowledge of real sequences, infinite series, various algebraic structures, group theory and ordinary differential equations.

Signature of Teacher :

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Dr. A. B. Jadhav **Department: Mathematics**
Program: BSc SY Sem-III **Subject: Mathematics** **Course Code: CCM-3 Section C**
Paper Title: Ordinary Differential Equations **Paper No.: VIII**

Unit No.	Unit Name	Topics	Unit-wise Outcome
1	First order and the first degree differential equations, exact differential equations	Formation of a Differential Equation: Ordinary and partial differential equations, Order and degree, Solution and constant of integration, Equation of the first order and the first degree: Equations of the form $f_1(x)dx+f_2(y)dy = 0$, Homogeneous, Non-homogeneous equations in x and y, Exact differential equations, rules for finding the solution, integrating factors(I.F.), finding I. F. by inspection.	Student understands concepts of solution of a differential equation, order and degree. Student will be able to verify whether the given differential equation is exact or nor.
2	Linear differential equations, Clairaut's equation	Rules for finding integrating factors, Linear equations, Equation reducible to the linear form. Equations of the first order but not of first degree: Equations that can be resolved into component equations of the first degree, Equations that can't be resolved into component equations, Equations solvable for y, for x, Equations that do not contain x, that do not contain y, Clairaut's equation.	Student can find the solution of the exact Student can transform non-linear equation to linear equation and solve it. differential equation. Student will be able to solve Clairaut's equation.
3	Linear differential equations with constant coefficients	Linear equations with constant coefficients: The Complementary Function, The particular integral, The complete solution, The linear equation with constant coefficients and second member zero, auxiliary equation having equal roots, imaginary roots, The symbol D, another way of finding the solution when the auxiliary equation has repeated roots, The linear equation with constant coefficients and a second member a function of x.	Student understands the concept of particular integral & complete solution. Student can find the solution of a differential equations when the auxiliary equations have equal , imaginary roots.
4	Linear differential equations with variable coefficients	Integral corresponding to a term of the form e^{ax}, x^m, sin ax or cos ax, $e^{ax}V$, xV in the second member Linear Equations with Variable Coefficients: Methods of solution- to find the complementary function, the particular integral, Integral corresponding to a term of the form x^m in the second member.	Student can find integral corresponding to a term of the form e^{ax}, x^m, sin ax in the second member. Student can find the solution of linear equation with variable coefficients.

Specify Course Outcome: Student learns elementary knowledge of ordinary differential equations. Student can solve problems on ordinary differential equations.

Specify Program Outcome: Student learned elementary knowledge of real sequences, infinite series, various algebraic structures, group theory and ordinary differential equations.

Signature of Teacher :

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: V. A. Kalyan **Department: Mathematics**
Program: BSc SY Sem-IV **Subject: Mathematics** **Course Code: CCM-4 Section A**
Paper Title: Real Analysis-II **Paper No.: IX**

Unit No.	Unit Name	Topics	Unit-wise Outcome
1	Riemann Integral	Introduction, Definition, and existence of the integral, Definitions, Inequalities for integrals, Refinement of partitions, Darboux's theorem, Conditions of integrability, Deductions, integrability of the sum and difference of integrable functions, Integrability of the product, Quotient and the modulus of Integrable functions.	Student understands difference between upper sum & lower sum. Student understands the concept of upper integral & lower integral.
2	Riemann Sum and Some Fundamental Theorems	The integral as a limit of sums (only definitions of Riemann sums), Some applications, Some integrable functions, Integration and differentiation, Fundamental theorem of calculus, Mean value theorems of integral calculus.	Student understands the concept of Riemann sum and Riemann integral. Student solves problems on Riemann integral.
3	Improper Integral-Range of Integration is Finite	Introduction, Integration of unbounded functions with finite limits of integrations, Comparison tests for convergence, Useful comparison integral, Examples, General test for convergence, Absolute convergence.	Student can check the convergence of improper integral using various tests. Student distinguishes between convergence and absolute convergence of improper integral.
4	Improper Integral-Range of Integration is Infinite	Infinite range of integration, comparison tests for convergence at ∞, Comparison test first and second, Useful comparison integral, General test for convergence at ∞, Absolute convergence, Integrand as a product of functions (convergence at ∞).	Student understands the concept of improper integral with infinite range of integration. Student solves problems on improper integral using comparison integral & general test.

