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

Program and course outcomes (2.6.1)

Name of Teacher: Sayyed Afrin Sayyed Sagir **Department: Mathematics**
Program: MSc FY SEM-I **Subject: Mathematics** **Course Code: SMATC401**
Paper Title: Algebra **Paper No.: I**

Module /Unit No.	Unit Name	Topics	Unit-wise Outcome
I	**Cyclic Group**	Semi groups and groups, Subgroups and Cosets, Cyclic groups, Generators and relations, Normal subgroup and quotient group, Isomorphism theorems, Automorphism.	Students will be knowledgeable of different types of subgroups such as normal subgroups, cyclic subgroups
II	**Conjugacy and G-sets**	Conjugacy and G-sets, Normal series, Solvable groups, Nilpotent groups, Permutation Groups, Cyclic decomposition, alternating group A_n.	Student can analyse Permutation groups and cyclic decomposition. Students will have a working knowledge of important mathematical concepts in abstract algebra such as definition of a group, order of a finite group and order of an element
III	**Structure of groups**	Structure of groups, Direct product, Finitely Generated Abelian Groups, Invariants of a finite Abelian group.	Student understands the concept of the Fundamental theorem of finite Abelian group and its applications.
IV	**Ring Theory**	Rings, Examples of rings, Types of rings, Subrings and Characteristic of a ring, Ideals and homomorphism, Maximal and Prime Ideals, Principal ideal, Nilpotent and Nil ideals, Unique Factorization Domains, Principal Ideal Domains, Euclidean Domaisns.	Student understands information on ideals and Quotient rings, Integral domain, PID, UFD and ED.

Specify Course Outcome:
Students will be knowledgeable of different types of subgroups such as normal subgroups, cyclic subgroups. Student learned the concept of Normal subgroups, Quotients groups and Isomorphism. Analyse Permutation groups and cyclic Decomposition.

Specify Program Outcome: Students are able to crack competitive examinations, lectureship and fellowship exams approved by UGC like CSIR-NET and SET.

Signature of Teacher :

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

Program and course outcomes (2.6.1)

Name of Teacher: Ansari Umme Ruman **Department: Mathematics**
Program: M.Sc. F. Y. SEM-I **Subject: Mathematics** **Course Code: SMATC402**
Paper Title: Real Analysis **Paper No.: II**

Module /Unit No.	Unit Name	Topics	Unit-wise Outcome
I	**The Riemann Stieltjes Integral**	Definition and existence of integral, Properties of the integral, Theorem on change of variable, Integration and Differentiation, The fundamental theorem of calculus, integration by parts, integration of vector-valued functions, Rectifiable curves, Examples.	Student will be learn the functions of bounded variation, discuss the continuity, differentiability and Integrability of functions and its properties.
II	**Sequence and series of functions**	Pointwise convergence of a sequence and series of functions, Discussion of main problem, Uniform Convergence, Cauchy criterion for uniform convergence, Weierstrass M-Test for sequence and series of functions, Uniform Convergence and Continuity, Uniform Convergence and Integration, Uniform Convergence and Differentiation.	Student will understand the concept of point wise and uniform convergence and develop the ability to reflect on significant problems in the field of real analysis.
III	**Equicontinuous Families of Functions**	The Stone-Weierstrass theorem (Statements only), Examples, Power Series, Abel's and Taylor's theorems, Uniqueness theorem for power series.	Student apply the Stone-Weierstrass theorem and to solve the problems.
IV	**Derivative, Directional Derivative**	Derivative, Directional Derivative, Examples, Continuously differentiable functions, Mean Value Theorem, Chain rule, Examples, Inverse function theorem and Implicit function theorem, Examples.	Students will be able to Study the derivative, directional derivative, inverse and implicit function theorem..

Specify Course Outcome:

Students can understand and identify the concepts of continuity, Differentiability and inerrability of functions, point wise and uniform convergence.

Specify Program Outcome:

Assist students in preparing (personal guidance, books) for competitive exams e.g. NET, GATE, etc.

Signature of Teacher

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

Program and course outcomes (2.6.1)

Name of Teacher: Miss.P.D. Sapate **Department: Mathematics**
Program: M.Sc. F.Y. NEP SEM-I **Subject: Mathematics** **Course Code: SMATC401**
Paper Title: Complex Analysis

Module /Unit No.	Unit Name	Topics	Unit-wise Outcome
I	**Algebraic and Geometric Preliminaries** **Bilinear Transformation and Mapping** **Elementary Functions**	**1.1] Complex Number**, Algebra of complex numbers, Rectangular and Polar representation of Complex numbers, **1.2] De-Moivre's** Theorem, Mappings (Translation, Rotation, Rotation and Magnification, Rotation and Contraction, **1.3] Linear Transformation**, Inversion (definitions only)) Linear Fractional Transformation, cross ratio. The Exponential Function, Mapping Properties, The Logarithmic Function, **1.4]Branches of Logarithm**, Principal Branch of Logarithm, Complex Exponents.	Describe the Rectangular and Polar representation of Complex numbers. Comprehend the various mappings and complex functions.
II	**Analytic Function** **Complex Integration and Cauchy's Theorems**	**2.1] Continuity**, Differentiability, Cauchy–Riemann Equations, Analyticity, Harmonic Functions, Curves, **2.2] Initial and terminal points**, simply and multiply connected domains, contour integration, Parameterizations, M-L Inequality, **2.3] Line Integrals**, Green's Theorem, Fundamental theorem of Integration. Cauchy's weak Theorem, Cauchy's main theorem, Examples.	Students can be Analyse limit, continuity and differentiation of functions of complex variables. Student can be Understand Cauchy-Riemann equations, analytic functions and various properties of analytic functions. Evaluate the line integrals and different forms of Cauchy's Theorem. Students Understand Cauchy theorems.

