MAHATMA GANDHI VIDYAMANDIR'S		
M.S.G., ARTS, SCIENCE AND COMMERCE COLLEGE MALEGAON CAMP, NASHIK		
Program Outcomes (Mathematics)		
Name: of Programme : Bachelor of Science (B. Sc.)		
PO. No.	**Program Outcomes** **After successful completion of this program, a student will be able to**	**Graduate Attributes**
PO1	Demonstrate comprehensive knowledge and understanding of one or more disciplines which form a part of an undergraduate programme of study.	Disciplinary knowledge
PO2	Express thoughts and ideas effectively in writing and orally.	Communication Skills
PO3	Evaluate practices, policies and theories by following scientific approach to knowledge development.	Critical thinking
PO4	Apply one's learning to real life situations.	Problem solving
PO5	Draw valid conclusions and support them with evidence and examples.	Analytical reasoning
PO6	Plan, execute and report the results of an experiment or investigation.	Research-related skills
PO7	Work effectively and respectfully with diverse teams.	Cooperation/Team work
PO8	Critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective.	Scientific reasoning
PO9	Work independently, identify appropriate resources required for a project, and manage a project through to completion.	Self-directed learning

PO10	Effectively engage in a multicultural society and interact respectfully with diverse groups.	Multicultural competence
PO11	Adopt objective, unbiased and truthful actions in all aspects of work.	Moral and ethical awareness/reasoning
PO12	Have a capability for mapping out the tasks of a team or an organization.	Leadership readiness/qualities
PO13	Acquire skills to learn how to learn.	Lifelong learning
PO14	Develop social, cultural and national integrity.	Reflective thinking

Program Specific Outcomes

Name of Program (with Specialization) - Bachelor of Science in Mathematics

PO. No.	Program Outcomes After successful completion of this program, a student will be able to	Graduate Attributes
PSO1	Demonstrate fundamental systematic knowledge of mathematics and its applications in engineering, science, technology and mathematical sciences.	Critical thinking
PSO2	Demonstrate educational skills in areas of analysis, geometry, algebra, mechanics, differential equations etc.	Lifelong learning
PSO3	Apply knowledge, understanding and skills to identify the difficult/unsolved problems in mathematics and to collect the required information in possible range of sources and try to analyse and evaluate these problems using appropriate methodologies.	Digitally literate
PSO4	Fulfil one’s learning requirements in mathematics, drawing from a range of contemporary research works and their applications in diverse areas of mathematical sciences.	Problem solving
PSO5	Apply one’s disciplinary knowledge and skills in mathematics in newer domains and uncharted areas.	Reflective thinking & Cooperation/Team work
PSO6	Identify challenging problems in mathematics and obtain well-defined solutions.	Moral and ethical awareness/reasoning
PSO7	Exhibit subject-specific transferable knowledge in mathematics relevant to job trends and employment opportunities.	Lifelong learning

Course Outcomes

Name of Program (with Specialization) - Bachlelor of Science in Mathematics

Title of Course	CO. No.	Course Outcomes After successful completion of this Course a student will be able to
MT-111:- Algebra (Theory)	CO1	Find the gcd of two integers and express it as a linear combination of those two integers. (Evaluating)
	CO2	Learn about some important results in the theory of numbers including the Euclid's lemma and Fermat's theorem.(Understanding)
	CO3	Apply De Moivre's theorem in a number of applications to solve numericalproblems.(Applying)
	CO4	Identify the different types of relations and interrelate equivalence classes and partitions. (Analysing)
	CO5	Justify the algebraic properties of complex numbers. (Analysing)
	CO6	Construct a relation satisfying conditions of none, one or many of reflexive, symmetric and transitive relations.(Creating)
MT-112:- Calculus-I (Theory)	CO1	Describe fundamental properties of the real numbers and find the limits of sequences and functions.
	CO2	Understand the concept of sequence, properties of sequences and continuous functions.
	CO3	Solve algebraic equations and inequalities and prove simple identities.
	CO4	Identify the different types of sequences.
	CO5	Decide the existence of limit of sequences and the continuity of functions of one variable.
	CO6	Imagine the graphs of simple functions.
MT- 113:-	CO1	Relate the knowledge of Mathematics in real life. (Remembering)