Specify Course Outcome: Student understands concept and learns elementary knowledge of Riemann integral and improper integral. Student will be able to comparison and general tests.

Specify Program Outcome: Student understands concept of Riemann integral, improper integral, ring theory and partial differential equations.

Signature of Teacher :

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: V. A. Kalyan **Department: Mathematics**
Program: BSc SY Sem-IV **Subject: Mathematics** **Course Code: CCM-4 Section B**
Paper Title: Ring Theory **Paper No.: X**

Unit No.	Unit Name	Topics	Unit-wise Outcome
1	Definition, Examples & Elementary properties of a ring	Ring: Definition, Elementary properties of a ring, Integral multiples of the elements of a ring, Examples of rings, Some special types of rings, Integral domains, Field, Division ring or Skew field.	Student checks whether given algebraic structure is a Ring or not. Student learns elementary properties of a ring.
2	Isomorphism of rings, Ideals	Isomorphism of rings, Properties of isomorphism of rings, Subrings, Characteristics of a ring, Imbedding of a ring into another ring, the field of quotients, Ideals, More about ideals, Ideal generated by a given subset of a ring, Principal ideal, Principal ideal ring.	Student understands the concept of ideal and principal ideal of a ring. Student checks whether given two rings are isomorphic or not.
3	Polynomial rings, polynomial over an integral domain & Euclidean algorithm	Divisibility in an integral domain, Units, Associates, Prime elements, greatest common divisor, polynomial rings, Degree of the sum and the product of two polynomials, Ring of polynomials, R as a subset of R[x]; polynomial over an integral domain, Polynomial over a field, Ring of polynomials in n variables over an integral domain, Divisibility of polynomials over a field, Division algorithm for polynomials over a field, Euclidean algorithm for polynomials over a field	Student understands the difference between units and associates. Student solves problems on polynomial rings.
4	Unique factorization domain, homomorphism of rings & Euclidean rings	Unique factorization domain, Unique factorization theorem for polynomials over a field, Quotient rings or residue class rings, Homomorphism of rings, Kernel of a ring homomorphism, Maximal ideal, Some more results on ideals, Prime ideals, Euclidean rings or Euclidean domains, Properties of Euclidean rings.	Student checks whether given two rings are homomorphic or not. Student understands concept on Euclidean rings.

Specify Course Outcome: Student understands concept of rings, isomorphism & homomorphism of rings, ideals & principal ideals, polynomial rings and Euclidean rings.

Specify Program Outcome: Student understands concept of Riemann integral, improper integral, ring theory and partial differential equations.

Signature of Teacher :

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Dr. A. B. Jadhav **Department: Mathematics**
Program: BSc SY Sem-IV **Subject: Mathematics** **Course Code: CCM-4 Section C**
Paper Title: Partial Differential Equations **Paper No.: XI**

Unit No.	Unit Name	Topics	Unit-wise Outcome
1	Partial differential equation- basic concepts, Lagrange's linear equations	Partial differential equation (PDE), Order and method of forming PDE, solution of equations by direct integration, Lagrange's linear equations, method of multipliers.	Student can classify PDE. Student uses methods to solve problems on PDE. Student finds solution of PDE by direct integration.
2	Charpit's method, Linear homogeneous PDE	Partial differential equations non-linear in p and q; Charpit's method, Linear homogeneous PDE of nth order with constant coefficients, Rules for finding the complementary functions, Rules for finding the particular integral.	Student solves linear PDE of first and second order. Student uses Charpit's method for solving PDE.
3	Non-homogeneous linear equations	Non-homogeneous linear equations, Monge's method, Method of separation of variables, Equations of vibrating strings, Solution of the wave equation by D'Almbert's method.	Student understands concept of non-homogeneous linear equations. Student solves the wave equation by D'Almbert's method.
4	One-dimensional & two-dimensional heat flow, Laplace equations	One-dimensional heat flow, Two-dimensional heat flow, Laplace equations in polar co-ordinates, Transmission line equations.	Student applies PDE techniques to predict the behaviour of certain phenomena. Student solves problems using boundary conditions.