III	**Applications of Cauchy's Theorems**	**3.1] Cauchy's Integral Formula,** Cauchy's Generalized Integral Formula. Taylor's Theorem, Cauchy's Inequality, **3.2] Applications of Cauchy's Inequality,** Liouville's Theorem and Applications, Picard Theorem, Identity Theorem, **3.3] Maximum Modulus Theorem,** Gauss' Mean Value Theorem	Students can be apply Cauchy integral formulas and generalise formulae and they apply these to evaluate complex contour integrals. Student can be understand and apply Liouville's Theorem, Picard Theorem, Maximum Modulus Theorem in different related theorems
IV	**Laurent Series and the Residue Theorems.**	**4.1] Laurent Series**, Laurent's Theorem, Singularities, Isolated Singularity, Non- Isolated Singularity, Riemann's Theorem, **4.2] Casorati –Weierstrass Theorem**, Principle and Analytic Part of Laurent Series, Residue of function, Residue Theorem, **4.3] Residue Theorem for C_∞,** Evaluation of real Integrals, The Argument Principle, Rouche's Theorem, **4.4] Comparison with Analytic functions**, Conformal Mapping, Isogonal Mapping.	Students can Analyse the concepts of Laurent Series, Singularities, Principle & analytic part of Laurent Series. Compare Residue theorem and the argument principle. They discuss Conformal Mapping and isogonal mapping.

Specify Course Outcome:

Analyse the Rectangular and Polar Representation of Complex numbers,
the various types of mappings and complex functions, C-R equation, the line integral and different form of Cauchy's theorem
Help to analyse the concepts of Laurent Series, Singularities, Principle & analytic part of Laurent Series. Residue theorem and argument Principle. Conformal Mapping,

Specify Program Outcome:

Apply the Mathematical concepts, in all the fields of learning including higher research, and recognize the need and prepare for lifelong learning.
Students study the Laurent theorem and singularities.

Signature of Teacher :

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

Program and course outcomes (2.6.1)

Name of Teacher: Ansari Umme Ruman **Department: Mathematics**

Program: MSc FY SEM-I **Subject: Mathematics** **Course Code: SMATE401 (A)**

Paper Title: Ordinary Differential Equations **Paper No.: IV**

Module /Unit No.	Unit Name	Topics	Unit-wise Outcome
I	**Linear Equations with Constant Coefficients**	Linear dependence and independence, A formula for the Wronskian, the non-homogeneous equation of order two, the homogeneous equation of order n, initial value problems for nth order equations, equations with real constants, the non-homogeneous equation of order n, a special method for solving the nonhomogeneous equation.	Students to understand the formation of Differential equation from the given physical problems and to solve first order ordinary differential equation by various methods.
II	**Linear Equations with variable Coefficients**	Initial value problems for the homogeneous equations, Solution of homogeneous equation, the Wronskian and linear independence, reduction of the order of homogeneous equation, the non homogeneous equation, homogeneous equation with analytic coefficients, the Legendre equation. Sequence and series of functions, Uniform Convergence and Continuity, Uniform Convergence and Integration, Uniform Convergence and Differentiation.	Student understand the concept of Wronskian, linear dependent and Independent, Legendre equation, Uniform Convergence and Integration, Uniform Convergence and Differentiation.
III	**Linear Equations with Regular Singular Points**	The Euler equation, second order equations with regular singular points-an example, second order equations with regular singular points-the general case, the Bessel equation.	Student will be able to Comprehend the Euler equations, the Bessel equation and Regular singular points.

IV	**Existence and Uniqueness of Solutions to first order Equations**	Equations with variable separated, exact equations, the method of successive approximations, the Lipchitz condition and convergence of successive approximation	Student understand the existence and uniqueness of solutions to first order linear differential equations.

Specify Course Outcome:
Students to understand the formation of Differential equation from the given physical problems and to solve first order ordinary differential equation by various methods., the Euler equations, the Bessel equation and Regular singular points, the existence and uniqueness of solutions to first order linear differential equations.

Specify Program Outcome: Developed the problems solving skills and computational skills.

Signature of Teacher :

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

Program and course outcomes (2.6.1)

Name of Teacher: Sayyed Afrin Sayyed Sagir **Department: Mathematics**
Program: M.Sc. FY SEM-I **Subject: Mathematics** **Course Code: SMATP401**
Paper Title: Latex Typesetting (Practical)

Module /Unit No.	Unit Name	Topics	Unit-wise Outcome
I	**Latex Environment: Getting Acquainted**	Introduction to LaTeX, Installation of LaTeX, Layout Design, LaTeX input files, Input file structure, document classes, Packages, environments, page styles, Typesetting texts, Fancy Header, tables.	Student will be able to Install LaTeX in their systems typeset and control key LaTex environments typesetting of complex mathematical formulae using LaTeX.
II	**Mathematical Expressions in Latex: Carrying on**	Inline math formulas and displayed equations, Math symbols and fonts, Delimiters, matrices, arrays, Typesetting Mathematical formulae: fractions, Integrals, sums, products, etc. Producing Mathematical	Students use various methods to either create or import graphics into a LaTeX document.
III	**Latex Class and formatting : Other document classes**	Document classes for paper writing, thesis, books, etc. Table of contents, index, hypertext, pdf pages, geometry, fancy header and footer, Verbatim, itemize, and enumerate, boxes, equation number. Creating Tables, Inserting figures, enumeration list, itemized list, font effects, and inserting equations.	Student will be able to Typesetting of journal articles, technical reports, thesis, books, and slide presentations.
IV	**Presentation in Latex : Designing It Yourself**	Beamer class, beamer theme, frames, slides, pause, Overlay transparent, hand outs and presentation mode, Inserting references, Manual reference, Reference using BibTex, citing reference.	Students understand Automatic generation of table of contents, bibliographies and indexes ,Understand that LaTeX is the most flexible, portable and efficient approach for typesetting the document, project reports, research papers and books.