Mathematics Practical (Sem-I)	CO2	Learn to find graphs, roots and primes integer using Maxima software.(Understanding)
	CO3	Gain confidence in solving problems. (Evaluating)
	CO4	Compare the graphs of two different functions using Maxima software.(Applying)
	CO5	Decide the sequence whether it is convergent, divergent or bounded. (Analysing)
	CO6	Construct different types of relations and sequences of real numbers (Creating)
MT- 231:-Calculus of Several variables	CO1	**Understanding:**Functions of two, three or more variables, Domain and Range of functions Chain Rule, Change of order of integration for two variables. Local Maxima and minima, saddle point.
	CO2	**Evaluating:** Domain and range, limit, continuity, partial derivatives of two variables functions. Double and triple integration of function of two and three variables respectively.
	CO3	**Creating: By** Graphs creates domain , range of functions, Level curves. Limit , derivatives at different points
	CO4	**Remembering :** function of one variable, limit and continuityand Integration of one variable function.
	CO5	**Analysing :** Maxima and minima, Change of order of integration for two variables. Double integral in Polar coordinates.Triple integrals , Triple integrals in spherical coordinates
	CO6	**Applying:** Claraiut's theorem, Chain Rule, Euler's theorem. Secon derivative Test, Langranges Multipliers, Fubini's theorem and Jacobian to solve examples. Applying Maxima Software to draw a graph, domain. Also solve Patial derivaties and double, triple integration by Maxima software.
	CO7	**Comparing :** Compare solution obtained by graph and by calculation. Compare a solution by changing order of derivatives.
MT-232(B):-Graph Theory	CO1	The mathematical maturity of students in their current and future courses shall develop. (Understanding)
	CO2	The students develops theoretical, applied and computational skills. (Remembering)
	CO3	The student gains confidence in proving theorems and solving problems. (Evaluating)

	CO4	The students gains interest in the course and can contribute in research field in future. (Analyzing)
	CO5	The students relates daily life problems with the content and apply the taught techniques to solve them. (Applying)
	CO6	Enabling students to develop a positive attitude towards graph theory as an interesting and valuable subject of study. (Creating)
MT- 233:- Mathematics Practical (Sem-III)	CO1	Relate the knowledge in real life. (Applying)
	CO2	Learn to draw graphs, find number of vertices and degree of each vertex, shortest paths and Hamiltonian circuits by using Maxima software. (Applying)
	CO3	Gain confidence in solving problems. (Evaluating)
	CO4	Understands limits and continuity, partial derivatives, differentiability, extreme values and multiple integrals and their applications. (Understanding)
	CO5	Build critical thinking regarding Calculus of several variables and Graph theory. (Creating)
	CO6	Acquire thinking skills in Calculus of several variables and Graph theory. (Analyzing)
MT-351:- Metric Spaces (Theory)	CO1	Recall basic concepts of real numbers. Classify the intervals and sets into open and closed sets in R.(Remembering)
	CO2	Examine continuous functions, compact sets in $\mathbb{R}$. (Evaluating)
	CO3	Define metric spaces & it's different inequalities and apply them to check metrices. (Applying)
	CO4	Define sequences and their properties. Apply it to check and classify compact, connected, dense sets.(Understanding)
	CO5	Define, examine, verify continuous functions on general metric space. (Analysing)
	CO6	Discuss and explain the open and closed sets in Metric spaces. Describe the domain, range, graphs and limits and continuity of functions. (Creating)
MT-352:-Real Analysis-I	CO1	Learn basic techniques and examples in analysis to be well prepared for courses like Topology, Measure theory and Functional analysis. (Understanding)

	CO2	Study various types of sets and relations, and concept of countable and uncountable. (Remembering)
	CO3	Solving problems on sequence and series and hence find sum of infinite terms with different methods. (Evaluating)
	CO4	Apply notion of lub and glb which helps to learn integrations which helps to find area under any functions. (Applying)
	CO5	Creating logic tables and use in real life. (Creating)
	CO6	Decide the convergence and divergence of series. (Analysing)
MT-353: Group Theory	CO1	Learn Fundamental properties and Mathematical tools such as closure, identity, inverse and generators.(Remembering)
	CO2	Study algebraic stucture 'Groups' in detail which is useful in study of Rings, Modules, Algebraic topology, Analysis. (Analysing)
	CO3	Enhance abstract thinking of students. (Creating)
	CO4	Learn about structure preservating maps between groups and their consequences. (Understanding)
	CO5	Learn to compare two different algebraic stuctures and study transfer of properties in between these stuctures through homomorphism and isomorphism. (Applying)
	CO6	Explain the significance of the notion of cosets, normal subgroups and factor groups. (Evaluating)
MT-354:-Ordinary Differential Equations	CO1	Understand the world of differential equations, system of differential equations and their applications. (Understanding)
	CO2	Solve simultaneous linear equations with constant coefficients and total differential equations. (Evaluating)
	CO3	Compute all the solutions of second and higher order linear differential equations with constant coefficients, linear equations with variable coefficients. (Analyzing)
	CO4	Understand the genesis of ordinary differential equations. (Understanding)