Specify Course Outcome: Student understands concept of Partial differential equations. Student learns different methods of solutions of PDE and are introduced to real-world problems like wave equation, heat equation, etc.

Specify Program Outcome: Student understands concept of Riemann integral, improper integral, ring theory and partial differential equations.

Signature of Teacher :

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: V. A. Kalyan **Department: Mathematics**
Program: BSc TY Sem-V **Subject: Mathematics** **Course Code: DSEM-5 Section A**
Paper Title: Metric Spaces **Paper No.: XII**

Unit No.	Unit Name	Topics	Unit-wise Outcome
1	Open and Closed sets	Definition of Metric Space, Examples of Metric Space, Diameter of a nonempty Set. Open and Closed Spheres, Neighbourhood of a Point, Open Sets, Limit Points, Closed Sets, Subspaces, Closure of a Set.	Student understands concepts of open & closed sets. Student can define subspace, closure of a set.
2	Convergence, Completeness, Continuity and Uniform Continuity	Definition, Cauchy Sequence, Cantor's Intersection Theorem, Baire's Category Theorem. Continuity - Definitions, Examples, Theorems on Continuity and Uniform Continuity, Banach Fixed Point Theorem.	Student can verify the convergence of sequences. Student understands concepts of continuity and uniform continuity.
3	Compactness	Definitions and Theorems on Compactness, Heine-Borel Theorem, Compactness and Finite Intersection Property, Relative Compactness, ϵ-Nets and Totally Bounded Sets, Lebesgue Number for Covers. Separated Sets, Definition and Theorems on Connectedness.	Student understands concept of compactness. Student can verify compactness of given metric spaces.
4	Connectedness	Definition and Theorems on Lebesgue Number for Covers, Separated Sets, Definition and Theorems on Connectedness.	Student understands concept of connectedness. Student can verify connectedness of given metric spaces.

Specify Course Outcome: Student understands conceptofopen and closed sets.Student verifies the convergence of sequences, completeness compactness and connectedness of given metric spaces.

Specify Program Outcome: Student understands conceptof metric spaces, vector spaces andequilibrium of forces & resultant force of forces.

Signature of Teacher :

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: V. A. Kalyan **Department: Mathematics**
Program: BSc TY Sem-V **Subject: Mathematics** **Course Code: DSEM-5 Section B**
Paper Title: Linear Algebra **Paper No.: XIII**

Unit No.	Unit Name	Topics	Unit-wise Outcome
1	Vector spaces	Vector spaces, Subspaces, Span of a set, More about subspaces, Linear Dependence, Independence.	Student can define vector space, dual space. Student will be able to apply methods to solve examples.
2	Dimension and Basis	Dimension and Basis, Definition and Examples of Linear transformations, Range and Kernel of a linear map, Rank and Nullity.	Student understands concepts of basis, and kernel. Student can find rank of a linear transformation.
3	Linear Transformations	Inverse of a linear transformation, Consequences of Rank-Nullity theorem, The space L(U,V), composition of linear maps, operator equations.	Student understands concepts of inverse of a linear transformation. Student recognizes composition oflinear maps.
4	Matrices	Matrix associated with a linear map, Linear map associated with a matrix, Linear operators in $M_{m,n}$, Determinants: Eigenvalues, Eigenvectors, More matrix theory: Innerproduct spaces.	Student can associate a matrix with a linear map. Student will be able to find Eigen values and Eigen vectors.

Specify Course Outcome: Students will be able to find dimensions of various vector spaces and by using determinant concept students can solve the linear equationsin two, three unknowns.

Specify Program Outcome: Student understands concepts of metric spaces, vector spaces andequilibrium of forces & resultant force of forces.