Specify Course Outcome: Student studied LaTeX software and its application to solve problems in Mathematical Expressions in Late and Understand that LaTeX is the most flexible, portable and efficient approach for typesetting the document, project reports, research papers and books.

Specify Program Outcome: Students learned Typesetting complex mathematical formulae
They also learned Presentation in Latex and Mathematical Expressions in Latex, bibliographies and indexes.

Signature of Teacher :

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

Program and course outcomes (2.6.1)

Name of Teacher: Miss P.D. Sapate **Department: Mathematics**
Program: M. Sc. F.Y. SEM-I **Subject: Mathematics** **Course Code: SVECRM401**
Paper Title: Research Methodology

Module /Unit No.	Unit Name	Topics	Unit-wise Outcome
I	**Research Methodology: An Introduction Defining the Research Problem**	Meaning of research, Objectives of research, Types of research, Research approaches, Significance of research, Research methods versus methodology, Research and scientific methods, Research processes, Criteria for good research, Research problem, Selecting the problem, Necessity of defining the problem, Techniques involved in defining a problem,	Students who complete this course will be able to understand and comprehend the basics in research methodology and applying them in research/ project work
II	**Research Design and Design of Sample Surveys**	Meaning and need for research design, features of a good design, Important concepts relating to research design: Dependent and independent variables, Extraneous variables, Control, Research hypothesis, Experimental and non-experimental hypothesis – Testing research, Experimental and control group, different research designs: Research design in case of exploratory research studies, Research design in case of hypothesis- testing research studies, basic principles of experimental designs, Important Experimental Designs, Sampling Design, steps in sample design, criteria of selecting a sampling procedure, characteristics of a good sample design, different types of sample design,	Students can Understand the concept of research design and survey methodology. This course will help them to select an appropriate research design

III	**Measurement and scaling, Data Preparation and Descriptive Statistics**	Measurements in Research, Measurement Scales, Sources of errors in measurement, Collection of primary data: Observation Method, Interview Method, through questionnaires, through schedules, difference between questionnaire and schedule, Collection of secondary data, Selection of appropriate methods for data collection, Case study method, Data processing, processing operations: editing, coding, classification, tabulation, graphical representation, types of analysis, Statistics in research, Dispersion and Asymmetry, Measures of Relationship, Regression Analysis,	The Students will develop skills in qualitative and quantitative data analysis and presentation
IV	**Descriptive Statistics and Analysis of Variance**	Basic Concepts Concerning Testing of Hypotheses, Procedure and Flow diagram for Hypothesis Testing, Measuring the Power of a Hypothesis Test, Tests of Hypotheses , Hypothesis Testing of Correlation Coefficients and Limitations of the Tests of Hypotheses , Chi-Square Test: Chi-Square Test for Comparing Variance, Chi-square as a Non-parametric Test, Conditions for the Application of Chi-Square Test, Steps Involved in Applying Chi-square Test, Important Characteristics of Chi-Square Test and caution in using Chi-Square test. Relationship between Spearman's r's and Kendall's, Characteristics of Distribution-free or Non-parametric Tests, Analysis of Variance (ANOVA), Analysis of Co-Variance (ANOCOVA), Distribution-free Tests, its importance, Multivariate Analysis Techniques, Characteristics and Applications, Classification of Multivariate Techniques, Variables in Multivariate Analysis, Important Multivariate Techniques.	\ Students will able to Inferential analysis of data with hypothesis testing and multivariate technique

Specify Course Outcome:
Student understands concept of research and concept of research design and survey methodology.

Specify Program Outcome: Apply ethical principles and commit to professional ethics, responsibilities, and norms in the society
student learned Collection of data, processing of data and descriptive measures of data and Inferential analysis of data with hypothesis testing and multivariate technique.

Student can formulate mathematical models

Signature Of Teacher :

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

Program and course outcomes (2.6.1)

Name of Teacher: Sayyed Afrin Sayyed Sagir **Department: Mathematics**
Program: M. Sc. F.Y. NEP SEM-II **Subject: Mathematics** **Course Code: SMATC451**
Paper Title: Linear Algebra

Module /Unit No.	Unit Name	Topics	Unit-wise Outcome
I	**Vector space**	Introduction, Vector spaces, subspaces, Quotient Spaces, Linear combinations and system of linear equations, linear dependence and independence, Bases and dimension, Maximal Linear Independent Subsets	Student will be able to identify the concepts of Liner Independence, bases and Dual spaces.
II	**Linear Transformations**	Linear Transformations, Null spaces, Ranges, The matrix representation of a linear transformation, Composition of linear transformations, Invertibility and Isomorphism, The change of Co-ordinate matrix, Dual spaces.	Student discuss Algebra of Linear Transformations and Characteristics roots.
III	**Elementary Matrix Operations**	Elementary Matrix Operations and elementary matrices, The rank of a matrix, System of linear equations-Theoretical Aspects, System of linear equations-Computational Aspects, Eigen values and Eigen vectors, Diagonalizability, Triangulable Operators, Invariant Subspaces, Cayley-Hamilton Theorem.	Student will be able to explain canonical forms and Cayley-Hamilton Theorem, Eigen values and Eigen vectors
IV	**Inner products space**	Inner products and Norms, The Gram-Schmidt Orthogonalization process and orthogonal complements, the adjoint of a linear operator, Bilinear forms, Quadratic forms. Jordan Canonical form-I, Jordan Canonical form-II, The Minimal Polynomial, Rational Canonical form.	Student understand analyze rational canonical forms and Determinants, Jordan Canonical form-I, Jordan Canonical form-II

Specify Course Outcome:. Students understand and Identify the concepts of Liner Independence, bases and Dual spaces ,canonical forms and Cayley-Hamilton theorem.

Specify Program Outcome: Students understood the theories, concepts and developed working knowledge of vector spaces, linear transformations, canonical forms, Inner product space.