	CO5	Learn various techniques of getting exact solution of solvable 1st order differential equations and linear differential equations of higher order. (Remembering)
	CO6	Grasp the concept of a general solution of a linear differential equations of an arbitrary order and also learn a few methods to obtain the general solution of such equation. (Creating)
MT-355(A):- Operations Reaserch	CO1	Learn conversion of real life problems into mathematical models which enhance their problem solving and decision making abilities. (Understanding)
	CO2	Calculate optimal solution of models through graphical and iterative method. (Evaluating)
	CO3	Study transportation and assignment models and methods to solve them. (Remembering)
	CO4	Analyze and solve linear programming models of real-life situations. (Analysing)
	CO5	Find graphical solution of LPP with only two variables, and illustrate the concept of convex set and extreme points. (Creating)
	CO6	Determining solutions with applications to transportation, assignment and two-person zero-sum game problem. (Applying)
MT-356(B): Number Theory	CO1	Illustrate the Division and Euclidean Algorithm.
	CO2	Some of the open problems related to prime numbers.
	CO3	Write a formula for a number of +ve integer less than n that are relatively prime to n.
	CO4	State the Chinese Remainder Theorem, Fermat's Theorem and Wilson's Theorem.
	CO5	About number theoretic functions and modular arithmetic.
	CO6	The Law of Quadratic Reciprocity and other methods to classify primitive roots, quadratic residues, and quadratic non-residues.
MT-358:- Practical Course Lab-II (on Group Theory and	CO1	Learn how to use different methods of solving differential equations and group theory to solve problems in daily life. (Understanding)
	CO2	Gain confidence in solving problems. (Evaluating)

Ordinary Differential equations)	CO3	Acquire thinking skills in ordinary differential equations and group theory. (Applying)
	CO4	Build interest in courses and go in future for further studies. (Remembering)
	CO5	Research today's problems of ordinary differential equations and group theory and find solutions of them. (Analyzing)
	CO6	Invent new ideas and methods in ordinary differential equations and group theory. (Creating)
MT-3510:- Programming in python- I	CO1	Understand python looping,control statements and string manipulations. (Understanding)
	CO2	Learn how to use lists,tuples and dictionaries in python. (Evaluating)
	CO3	Explain basic principles of python programming language. (Remembering)
	CO4	Implement object oriented concepts. (Creating)
	CO5	Gain confidence in solving difficult problems in mathematics using python. (Analysing)
	CO6	Visualize the mathematical functions using python. (Applying)
MT-3511: Latex for Scientific Writing	CO1	**Understanding:** Definition and application of Latex. Preparation and Compilation of Latex input file.
	CO2	**Evaluating:** Latex Syntax, Key board Characteristics in Latex
	CO3	**Creating:** Text and Math mode fonts,Emphasized and colored fonts, creating and filling blank spaces
	CO4	**Remembering :** Formatting words, lines and Paragraph, text alignment and Qupted text, new line and paragraphs
	CO5	**Analysing :** Table through the tabular and tabularX Environment, Merging rows and columns of Tables.
	CO6	**Applying:** Table through the tabular and tabularX Environment, New lines and paragraphs,
	CO7	**Comparing :** Vertical Positioning of Tables, Rotated texts in Tables, Adjusting column width in tables.

	TERM-II	
MT-121: ANALYTICAL GEOMETRY	CO1	Understands transformations by Translation and Rotation. (Understanding)
	CO2	Analyze the various forms of equation of plane, line, sphere and circle. (Analysing)
	CO3	Find centre of Conic, nature of Conic, Direction Ratios and Direction Cosines. (Applying)
	CO4	Evaluate length of the perpendicular from a point to a plane, angle between a line and a plane, intersection of a Sphere and a Line. (Evaluating)
	CO5	Define General and Normal form of equation of Plane, Coplanar Planes, General equation of second degree in two variables. (Remembering)
	CO6	Describe System of Planes, Determination of a plane under conditions. (Creating)
MT- 122:-Calculus-II (Sem-II)	CO1	Find the series expansion of different functions using Taylor's and Maclaurin's theorem.
	CO2	Understand differentiation and fundamental theorem in differentiation.
	CO3	Apply L'Hospital rule to find the limits in indeterminate forms.
	CO4	Find the nth derivatives of the function, evaluate its indeterminate forms.
	CO5	Explain the different methods of solving differential equations.
	CO6	Use appropriate method to find an integrating factor of differential equation.
MT- 123:- Mathematics Practical (Sem-II)	CO1	Relate the knowledge of Mathematics in real life. (Applying)
	CO2	Learn to find solutions of differential equations using maxima software.
	CO3	Gain confidence in solving problems. (Evaluating)