Signature of Teacher :

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Dr. A. B. Jadhav **Department: Mathematics**
Program: BSc TY Sem-V **Subject: Mathematics** **Course Code: DSEM-5 Section C**
Paper Title: Mechanics-I (Statics) **Paper No.: XIV**

Unit No.	Unit Name	Topics	Unit-wise Outcome
1	Forces Acting on a Particle	Definitions, Law of Parallelogram of Forces, Magnitude and Direction of theResultant, Deductions, Resultant of Forces, Components and Resolved parts,Algebraic Sum of the Resolved Parts, Magnitude and Direction of the Resultant of any number of Forces.	Student can describe Law of Parallelogram of Forces. Student will be able to define subspace, closure of a set.
2	Equilibrium of Forces Acting on a Particle	Resultant of Parallel Forces,Triangle law of Forces, Converse of the Triangle Law of Forces, Polygon of Forces, Lami's Theorem.	Student understands concept of resultant of Parallel Forces. Student will be able to explainTriangle law of Forces.
3	Forces Acting on a Rigid Body	Conditions of Equilibrium of Forces acting on aParticle,Moment of a Force, Sum of the Vector Moment of a System ofForces, Sum of the Vector Moments of to like Parallel Forces.	Student understands concept of equilibrium of Forces. Student evaluates examples on Vector Moment of the Resultant Couple of two Couples acting upon a Rigid Body.
4	Forces Acting on a Rigid Body	Couples, TwoCouples acting in one Plane upon a Rigid Body, Equivalent Couples, VectorMoment of the Resultant Couple of two Couples acting upon a Rigid Body,System of Forces acting upon a Rigid Body, Conditions of Equilibrium of Forces, Conditions of Equilibrium of Coplanar Forces.	Student understands concept of equivalent couples, vector moment. Student will be able to state Conditions of Equilibrium of Forces.

Specify Course Outcome: Students learns basic, primary knowledge of motion, force and their relations. Student understands the force systems, the concept of motion of particles and rigid bodies.

Specify Program Outcome: Student understands concepts of metric spaces, vector spaces andequilibrium of forces & resultant force of forces.

Signature of Teacher :

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Dr. A. B. Jadhav **Department: Mathematics**
Program: BSc TY Sem-VI **Subject: Mathematics** **Course Code: DSEM-VISection A**
Paper Title: Complex Analysis **Paper No.: XV**

Unit No.	Unit Name	Topics	Unit-wise Outcome
1	Complex Numbers and Analytic functions	Complex Numbers: Exponential form, Roots of complex numbers, Regions in the complex plane. Analytic functions: Functions of complex variables, Mappings, Mappings by the exponential Function, Limits, Theorems on limits, Limit involving, The point at infinity, Continuity, Derivatives, Differentiation formulae.	Student understands concept of functions of complex variables, limit and continuity. Student finds limits and derivatives of functions of complex numbers.
2	Elementary functions	Analytic functions: Cauchy- Riemann equations, Sufficient conditions for derivability,polar co-ordinates, Analytic functions,Harmonic functions, Elementary functions: The exponential functions, The logarithmic functions, Branches and Derivatives of logarithms,Some identities involving logarithms, Complex exponents.	Student uses Cauchy-Riemann equations for solving problems. Student understands concepts ofAnalytic functions, Harmonic functions.
3	Integrals	Integrals: Derivatives of functions w(t), Definite integrals of functions w(t); Contours,Contour Integrals, Upper bounds for moduli of contour integrals, Antiderivatives, Simply and Multiply connected domains.	Student can find the integral of a complex variable function. Student understands concepts of numerical differentiation.
4	Integrals and Series	Integrals: Cauchy integral formula, Derivatives of analytic functions, Liouville's theoremand the Fundamental theorem of algebra. Series: Convergence of sequences, Convergence of series, Taylor series, Laurent series.	Student understands concepts of derivatives of analytic functions. Student uses Cauchy integral formula and Liouville's theorem for solving problems.

Specify Course Outcome: Student can find the missing terms in the given data using numerical techniques. Student can apply numerical derivation and numerical integration methods for solving problems. Student can find the solutions of ordinary differential equations.

Specify Program Outcome: Student understands some fundamental ideas ofcomplex analysis, integral transforms, Laplace transforms. Student also gets an elementary knowledge about Topology.