Signature of Teacher

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

Program and course outcomes (2.6.1)

Name of Teacher: MISS P.D. SAPATE **Department: Mathematics**
Program: M. Sc. F.Y. NEP SEM-II **Subject: Mathematics** **Course Code: SMATC452**
Paper Title: Measure and Integration Theory

Module /Unit No.	Unit Name	Topics	Unit-wise Outcome
I	**Lebesgue outer measure**	Lebesgue outer measure, Measurable sets, Regularity, Measurable functions, Borel and Lebesgue measurability, Integration of non-negative functions, Fatou's Lemma, Lebesgue's Monotone Convergence Theorem, The general integral, Lebesgue's Dominated Convergence, Integration of series, Riemann and Lebesgue Integrals.	Student will be able to Comprehend the measurable sets, Lebesgue measure, Fatou's Lemma, Lebesgue's Dominated Convergence and Integration of series.
II	**Differentiation**	The four derivatives, Continuous non-differentiable functions, Functions of bounded variations, Lebesgue Differentiation Theorem (Statement only), Differentiation and integration, The Lebesgue Set	student discuss the four derivatives, Functions of bounded variations, Lebesgue Differentiation Theorem
III	**Abstract measure spaces**	Measure and outer measure, Hereditary, Complete Measure, Extension of measure, Uniqueness of the extension, Completion of measure, Measure spaces, Integration with respect to measure.	student will be able to define the Hereditary class and Measure spaces.
IV	**Signed measure and their derivatives**	Signed measure and the Hahn-Decomposition, The Jordan decomposition, The Raydon–Nikodym theorem (Statement only).	student will be able to explain signed measure and their derivatives.

Specify Course Outcome:. Student understand Comprehend of measurable sets, Lebesgue measure, Fatou's Lemma, Lebesgue's Dominated Convergence and Integration of series and the four derivatives, Functions of bounded variations

. **Specify Program Outcome:** Student Can analyze the differentiation and integration

Signature of Teacher

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

Program and course outcomes (2.6.1)

Name of Teacher: Ansari Umme Ruman **Department: Mathematics**
Program: M.Sc. F.Y. NEP SEM-II **Subject: Mathematics** **Course Code: SMATC453**
Paper Title: Topology

Module /Unit No.	Unit Name	Topics	Unit-wise Outcome
I	**Topological Spaces**	Basis for a topology, Order topology, Subspace Topology, Product topology, closed sets and limit points	student will be able to understand basics of Topological Spaces and their properties
II	**Continuous functions**	Continuous functions, Metric Topology, Connected spaces, Connected Subspaces of Real Line, Components and Local Connectedness	Student will be able to Study Continuous functions, Metric Topology, Connected Spaces, Limit Point, Compactness, Local Compactness, Limit point Compactness.
III	**Compact spaces**	Compact spaces, Compact Subspaces of the Real Line, Limit point compactness, Local Compactness..	Student will be able to Achieve the zenith in treating Countable Axioms, Separable, Regular and Normal spaces.
IV	**Countability Axioms**	Countability Axioms, Separation axioms, Normal Spaces, Urysohn's Lemma (without proof), The Urysohn's Metrization Theorem (without proof), Tietze Extension Theorem (Without Proof), Tychonoff's Theorem.	Students Understand the Urysohn's Lemma, Urysohn's Metrization Theorem and their applications.

Specify Course Outcome:. Students understand the Continuous functions, Metric Topology, Connected Spaces, Limit Point, Compactness, Local Compactness, Limit point Compactness

Specify Program Outcome: Student can analyse Topology, Compact spaces, Count ability Axioms. Student developed mathematical models and the problems solving skill

Signature of Teacher

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

Program and course outcomes (2.6.1)

Name of Teacher: Ansari Umme Ruman **Department: Mathematics**
Program: M.Sc. F.Y. NEP SEM-II **Subject: Mathematics** **Course Code: SMATE451 (A)**
Paper Title: Partial Differential Equations (IX)

Module /Unit No.	Unit Name	Topics	Unit-wise Outcome
I	**Curves and surfaces**	Curves and surfaces, Genesis of first order PDE, classification of integrals, linear equations of first order, Pfaffian differential equations, Compatible systems.	Students analyze the origin of first order partial differential equations
II	**Solution of differential equation**	Charpits method, Jacobi's method, integral surface through a given curve, Quasilinear equations, non-linear first order partial differential equation.	Student will be able to understand non-linear first order partial differential equation, Quasilinear equations
III	**second order partial differential equation**	Genesis of second order partial differential equation, classification of second order partial differential equation, vibrations of an infinite string, vibrations of semi-infinite string, vibrations of a string of finite length, method of separation of variables.	Student will be able to understand Genesis of second order partial differential equations, vibrations of an infinite string, vibrations of semi-infinite string, vibrations of a string of finite length
IV	**Boundary value problems**	Boundary value problems, Maximum and Minimum principles, the Cauchy problem, the Dirichlet problem, Neumann problem, Harnacks theorem, heat conduction problem, Duhamels principle, classification in the case of n-variables.	Student will be able to solve the boundary value problems and classification in the case of n-variables.

Specify Course Outcome:. Student can analyze the origin of first order partial differential equations and solving them using Charpits method and non-linear first order partial differential equation.

Specify Program Outcome: Delveloped mathematical models and the problems solving skills.