	CO4	Compare two dimensional shapes and three dimensional shapes using Maxima software. (Understanding)
	CO5	Decide the method to solve the given ordinary differential equation. (Creating)
	CO6	Create syntax in maxima softwareto draw the graphs and to find the solutions of differential equations. (Analyzing)
MT-241: Linear Algebra	CO1	Solve systems of linear equations and interpret their results.(Evaluating)
	CO2	Describe properties of linear systems using vectors. (Remembering)
	CO3	Demonstrate and understanding of vector spaces, subspaces, bases, dimension, and their properties. (Analysing)
	CO4	Compute and interpret determinants of matrices. (Applying)
	CO5	Demonstrate and understanding of linear transformations. (Understanding)
	CO6	Obtain various variants of diagonalisation of linear transformation. (Creating)
MT 242(A) : Vector Calculus	CO1	**Understanding:** Vector, Scalar, Curves in Space, Limits and Continuity, Derivatives and Motion, Differentiation Rules for Vector Function, Vector Functions of Constant Length.Arc Length along a Space Curve, Speed on a Smooth Curve, Unit Tangent Vector.
	CO2	**Evaluating:** Curvature of a Plane Curve, Circle of Curvature for Plane Curves, Curvature and Normal Vectors for a Space Curve. Ntegrals,Surface Integrals
	CO3	**Creating:** Line Integral in Plane, Vector Fields, Gradient Fields, Line Integral of Vector Fields, Line Integrals with respect to dx, dy, dz .
	CO4	**Remembering :** Work done by a Force over a Curve in Space, Flow Integrals and Circulation for Velocity Fields, Flow across the Simple Closed Plane Curve. Path Independence, Conservative and Potential Functions. Divergence, Two forms for Green's Theorem, Green's Theorem in the Plane

	CO5	**Analysing :** Parameterizations of Surfaces, Implicit surfaces. Surface integrals, Orientation of Surfaces. Surface Integrals of Vector Fields
	CO6	**Applying:** Divergence in three Dimensions, Divergence Theorem, Unifying the Integral Theorems.
	CO7	**Comparing :** The Curl Vector Field, Stokes' Theorem , Conservative Fields and Stokes' Theorem, Divergence in three Dimensions, Divergence Theorem
MT-361:-Complex Analysis (Sem-VI)	CO1	Compute sums, products, quotients, conjugate, modulus, and argument of complex numbers. (Understanding)
	CO2	Calculate exponentials and integral powers of complex Numbers (Remembering)
	CO3	Write equation of straight line, circle in complex form (Evaluating)
	CO4	Understand the significance of differentiability for complex functions and be familiar with the Cauchy-Riemann equations.(Analyzing)
	CO5	Determine whether a given function is analytic. (Creating)
	CO6	Use Cauchy's integral theorem and formula to compute line integrals
MT-362:Real Analysis-II	CO1	Beta and gamma functions and their properties. (Understanding)
	CO2	Rcognize the difference between pointwise . (Remembering)
	CO3	Uniform convergence of a sequence of functions.(Evaluating)
	CO4	Some of the families and properties of Riemann integrable functions. (Creating)
	CO5	Illustrate the effect of uniform convergence on the limit function with respect to continuity, differentiability, and integrability. (Analysing)
	CO6	Applications of the fundamental theorems of integration. (Applying)
MT-263: Ring Theory	CO1	To write precise and accurate mathematical objects in ring theory.(Creating)
	CO2	For checking the irreducibility of higher degree polynomials over ring. (Evaluating)