Signature of Teacher :

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: Dr. A. B. Jadhav **Department: Mathematics**
Program: BSc TY Sem-VI **Subject: Mathematics** **Course Code: DSEM-VISection B**
Paper Title: Integral Transforms **Paper No.: XVI**

Unit No.	Unit Name	Topics	Unit-wise Outcome
1	Laplace Transformations	Introduction, Laplace Transform, Important Formulae, Properties of Laplace Transforms, Laplace Transform of the Derivative of f(t); Laplace Transform of the Derivative of Order n, Laplace Transform of Integral of f(t); Laplace Transform of t f (t), Laplace Transform of 1/t f(t), Unit Step Function, Second ShiftingTheorem, Impulse Function, Periodic Functions, Convolution Theorem, Evaluation of Integrals, Properties of Laplace Transform.	Student understands concept of functions of complex variables, limit and continuity. Student finds limits and derivatives of functions of complex numbers.
2	Inverse Laplace Transforms	Inverse Laplace Transforms, Important Formulae, Multiplication by s, Division by s, First Shifting Property, Second Shifting Property, Inverse LaplaceTransforms of Derivatives, Partial Fractions Method,Inverse Laplace Transform by Convolution.	Student understands concept of inverse Laplace transform. Student can solve examples on inverse Laplace transforms.
3	Solutions of Differential Equations and Integral Transforms	Solution of Differential Equations by Laplace Transforms, Solution of Simultaneous Differential Equations by Laplace Transforms, Introduction to Integral Transforms.	Student can apply the integral transforms along with their inversion formulae for solving differential equations. Student uses various properties of Laplace transforms for solving problems.
4	Fourier Transforms	Fourier Integral Theorem, Fourier Sine and Cosine Integrals, Fourier's Complex Integral, Fourier Transforms, Fourier Sine and Cosine Transforms, Properties of Fourier Transforms.	Student studies properties of Fourier Transforms.Student uses Fourier Integral theorem for solving problems.

Specify Course Outcome: Student understands the concept of Integral Transforms. Student can identify integral transforms by their integration limits and kernels. Student can apply the integral transforms for evaluating integrals.

Specify Program Outcome: Student understands some fundamental ideas of complex analysis, integral transforms, Laplace transforms. Student also gets an elementary knowledge about Topology.

Signature of Teacher :

Dnyanopasak Shikshan Mandal's
College of Arts, Commerce and Science, Parbhani

Pro-forma for program and course outcomes (2.6.1)

Name of Teacher: V. A. Kalyan **Department: Mathematics**
Program: BSc TY Sem-VI **Subject: Mathematics** **Course Code: DSEM-VISection C**
Paper Title: Topology **Paper No.: XVII**

Unit No.	Unit Name	Topics	Unit-wise Outcome
1	Set Theory and Logic	Set Theory and Logic: Fundamental Concepts, Functions, Relations, The Integers andthe Real Numbers, Cartesian Product, Finite Sets, Well-ordering Theorem. TopologicalSpaces and Continuous Functions: Topological Spaces, Basis for Topology.	Student will be able to prove the well-ordering theorem. Student understands concept of Topological spaces.
2	Topological Spaces and Continuous Functions	Topological Spaces and Continuous Functions: The Order Topology, The Product Topology, The Subspace Topology.	Student understands concepts of order topology and product topology. Student will be able to understand the concept of subspace topology.
3	Hausdroff Spaces	Topological Spaces and Continuous Functions: Closed Sets and Limit Points, Closure and Interior of a Set, Limit Points, Hausdroff Spaces.	Student understands concept of continuous functions in a topological space. Student understands concept of Hausdroff Spaces.
4	Connectedness and Compactness	Connectedness: Definition , Examples and Basic Results. Compactness Definition , Examples and Basic Results.	Student understands concepts of connectedness and compactness of a set in a topological space. Student can verify whether a topological space is connected or not.

Specify Course Outcome: Student can understand concepts of topological spaces, topological properties of sets, order topology, product topology and subspace topology. Student can understand basic concept of connected spaces and compact spaces with their utility.

Specify Program Outcome: Student understands some fundamental ideas of complex analysis, integral transforms, Laplace transforms. Student also gets an elementary knowledge about Topology.

Signature of Teacher :