Signature of Teacher

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

Program and course outcomes (2.6.1)

Name of Teacher: Miss P.D. Sapate **Department: Mathematics**
Program: M.Sc. F.Y. NEP SEM-II **Subject: Mathematics** **Course Code: SMATP451**
Paper Title Introduction to Scilab (Practical)

Module /Unit No.	Unit Name	Topics	Unit-wise Outcome
I	**Introduction to Scilab**	Introduction to Scilab, Installation of Scilab, Basic elements of the language, Looping and Branching: If, select, for, break, continue, Functions, return, Contour plots, tiles, axes, legends.	Student will be able to install Scilab and execute looping and branching commands
II	**Linear Algebra using Scilab**	Creating matrices, sum, product of matrices, inverse, rank determinant, Comparing matrices, system of equations, High level linear algebra features, working with polynomials, Matrix inversions, Solving system of equations.	Student will be able to understand the basic concepts of programming.
III	**Scilab Demonstrations**	Polynomials, discrete and continuous Random variables, Basic functions, animation, Bezier curves and surfaces, matplot, complex elementary functions. Scilab	Students handle matrices and their operations in scilab; Plot and visualize 2D and 3D graphs of various functions.
IV	**Calculus Using Scilab**	Plotting 2D and 3D graphs, defining a function and output arguments. Parametric plots, Polar plots 4Evaluation of definite integrals, Generating prime numbers ,Illustration of Rolle's and Mean value theorems.	Student understand the main features of the SCILAB program development environment to enable it's usage in the higher learning. interpret and visualize simple mathematical functions and operations by using plots.

Specify Course Outcome: Student understand the main features of the SCILAB program development environment to enable it's usage in the higher learning.

Specify Program Outcome: Students handle matrices and their operations in scilab; Plot and visualize 2D and 3D graphs of various functions.

Signature of Teacher

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

Program and course outcomes (2.6.1)

Name of Teacher: Miss Sapate P.D **Department: Mathematics**
Program: M.Sc. S.Y. CBCS (SEM-III) **Subject: Mathematics** **PAPER NO. - XIII**
Paper Title: Functional Analysis

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	**Banach Spaces**	Normed linear Space, Banach Space, Some examples, Subspace and Quotient Space Holder's Inequality, Continuous linear transformations, The Hahn-Banach theorem, Applications of Hahn Banach Theorem, The natural embedding of N in N**, The Open Mapping Theorem, Closed Graph Theorem, The conjugate of an operator, Uniform Boundedness Principle Theorem.	Students Comprehend the Normed Linear space, Banach Spaces Hahn Banach and Open Mapping Theorem
II	**Hilbert Spaces**	Inner product. Inner product space, Hilbert space, The definition and some properties, Parallelogram law, Polarization identity, Schwarz Inequality, Orthogonal vectors, Orthogonal set, Vector orthogonal to a set, Pythagoras theorem and applications,Orthogonal complements, Pythagoras theorem and applications, Orthonormal vectors, Orthonormal set, Complete orthonormal set, Bessel's Inequality, The conjugate space H*, Riesz Representation Theorem.	Students Define the Orthogonal sets , Different types Operators.

III	**Operator and Adjoint of an Operator**	Operator, The adjoint of on operator, definition and examples. Properties of adjoint of operator of T, The Self adjoint operators, Positive operators, Normal operators, Real and Imaginary part of an operator. Normal Operator, Unitary operator, Projections on Hilbert space, Orthogonal Projection. Invariant subspace, Reducibility	They Identify, Self Adjoint, Normal, Unitary and Positive operators and to analyze the invariant subspace and reducible transformations.
IV	**Finite Dimensional Spectral Theory**	Introduction, Finite dimensional Hilbert space, eigen value, eigen vector, eigen space, spectrum of an operator, The spectral theorem.	Student Analysing the Spectrum theorem and to Provide information on Eigen Value, Eigen Vectors, Eigen Spaces and Spectrum of T.

Specify Course Outcome: Identify Normed Linear Space, Banach Space, continous Linear transformations, Conjugate space, Banach Algebra, Graph of L.T.Hahn-Banach TheoremAnalyze Hilbert space, Orthogonal and Orthonormal vectors and sets, Orthogonal Compliments and conjugate space H*

Specify Program Outcome:

To understand the basic concepts of advanced mathematics.
To develop the problems solving skills and computational skills.:
To enhance self learning and improve own performance.

Signature of Teacher

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

Program and course outcomes (2.6.1)

Name of Teacher: Ansari Umme Ruman **Department: Mathematics**
Program: M.Sc. S.Y. CBCS (SEM-III) **Subject: Mathematics** **PAPER NO. - XIV**
Paper Title: TOPOLOGY

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	**Topological Spaces**	Topological Spaces: Basis for a topology, Order topology, Subspace Topology, Product topology, closed sets and limit points.	The students define types of Topologies and explain continuous functions.
II	**Connected and**	Continuous functions, Metric Topology, Connected spaces, Connected Subspaces of Real Line, Components and Local Connectedness.	The students compares Different types of connected space
III	**Compact Spaces**	Compact spaces, Compact Subspaces of the Real Line, Limit point compactness, Local Compactness.	Achieve the zenith in treating Countable Axioms, Separable, Regular and Normal spaces
IV	**Countability and Separation Axioms**	Countability Axioms, Separation axioms, Normal Spaces, Urysohn's Lemma (without proof), The Urysohn's Metrization Theorem (without proof), Tietze Extension Theorem (Without Proof), Tychonoff's Theorem.	Understand the Urysohn's Lemma, Urysohn's Metrization Theorem and their applications.

Specify Course Outcome:.

Students are able to understand Topology, basis, continuous functions etc.

Students able to examine connected, compact and separation axioms.

Specify Program Outcome:

Developed the basic concept of Topology.