	CO3	To understand the concepts like ideals and quotient rings. (Applying)
	CO4	To understand the concepts of ring homomorphism.(Understanding)
	CO5	Describe polynomial rings, principal ideal domain, Euclidean domain and unique factorisation domain, and their relationship.(Analysing)
	CO6	To understand the concepts of gaussian integers and norms. (Remembering)
MT-364:-Partial Differential Equations	CO1	Understand the world of partial differential equations, surfaces & curves in 3 dimensions, simultaneous differential equations of 1st order & 1st degree in 3 variables. (Understanding)
	CO2	Solve Pfaffian differential equations in 3 variables, . (Evaluating)
	CO3	Compute all the solutions of reducible equations & irreducible equations with constant coefficients, Integral equations passing through given Curve. (Analyzing)
	CO4	Understand the Origin of 1st order PDE and Canonical forms of 2nd order differential equations. (Understanding)
	CO5	Learn mathods of solving Linear Partial Differential Equations & rules of finding complementary functions & particular integrals. (Remembering)
	CO6	Grasp the concept of solution of Laplace equations, periodic differential equations & wave equation by Separation Variables method. (Creating)
MT- 366(B): Computational Geometry	CO1	Describe and construct basic geometric shapes and concepts by computational means (Creating)
	CO2	Construct algorithms for simple geometrical problems.(Evaluating)
	CO3	Three dimensional – Scaling, shearing, rotation, reflection, translation.(Remembering)
	CO4	Characterize invariance properties of Euclidean geometry by groups of transformations. (Analysing)
	CO5	Projection – A Geometric Interpretation of Homogeneous Coordinates.(Understanding)
	CO6	Bezier Curves – Introduction, definition, properties Curve fitting , equation of the curve in matrix form .(Applying)

MT-365(C): Financial Mathematics	CO1	Describe and explain the fundamental features of the instruments.
	CO2	Demonstrate a clear understanding of financial research planning.
	CO3	Demonstrate a clear understanding of financial research methodology and implementation.
	CO4	Demonstrate understanding of basic concepts of linear algebra relating to the linear equations.
	CO5	Demonstrate understanding of basic concepts of matrices and optimization.
	CO6	Demonstrate understanding of basic concepts relating to functions and annuities.
MT-3610: Programming in Python –II	CO1	Demonstrate the use of Python in Mathematics such as operations research and computational Geometry etc. (Evaluating)
	CO2	Study graphics and design and implement a program to solve a real world problem. (Applying)
	CO3	The students will implement the concepts of data with python and database connectivity. (Creating)
	CO4	Develop the skill of designing Graphical user Interfaces in Python. (Analysing)
	CO5	Learn and understand Python programming basics and paradigm. (Understanding)
	CO6	Study data visualization using python libraries as Matplotlib,Plotly,MayaVI. (Remembering)
MT-3611: Mathematics Into Latex	CO1	Commands and Environments, Inserting figures, Mathematical Operators, User-Defined Macros. (Understanding)
	CO2	Functional Values and Splitting in Math Mode. (Evaluating)
	CO3	Figures in Tables, Mathematical Notations, Operators and Expressions on Latex. (Creating)
	CO4	Array of Equations, Alignment and Numbering a Set of Equations. (Analysing)
	CO5	Vector and Matrix, Sub-numbering a set of Equations. (Remembering)
	CO6	New Commands, New Environments, Conditional Expressions. (Comparing)

Program Outcomes (Mathematics)

Name: of Programme : Master of Science (M. Sc.)

PO. No.	Program Outcomes After successful completion of this program, a student will be able to	Graduate Attributes
PO1	**Knowledge domain:** Demonstrate an understanding of the basic concepts in mathematics, statistics, operations research and their importance in the solution of some real- world problems.	Disciplinary knowledge
PO2	**Problem analysis:** Analyze and solve the well-defined problems in mathematics statistics, and operations research. Utilize the principles of scientific enquiry, thinking analytically, clearly and critically, while solving problems and making decision. Find, analyze, evaluate and apply information systematically and shall make defensible decisions.	Communication Skills
PO3	**Presentation and Interpretation of Data:** Demonstrate the ability to manipulate and visualize data and to compute standard statistical summaries.	Critical thinking
PO4	**Modern tool usage**: Learn, select, and apply appropriate methods and procedures, resources and computing tool such as PYTHON, Machine Learning,Excel, MATLAB, MATHEMATICA, SPSS etc with an understanding of the limitations.	Problem solving
PO5	**Ethics:** Analyze relevant academic, professional and research ethical problems and commit to professional ethics and responsibilities with applicable norms of the data analysis and research practices.	Analytical reasoning
PO6	**Communication**: Effectively communicate about their field of expertise on their activities, with their peer and society at large. Such as, being able to comprehend and write effective reports and design documentation, make effective presentations.	Research-related skills
PO7	**Project Management:** Apply Knowledge and understanding of principles of mathematics and statistics effectively as an individual, and as a member or leader in diverse teams to manage projects in multidisciplinary environment.	Cooperation/Team work

PO8	**Research Proposal:** Define, design and deliver a significant piece of research work that is clear and concise. Demonstrate the necessary skills and knowledge of deeper understanding of their chosen research area. Understand the philosophy of research in mathematical sciences and appreciate the value of its development.	Scientific reasoning
PO9	**Thrust area:** Riemannian Geometry studies smooth manifolds using a Riemannian metric. There are many applications of Riemannian geometry to other branches of mathematics and to the sciences. Einstein used it and its generalization. It impacted group theory, representation theory analysis, algebraic and differential topology.	Self-directed learning

