Department of Mathematics

PROGRAMME NAME : *B.Sc MATHEMATICS*

PROGRAMME OUTCOMES

1	Bachelor's degree in mathematics is the culmination of in-depth knowledge of algebra, calculus,geometry,differential equations and several other branches of mathematics.This also leads to study of related areas like computer science and statistics.Thus,this programme helps the learners in building a social foundation for higher studies in mathematics.
2	The skills and knowledge gained has intrinsic beauty, which leads to proficiency in analytical reasoning.This can be utilized in modelling and solving real life problems
3	Students undergoing this programme learn to logically questions assertions, to recognise patterns and to distinguish between essential and irrelevant aspects of problems. They also share ideas and insights while seeking and benefitting from knowledge and insight of others. This helps them to learn behave responsibly in a rapidly changing independent society
4	Students completing this programme will be able to present mathematics clearly and precisely, make vague ideas precise by formulating them in the language of mathematics, describe mathematical ideas from multiple perspectives and explain fundamental concepts of mathematics to non-mathematicians.
5	Completion of this programme will also enable the learners to join teaching profession in primary and secondary schools.
6	This programme will also help students to enhance their employability for government jobs, jobs in banking, insurance and investment sectors, data analyst jobs and jobs in various other public and private enterprises.

SL. NO.	COURSE NAME	COURSE OUTCOME	
1	Calculus and Classical Algebra	CO1	Apply the mathematical knowledge to analyze the properties of a curve such as curvature, radius of curvature, Involute and Evolute.
		CO2	Classify double and triple integrals
		CO3	Identify Beta and gamma function and to apply the rules of beta and gamma function in evaluating double and triple integrals.
		CO4	Construct different types of equations and to find the roots of the equations by Newton's Theorem
		CO5	Solve the different types of reciprocal equations and to find the number of real roots using Descartes rule of signs.
2	Statistics- I (For Mathematics Students)	CO1	Find and relate the concepts of moments, skewness and kurtosis and to demonstrate the method of least squares and to classify parabolic, exponential and logarithmic curves.
		CO2	Interpret correlation and regression and to illustrate Karl's Pearson's coefficient of correlation and also the lines of regression and coefficient of regression
		CO3	Develop the statistical techniques used in the theory of attributes and to analyze consistency of data and criteria independence and to interpret Yule's coefficient of association.
		CO4	Explain distribution function and its properties, able to find mathematical expectation and to find the cumulants using generating function.
		CO5	Distinguish discrete and continuous probability distributions and to construct binomial, Poisson distribution

3	Algebra and Differential equations (For Science Students)	CO1	Construct different types of equations and to compare and to find the relationships between roots and coefficients.
		CO2	Identify the transformation of equations and to find approximate solutions to equations by making use of Newton's Method and Korner's Method.
		CO3	Identify types of matrices and to find the characteristic equation of matrix. Eigen values and eigen vectors can be determined by applying Cayley Hamilton Theorem.
		CO4	Distinguish the differential equations of first order and higher degrees and to identify the equations which are all solvable for p, x, y and the equations in the standard form Pp+Qq=R.
		CO5	Identify and distinguish Laplace transformation and inverse Laplace transformation
4	Differential Equations and Analytical Geometry of Three dimension	CO1	Solve the differential equations which are all solvable for x, y, p and Clairaut's form.Also, to illustrate the method of solving the differential equations of the form f1 (D)x+g1(D)y=h1t, f2(D),x+ g2(D)y = h2(t)
		CO2	Identify and solve the second order linear differential equation with constant coefficients and to interpret the linear equations of second order with variable coefficients.
		CO3	Analyze the 3D-co-ordinate systems and how to find the direction cosines and direction ratios.. Also to find the angle between planes , the length of the perpendicular and angle of bisection.
		CO4	Find and classify the equation of lines in different forms and calculate the image of the point, image of a line and to distinguish lines and planes.The angle between the line and plane can be determined. coplanar lines can be shown and the shortest distance between
		CO5	The equations of spheres and circles of intersection can be interpreted and to illustrate and analyze the tangency of sphere.