The goal of the course is to provide in depth knowledge of this fundamental core course in mathematics to show various techniques from analysis, set theory, logic that are used in topological spaces to obtain their properties, to demon strate application in physics

Signature of Teacher

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

Program and course outcomes (2.6.1)

Name of Teacher: Sayyed Afrin Sayyed Sagir **Department: Mathematics**
Program: M.Sc. S.Y. CBCS (SEM-III) **Subject: Mathematics** **PAPER NO. – XV(A)**
Paper Title: ANALYTICAL NUMBER THEORY

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	**The Theory of Congruences and Fermat's Theorem**	Congruence's, Basic properties of congruence's, Binary and decimal representation of integers, Linear congruence's and Chinese Remainder theorem, Pierre de Fermat theorem, Fermat's little theorem and pseudo-primes, Wilson's theorem.	The student describes properties of congruence and solves the problems.
II	**Primitive Roots and Indices**	The order of an integer modulo n, primitive roots for primes, Lagrange's theorem, Composite numbers having primitive roots, the theory of indices.	Student can be Analyze primitive roots and indices
III	**The Quadratic Reciprocity Law**	Euler's criterion, The Legendre symbol and its properties, Gauss Lemma, Quadratic reciprocity, Quadratic reciprocity law, Quadratic congruence's with composite moduli, The equation x 2+y 2=z 2 , Pythagorean triple.	Discuss Legendre symbol and its properties, Quadratic reciprocity law.

IV	**Arithmetical Functions & Dirichlet Multiplication**	The Mobius function $\mu(n)$, The Eular Totient function $\varphi(n)$, A relation connecting μ and φ, The product formula for $\varphi(n)$, Dirichlet product of arithmetic function, Dirichlet inverses and Mobius inversion formula, The Managoldt function $\Lambda(n)$, Multipicative function, Multipicative function and Dirichlet Multiplication, Inverse of Completely multiplicative function, Liouville's function, The divisor function, Generalized convolution, Formal power series, The Bell series of an arithmetic function, bell series and Dirichlet multiplication, derivatives of arithmetic function, The Selberg identity.	Student can be study arithmetical functions and Dirichlet multiplication.

Specify Course Outcome:.

Students are able to identify the concept of number theory, Legendre symbol and its application.

Understand the types of function depend on Arithmetical Functions & Dirichlet Multiplication.

Specify Program Outcome:

Develop the problems solving skills and computational skills of number theory.

Signature of Teacher

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

Program and course outcomes (2.6.1)

Name of Teacher: Ansari Umme Ruman **Department: Mathematics**
Program: M.Sc. S.Y. CBCS (SEM-III) **Subject: Mathematics** **PAPER NO. – XVI(A)**
Paper Title: FLUID MECHANICS-I

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	**Real fluids and ideal fluids**	Real fluids and Ideal fluids, Velocity of fluid at a point, Streamlines and Pathlines, steady and unsteady flows, the velocity potential, the vorticity vector, Local and particle rates of change, the equation of continuity, worked examples, acceleration of fluid, Conditions at a rigid boundary, general analysis of fluid motion.	The students describes the fluids and explain various properties of fluids.
II	, **Eulers equation of motion, Bernoullis equation**	Pressure at a point in a fluid at rest, Pressure at a point in a moving fluid, Conditions at a boundary of two inviscid immiscible fluids, Eulers equation of motion, Bernoullis equation, Mechanism of Pitot Tube and Venturi meter, worked examples	The students describes the pressure in a fluid in different point, discuss the Euler's equation of motion , Bernoulli's equation.

III	**Steady motion under conservative body forces**	Discussion of the case of steady motion under conservative body forces, some potential theorems (statement only), Some flows involving axial symmetry, some special two dimensional flows, Impulsive motion, some further aspects of vortex motion	Student can ve solve the flow problems
IV	**Two dimensional flow**	Meaning of two dimensional flow, use of cylindrical polar coordinates, The Stream function, The complex velocity potentials for standard two-dimensional flows, Uniform stream, line sources and line sinks, line doublets, line vortices, some worked examples.	Acquire command on stream function. Also student can be solve problem of sink and source ,line doublets

Specify Course Outcome:.

Understand the various properties of fluid , Applying the Euler equation, Bernoulli's equation. Analysing link Source, sink, and Doublet.

Specify Program Outcome:

Students can analyze the variuous Euler equation, Bernoulli's equation. Analysing link Source, sink, and Doublet.

Signature of Teacher

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

Program and course outcomes (2.6.1)

Name of Teacher: Miss Sapate P.D **Department: Mathematics**
Program: M.Sc. S.Y. CBCS (SEM-III) **Subject: Mathematics** **PAPER NO. – XVII(A)**
Paper Title: Integral Transform

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	**The Laplace Transform**	The Laplace Transform: Introduction, The Laplace Transform of some typical functions, Basic operational properties, Transforms of more complicated functions, The inverse Laplace Transform, Complex Inversion Formula, Additional Topics.	Identify the Laplace transform some typical function and its application.
II	**Applications involving Laplace Transform**	Applications involving Laplace Transform: Introduction, Evaluating integrals, Solutions of ODEs, Solutions of PDEs. The Mellin transform, Evaluation of Mellin transform, Complex variable methods, Applications.	Formulate the physical problem under consideration in terms of different types of ordinary and partial differential equations with initial and boundary conditions.
III	**Fourier integrals and Fourier Transforms**	Fourier integrals and Fourier Transforms: Introduction, Fourier integral representations, Proof of the Fourier integral theorem, Fourier transform pairs, Properties of the Fourier Transform, The convolution integrals of Fourier, Transforms involving generalized functions.	Solve the initial value problems and boundary value problems using the appropriate integral transform.

IV	**Applications involving Fourier transforms**	Applications involving Fourier transforms: Introduction, Boundary value problems, Heat conduction in solids, The Hankel Transform, Introduction, Evaluation of Hankel Transform, Applications.	Analyze the nature of the solution of the initial value problems and boundary value problems.

Specify Course Outcome:. Can analyze the problems of Laplace transform and fourier transform to solve the problems.

Specify Program Outcome:

Understood the various types of integral transform and mathematical formulae in integral transform.