Program Specific Outcomes		
Name of Program (with Specialization) - Master of Science in Mathematics		
PSO.No.	**Program Outcomes** **After successful completion of this program, a student will be able to**	**Graduate Attributes**
PSO1	Understand the mathematical concepts and application in the field of algebra / analysis, statistic, manifolds, relativity & astrophysics.	Critical thinking
PSO2	Get jobs in public / private sectors and pursuing higher studies at national and international level.	Lifelong learning
PSO3	To apply knowledge of Mathematics in all the fields of learning including higher research and extensions.	Digitally literate
PSO4	To provide a systematic understanding of the concepts and theories of mathematics and analyze the situations.	Problem solving

Course Outcomes

Name of Program (with Specialization) -Master of Science in Mathematics

Title of Course	CO. No.	Course Outcomes After successful completion of this Course a student will be able to
MTUT-111:-Linear Algebra	CO1	Understand the concept of vector space,linear transformations and dual vector spaces with multilinear algebra. (Understanding)
	CO2	Gain confidence in solving linear algebra problems. (Evaluating)
	CO3	Relate the knowledge of "Principle axis theorem" in real life. (Applying)
	CO4	Decide the nature of matrices. (Creating)
	CO5	Imagine the concept of symmetry. (Remembering)
	CO6	Aply the "Matrix concept" for solving problems in real life. (Analysing)
MTUT- 112: Real Analysis	CO1	**Understanding**: Set, Measure, Cantor Set, Lebesgue integration, continuity, Measurable function, Fundamental theorem of calculus, Monotone functions.
	CO2	**Evaluating:** Sequential pointwise limit and Approximations by simple function, Bounded variation of functions,
	CO3	**Creating:** Outer and inner approximation of Lebesgue Measurable functions.
	CO4	**Remembering :** Borel- Cantelli Lemma, Egoroff,s Lemma, Lusin Theorem, Lebesgue Differentiation theorem..Cantor_Lebesgue functions.
	CO5	**Analysing :** Littlewoods Three Principals, Countable additivity
	CO6	**Applying:** Borel-Cantelli Lemma, Integration of derivatives , differentiation of Indefinite integral.
	CO7	**Comparing :** Definition and algebra of Lebesgue measurable function, Jordan theorem, Sequential pointwise limit.
MTUT-113: Group Theory	CO1	Recognize the mathematical objects called groups. (Remembering)
	CO2	Link the fundamental concepts of groups and symmetries of geometrical objects. (Creating)

	CO3	Explain the significance of the notions of cosets, normal subgroups, and factor groups. (Evaluating)
	CO4	Describe inner automorphisms and their properties. (Understanding)
	CO5	Prove and apply Sylow's Theorems. (Applying)
	CO6	Investigate symmetry using group theory. (Analysing)
MTUT-114:- Advance Calculus	CO1	Develop an understanding of the various ways to evaluate line integrals (parameterization, potential function,Green's Theorem (Creating)
	CO2	Evaluate the divergence and curl of a vector field. Use them to evaluate the flux of a vector field through a surface (Evaluating)
	CO3	Describe double and triple integrals using a change and variables and the Jacobian. (Analysing)
	CO4	Decide the nature of surface and line integrals using the Divergence Theorem and Stoke's Theorem. (Understanding)
	CO5	Solvng difficult problems in real life using surface integral. (Applying)
	CO6	Studying differential calculus in vector form. (Remembering)
MTUT115:Ordinary Differential Equation	CO1	Will be able to explain the concepts of the differential equation.
	CO2	Expresses the Existence-Uniqueness Theorem.
	CO3	Uses the metthod of Variation of Parameter to ind the solution of higher order diffferrenttial equation.
	CO4	Solve the exact diffferential Equations.
	CO5	Solve the homogeneous System of Constant and Variable Coefficients.
	CO6	Determine the types of linear differential equations.
MTUT-131:- Functional Analysis	CO1	Understanding Concept of compact, Positive, projection, self-adjoint, normal and unitary operators. (Understanding)
	CO2	Viewing C[a,b] with sup norm and integration norm respectively as Banach space and incomplete norm linear space. (Analysing)
	CO3	Working with a complete orthogonal set in a Hilbert space. (Applying)
	CO4	Finding weak and weak * topologies on normed linear spaces. (Evaluating)
	CO5	Comparing the differences between Banach and Hilbert spaces. (Remembering)