Signature of Teacher

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

Program and course outcomes (2.6.1)

Name of Teacher: Miss Sapate P.D **Department: Mathematics**
Program: M.Sc. S.Y. CBCS (SEM-IV) **Subject: Mathematics** **PAPER NO. – XIX**
Paper Title: Numerical Analysis

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	**Transcendental and Polynomial equations**	Introduction, Bisection method, Iteration Methods based on first degree equation: Secant and Regula Falsi Method, Newton - Raphson Method, Iteration Methods based on second degree equation: Muller Method, Chebyshev Method, Rate of Convergence.	Student can be Identify the roots of equations and to obtain them by using different iteration Methods. Also to obtain rate of convergence of Iteration Methods.
II	**Direct Methods to Solve the System of n Equations in n Unknowns**	Some basic definitions: Square, Diagonal, Lower Triangular, Upper Triangular, Identity and Null Matrix. Symmetric and Skew-Symmetric Matrix, Hermitian and Skew□Hermitian Matrix, Orthogonal Matrix, Permutation Matrix, Property 'A', tri-diagonal and band Matrix, Positive definite Matrix, System of n equations in n unknowns. Direct methods to solve the system of n equations in n unknowns: Cramer's Rule, Gauss elimination method, Jordan elimination Method, Triangularization Method, Cholesky Method, Partition Method, Model Problems.	Student can be analyze the direct methods to solve the the system of n equations in n unknowns by using different direct methods.

III	**Iteration methods to solve the system of n equations in n unknowns**	Introduction, Iteration methods to solve the system of n equations in n unknowns: Gauss-Seidel Method, Jacobi Iteration Method, Successive Over Relaxation Method, Model Problems, Iteration Method to Obtain Inverse of a Square Matrix. Convergence of Iteration methods, Norms of Matrix: Absolute Row sum and Absolujte Coloum sum Norm, Euclidean Norm, Hilbert Norm, Eigen Value and Eigen Vectors, Eigen Value Problem, Bounds on Eigen Values Gresgorin and Braur's Theorems, Model problems	Student can be identify the Iteration Methods to Solve the System of n Equations in n Unknowns, Eigen Value problems and to obtain Bounds on Eigen Values
IV	**Interpolations and Approximations**	Introduction, Vandermonde's Determinant, Interpolating Polynomial, Langrange Interpolating Polynomial, Newton's Divided Difference Interpolating Polynomial, Aitken's Interpolating Polynomial, Quadratic Interpolation, Higher Order Interpolating Polynomials, Finite Difference Operators, Relation between the Finite Difference Operations and Derivatives, Interpolating polynomials using finite difference operators, Model Problems. Best Approximation, Least Square Approximation.	Student provide information on Interpolations and Approximations for the given function.

Specify Course Outcome:.
Students able to solve different types of methods.and analyze the eigen value and eigen vector.

Specify Program Outcome:
To understand the basic concepts of advanced mathematics. To develop the problems solving skills and computational skills. To enhance self learning and improve own performance.

Signature of Teacher

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

Program and course outcomes (2.6.1)

Name of Teacher: Miss Sapate P.D **Department: Mathematics**
Program: M.Sc. S.Y. CBCS (SEM-IV) **Subject: Mathematics** **PAPER NO. –XX**
Paper Title: Abstract Algebra- II (Field Theory)

Paper Title: XX Unit Number	Unit Name	Topics	Unit-wise Outcome
I	**Irreducible polynomial and extension**	Irreducible polynomial and Eisenstein criterion, Adjunction of roots, Algebraic extensions, Algebraically closed field.	Understand the main algebraic properties of fields
II	**Splitting field**	Splitting field, Normal extension, Multiple Roots, Finite Field, Separable Extensions.	Analyze properties of Finite, Algebraic, Normal, Simple, Cyclic & Separable extension and Splitting Fields.
III	**Automorphism groups and fixed fields**	Automorphism groups and fixed fields, fundamental theorem of Galois theory, fundamental theorem of algebra..	Develop knowledge of some classical Greek problems. Compute Galois groups in simple cases and to apply the group-theoretic information to comprehend results about fields and field extensions.

IV	**Roots of unity and cyclotomic polynomials**	Roots of unity and cyclotomic polynomials, Cyclic extension, polynomials solvable by radicals, symmetric functions, Ruler and Compass construction.	Understand the concepts Cyclotomic polynomials, Polynomials solvable by radicals, symmetric functions, ruler and compass construction to Develop abstract mathematical thinking about field

Specify Course Outcome:. Students can Comprehend the polynomial and extension automorphism and Galois theory a, polynomial and solve the problems.

Understand the concepts Cyclotomic polynomials, Polynomials solvable by radicals, symmetric functions, ruler and compass construction to Develop abstract mathematical thinking about fiel

Specify Program Outcome:

Student Can analyze polynomial and automaorphism.
To equip students with knowledge, abilities and insight in mathematics and related fields.
Have the ability to pursue interdepartmental research in Universities in India and abroad.

Signature of Teacher

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

Program and course outcomes (2.6.1)

Name of Teacher: Sayyed Afrin Sayyed Sagir **Department: Mathematics**
Program: M.Sc. S.Y. CBCS (SEM-IV) **Subject: Mathematics** **PAPER NO. – XXI (A)**
Paper Title: Classical Mechanics

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	**Mechanics of System of particles**	Mechanics of System of particles, generalized co-ordinates, Degree of freedom, Holonomic and Noholonomic system, Scleronomic and Rheonomic system, D'Alembert's principles and Lagrange's Equation of Motion, Different forms of Lagrange's Equation, Generalized Potential, Conservative fields and its Energy Equation, Application of Lagrange's formulation.	Student Understand D' Alembert's Principle and applications of the Lagrangian Formulation.
II	**Hamilton's Principle**	Hamilton's Principle, Hamitton's canonical Equations, Lagrange's Equation from Hamilton's Principle, Extension of Hamilton's Principle to Non-holonomic systems, Application of Hamilton's formulation, cyclic co-ordinates and conservation theorems, Routn's Procedure, Hamilton's Equations from variational principle, principle of least Action. Generalization of Euler Equation, Variational Problems with subsidiary conditions.	Students solve the problems Distinguish the concept of the Hamilton Equations of Motion and the Principle of Least Action.

III	**Functional and Linear Functional**	Functional, Linear Functional, Fundamental lemma of calculus of variations, Simple variational problems, The variation of functional, The extremum of functional, Necessary condition for Extreme, Euler Equation,	Analyze the Fundamental lemma of calculus of variations.
IV	**Eulers Equation of several variables**	Eulers Equation of several variables, Invariance of Euler Equation, Motivating Problems of calculus of variation, Shortest Distance, Minimum surface of Revolution, Brachistochrone Problem, Isoperimetric Problem, Geodesic, Variational problems in Parametric form, Generalization of Euler Equation, Variational Problems with subsidiary conditions.	Solve problems of calculus of variations using Euler's equation.

Specify Course Outcome:. Students develop types of equation and comparing types of system

Specify Program Outcome:

Student Can analyze the types of equation and comparing types of system.

To enable them to work as a mathematical professional or qualify for training as scientific researcher.

To enable students to recognize the need for society and the ability to engage in life-long learning.

Signature of Teacher

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

Program and course outcomes (2.6.1)

Name of Teacher: Ansari Umme Ruman **Department: Mathematics**
Program: M.Sc. S.Y. CBCS (SEM-IV) **Subject: Mathematics** **PAPER NO. – XXII(A)**
Paper Title: Fluid Mechanics-II

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	**Two-dimensional image systems**	Two dimensional image system, The Milne- Thomson circle theorem, Applications of the circle theorem, the theorem of Blasius, some worked examples.	Students Comprehend theorem.
II	**Compressibility effects in real fluids**	Compressibility effects in real fluids, The elements of wave motion, The speed of sound in a gas, Equation of motion of a gas, Subsonic, sonic and Supersonic flows, Isentropic gas flow, Reservoir discharge through a channel of varying section, Shock waves	Students describe compressibility effects in real fluids.
III	**Stress components in a real fluid**	Stress components in a real fluid, Relations between Cartesian components of stress, Translational motion of fluid element, The rate of strain quadratic and principle stresses, Some further properties of the rate of strain quadratic, Stress analysis in fluid motion, Relation between stress and rate of strain, The coefficient of viscosity and laminar flow. The Naiver Stokes equations of motion of a viscous fluid.	Student Analysing the fluid motion.

I V	**Flow between two parallel planes, Steady flow**	Flow between two parallel planes, Steady flow through tube of uniform circular cross section, some solvable problems in viscous flow, Steady viscous flow between concentric rotating cylinders. Uniqueness theorem, Diffusion of vorticity, Energy dissipation due to viscosity, Steady flow past a fixed sphere, Prandtl's Boundary Layer.	Evaluate the velocity of fluid flow.

Specify Course Outcome:. Students Comprehend theorem.

Students describe compressibility effects in real fluids

Specify Program Outcome: Developed the Comprehend theorem., compressibility effects in real fluids

Signature of Teacher

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

Program and course outcomes (2.6.1)

Name of Teacher: Miss Sapate P.D **Department: Mathematics**
Program: M.Sc. S.Y. CBCS (SEM-IV) **Subject: Mathematics** **PAPER NO. – XXIII(A)**
Paper Title: Integral Equations

Unit Number	Unit Name	Topics	Unit-wise Outcome
I	**PRELIMINARY CONCEPTS & CONVERSION OF ORDINARY DIFFERENTIAL EQUATIONS INTO INTEGRAL EQUATIONS**	Preliminary Concepts, Integral Equation: Definition, Linear and nonlinear Integral Equations, Fredholm Integral Equations, Volterra Integral Equations, Singular Integral Equations, Special Kinds of Kernels, and classification of integral equations, Special kinds of kernels, Convolution integrals, Conversion of an initial value problem into a Volterra integral equation, Conversion of a boundary value problem into a Fredholm integral equation, Homogeneous integral equations of the second kind with separable kernel	Students can be learn different types of Integral equations
II	**FREDHOLM INTEGRAL EQUATIONS OF THE SECOND KIND WITH SEPARABLE (OR DEGENERATE) KERNELS & METHOD OF SUCCESSIVE**	Solution of Fredholm integral equations of the second kind with separable kernel, Fredholm alternative, an approximate method Method of successive approximation: Iterated kernel, Resolvent kernel, Solution of Fredholm and Volterra integral equations of the second kind by the method of successive substitutions, Solution of Fredholm	Students compare Demonstrate a depth of understanding in advanced mathematical topics in relation to geometry of curves and surfaces.

	APPROXIMATIONS	and Volterra integral equations of the second kind by the method of successive approximations: Neumann series.	
III	**INTEGRAL EQUATIONS WITH SYMMETRIC KERNELS**	Integral Integral equations with symmetric kernels: Regularity conditions, Complex Hilbert space, An orthonormal system of functions, Fundamental properties of eigen values and eigen functions for symmetric kernels. Expansion in eigen functions and bilinear form, Hilbert□Schmidt theorem and some immediate consequences, Definite Kernels and Mercer's theorem	Apply the knowledge of integral transformation like Laplace transformation, Fourier transformation to solve different types of integral equation..
IV	**SINGULAR INTEGRAL EQUATIONS & INTEGRAL TRANSFORM METHODS**	Singular integral equations, The solution of Abel integral equation, general form of Abel integral equation, Another general form of Abel integral equation, Integral transform method, Application of Laplace transform to solve Volterra integral equations with convolution type kernels, Examples.	Apply the knowledge of integral transformation like Laplace transformation, Fourier transformation to solve different types of integral equation.

Specify Course Outcome:. Can analyze compressibility effects in real fluids the different kernel

Specify Program Outcome:

Developed the understanding compressibility effects in real fluids the different kernel

To develop the problems solving skills and computational skills

Able to crack competitive examinations, lectureship and fellowship exams approved by UGC like CSIR-NET and SET

Signature of Teacher