	CO6	Determining Adjoint of an operator on a Hilbert space. (Creating)
MTUT-132:-Field Theory	CO1	Understanding the concept of algebraic element, transcendental elements, minimal polynomials etc. (Understanding)
	CO2	Constrcting minimal polynomial ,splitting field and finite field. (Creating)
	CO3	Formulation of Galois groups and Galois field extensions. (Evaluating)
	CO4	Relate Structures of fields with certain related groups. (Analysing)
	CO5	Identify normal fields, separable fields. (Remembering)
	CO6	Apply "Galois theory" to classical problems. (Applying)
MTUT-133:-Programming with python (Theory)	CO1	Understand why Python is a useful scripting language for developers. (Understanding)
	CO2	Learn how to write loops and decision statements in Python. (Remembering)
	CO3	Decide how can one use lists, strings,tuples in solving Mathematical problems. (Applying)
	CO4	Design object-oriented programs with Python classes. (Creating)
	CO5	Acquire programming skills in core Python. (Evaluating)
	CO6	Use exception handling in Python applications for error handling (Analysing)
MTUT-133:-Programming with python (Practical)	CO1	Build packages in python modules for reusability. (Applying)
	CO2	Create Python Functions for File Handling: The OS Methods, Miscellaneous Functions and File Attributes. (Creating)
	CO3	Study the inheritance and there methods (Remembering)
	CO4	Define class,functions,attributes amd implement them into making classes. (Evaluating)
	CO5	Make functions using conditional statements and basic python built-in functions. (Analysing)
	CO6	Understand the object oriented pogramming concepts. (Understanding)

MTUTO-134:- Discrete Mathematics	CO1	Demonstrate the ability to write and evaluate a proof or outline the basic structure of statements of theorems, propositions, corollaries and give examples of each proof technique described. (Creating)
	CO2	Understand the basic principles of combinations and permutations. (Understanding)
	CO3	Find recurrence relations, generating functions and solve examples of combinations and permutations. (Evaluating)
	CO4	Write an argument using logics and facts. (Analyzing)
	CO5	Learn to apply theories in real life and solve daily life problems. (Applying)
	CO6	Build confidence in solving problems of graphs, arrangements and selections. (Remembering)
MTUTO137:Integral Equation	CO1	Determine the types of Integral Equations.
	CO2	State the types Fredholm and Volterra Integral Equations.
	CO3	Write the techniques for solving Integral Equations
	CO4	Expresses the Initial value Problem.
	CO5	By conversion of diferrential equations to integral equations
	CO6	States Abel's problem.
	TERM-II	
MTUT-121 Complex Analysis	CO1	**Understanding**: Complex Numbers, Basic Properties of Complex numbers, Polynomial function, Power series, Analytic functionContour Integration. Cauchy Riemann Equation.
	CO2	**Evaluating:** C-R equations, Primitives, Integration, Maximum Modulus, Zeros, Singularities, Laurent series, Residues, Trigonometric Integrals, Improper Integrals, Maximum modulus
	CO3	**Creating:** Mapping, Liouville Global Implication, Cauchys theorem via Greens theorem, inequality, Holomorphic functions
	CO4	**Remembering :** Cauchy's Goursat theorem, Green's theorem, Laurent series, Residues, Singularities, Cauchy's Integral formula, Liouville's Theorem, Schwartz, Jordan Inequality,

	CO5	**Analysing :** Open mapping theorem, polynomial and rational function, men value and maximum modulus, Analyticity of complex differentiable functions.
	CO6	**Applying:** Cauchy's Goursat theorem, Green's theorem, Laurent series, Residues, Singularities, Cauchy's Integral formula, Liouville's Theorem, Schwartz, Jordan Inequality
	CO7	**Comparing :** Cauchy-Goursat theorem, Trigonometric Integrals, Singularities, residues, Primitives, power series, Improper Integrals.
MTUT-122:- General Topology	CO1	Demonstrate an understanding of the concepts of metric spaces and topological spaces, and their role in mathematics.(Understanding)
	CO2	Demonstrate familiarity with a range of examples of these structures.(Remembering)
	CO3	Prove basic results about completeness, compactness, connectedness and convergence within these structures.(Evaluating)
	CO4	Use the Banach fixed point theorem to demonstrate the existence and uniqueness of solutions to differential equations.(Applying)
	CO5	Demonstrate an understanding of the concepts of Hilbert spaces and Banach spaces, and their role in mathematics.(Creating)
	CO6	Demonstrate familiarity with a range of examples of these structures.(Evaluating)
MTUT-123: Ring Theory	CO1	To write precise and accurate mathematical objects in ring theory. (Creating)
	CO2	Describe the fundamental concepts in ring theory such as of the ideals, quotient rings, integral domains, and fields. (Applying)
	CO3	Describe polynomial rings, principal ideal domain, Euclidean domain and unique factorisation domain, and their relationship.(Analysing)
	CO4	Check reducibility of a polynomial. (Evaluating)
	CO5	To understand the concept of ring homomorphism. (Understanding)
	CO6	To understand the concept of modules. (Remembering)
MTUT124:Advanced	CO1	Analyze methods
	CO2	Choose an appropriate methods.

Numerical Analysis	CO3	Prove basic properties of methods
	CO4	Derive new methods
	CO5	Conduct computational experiments
	CO6	Implement computational methods
MTUT 125: PARTIAL DIFFERENTIAL EQUATIONS	CO1	Application and Find solutions of partial differential equations and determine the existence, uniqueness of solution of partial differential equation.(Applying)
	CO2	Vibrating string- Variable separable solution(examples). (Evaluating)
	CO3	Classification of Second Order PDE Canonical Forms, Canonical Form for Hyperbolic Equation , Canonical Form .(Understanding)
	CO4	Charpit's method, Jacobi's method , Compatible systems and Non Linear first order P.D.E. (Remembering)
	CO5	Occurrence of the Laplace and Poisson Equations , Derivation of Laplace Equation , Derivation of Poisson Equation . (Analysing)
	CO6	Canonical Forms, Canonical Form for Hyperbolic Equation , Canonical Form. (Creating)
MTUT 141 : FOURIER SERIES AND BOUNDARY VALUE PROBLEMS	CO1	Application to Fourier series . (Applying)
	CO2	A Slab with Faces at Prescribed Temperatures, Related Problems, A Slab with Internally Generated Heat, Steady Temperatures .(Understanding)
	CO3	Best approximation in the Mean, Bessel"s Inequality and Parseval"s Equation .(Remembering)
	CO4	Generalized Fourier series, Examples .(Evaluating)
	CO5	Cylindrical Coordinates, String with Prescribed Initial Conditions, Resonance, Elastic Bar. (Analysing)
	CO6	A Temperature Problem, A Vibrating String Problem. (Creating)
MTUT 142: DIFFERENTIAL GEOMETRY	CO1	Appliction of Curves, surfaces, surface patches and parameterizations of curves and surfaces.(Applying)
	CO2	Analysing Gauss map and Normal curvatures, principle curvatures, Gaussian and mean curvatures. (Analysing)
	CO3	Draw Graphs and Level Sets.(Creating)
	CO4	Define Arc Length and Line Integrals .(Understanding)
	CO5	Geodesics , Parallel Transport.(Evaluating)

	CO6	The Tangent Space,Surfaces .(Remembering)
MTUT-143:- Introduction to data Science (Theory)	CO1	Understand Data science in a big data world. (Understanding)
	CO2	Study The big data ecosystem and data science. (Remembering)
	CO3	Create General programming tips for dealing with large data sets. (Creating)
	CO4	Gain confidence to apply the types of machine learning models on real world problems. (Applying)
	CO5	Evaluate Text mining techniques. (Evaluating)
	CO6	Analyse how to Clean , Integrate and transform data. (Analysing)
MTUT-143:- Introduction to data Science (Practical)	CO1	Predict the results and conclusions of different case studies using ML models. (Evaluating)
	CO2	Develope models using machine learning and data science process. (Analysing)
	CO3	Create the models for different datasets. (Creating)
	CO4	Measure the accuracy using Cross Validation, Confusion Matrix, Precision and Recall . (Applying)
	CO5	Study different ML algorithms. (Understanding)
	CO6	Understand The Exploratory data analysis. (Remembering)
MTUTO-144:- NUMBER THEORY	CO1	Illustrate the Division and Euclidean Algorithm, Describe the properties of prime numbers (Understanding)
	CO2	Show that every positive integer can be expressed as product of prime power in unique way (Evaluating)
	CO3	Write a formula for the number of positive integers less than n that are relatively prime to n (Applying)
	CO4	Find the Sum, product of all the divisors of N & the smallest number with N divisors. (Creating)
	CO5	Solve the system of linear congruence's. (Remembering)
	CO6	Solve problems by using Chinese Remainder Theorem, Fermat's thm and Wilson thm. (Analysing)
MTUTO148: Probability and Statistics	CO1	Define the principal concepts about probability
	CO2	Express the concepts of probability and its features.
	CO3	Formulate the distributions function.

	CO4	Explain major distributions of random variables.
	CO5	Calculate the expected value and the moments.
	CO6	define the continuous distributions and solve the problems about the distributions.