5	Statistics-II	CO1	To list out the characteristics of index numbers and to find Laspeyer's and Paache's, Fisher and Bowley'sEdgeworth's index numbers. The method to classify and analyse the unit test, commodity reversal test, time reversal test and circular tests can be shown
		CO2	Construct testing of hypothesis and to distinguish null hypothesis and alternative hypothesis. Type I and Type II errors can be classified. The level of significance and test of significance for large samples can be explained.
		CO3	Identify the distributions such as t-distributions and F-distribution. By making use of t-test the single mean and difference of means can be found out. Variance ratio test based on Chi-Square distribution by making use of this the goodness of fit can be decided.
		CO4	To find analysis of variance. One way and two way classified data can be explained and to randomize block design. Latin squarescan be analysed and constructed.
		CO5	To explain statistical quality control and its advantages. Process control can be illustrated by making use of this control chart, range chart, Pchart can be designed
6	Vector Calculus and Fourier Series	CO1	Analyze what is meant by vector differentiation and how to apply vector differentiation and its properties..
		CO2	Evaluate the double and triple integrals
		CO3	Analyze and apply vector integration. By making use of Vector integration line, surface and volume integralscan be interpreted.
		CO4	Analyze and apply Green's, Stokes and divergence theorems
		CO5	Determine the functions whether the functions are odd or even. By making use of these concepts half range series can be found out.

7	SEQUENCES AND SERIES	CO1	Analyse the real number system and also to classify rational and irrational numbers.To find the upper bounds,least upper bounds and maximum elementand to elaborate triangleinequality and Cauchy-Schwartz Inequality.
		CO2	Categorize the sequences as bounded sequences, monotonic sequences, convergent sequences and divergent sequences. Also to find the algebra of limits
		CO3	Demonstrate the behavior of monotonic sequences and to apply Cauchy's first limit theorem,Make use of Cauchy's Second limit theorem and Cesaro's Theorem. Contruct subsequence and to explain Cauchy's general principle of convergence.
		CO4	Interpret the series and to apply nth term test,Comparisontest,Kummer'stest, D'Alembert's ratio test,Raabe's test, Guass test and root test to compile the nature of the series.
		CO5	Analyse the alternating series .Apply the test for convergence for series of arbitrary terms.Also to identify the power series and to determine the radius of convergence.
8	VECTOR CALCULUS	CO1	Classify the vector point function and scalar point function.Determine the derivative of a vector and derivative of product of scalar and vector function.
		CO2	Find divergence,curl. Make use of the Laplacian operator
		CO3	Interpret the integration of point function and to illustrate line integral. To solve surface integral.
		CO4	Analyze and solve the volume integral.Also to illustrate and make use of Guass Divergence Theorem to solve problems.
		CO5	To solve problems based on Green's theorem and Stoke's Theorem
9	Mathematics for competitive Examinations -	CO1	Interpret simplification and find averages
		CO2	Determine ratio and proportion
		CO3	Assess partnership and solve percentage problems

		CO4	Distinguish profit and loss
		CO5	Solve problems on numbers
10	FUNDAMENTALS OF STATISTICS-I	CO1	Analyse the classification of datas.Also to construct bar diagram and Pie chart.
		CO2	Illustrate measure of central tendency and to find mean,median and mode.
		CO3	Explain the measure of dispersion .Also to find standard deviation,variance,quartile deviation and to obtain the relationship between them.
		CO4	Interpret correlation and to solve rank correlation problems.
		CO5	To find solution for regression equations
11	ABSTRACT ALGEBRA	CO1	Explain the definitions of groups and its examples.Also to determine the order of an element.Illustrate about Subgroups.
		CO2	Interpret cyclic groups and to find the generators of cyclic subgroups. Illustrate and apply Lagrange'sTheorem,Euler's Theorem and Fermat's Theorem.
		CO3	Elaborate about Normal Subgroups and group homomorphism.Illustrate Isomorphism ,Automorphism .Also to apply Cayley's theorem wherever required.
		CO4	Compare and classify Rings and its types.Illustrate about Integral domain and Fields .To summarize about maximal and minimal ideals.
		CO5	Utilize the concept of homomorphism and isomorphism on rings .Also to find kernel of homomorphism and to make use of fundamental theorem.
12	TRIGONOMETRY,LAPLACE TRANSFORMS AND FOURIER SERIES	CO1	Summarize about Trigonometry and to illustrate about the expansion of sinnx, cosnx, Sinnx, Cosnx
		CO2	Obtain the relationship between hyperbolic functions and circular function. Explain about inverse hyperbolic functions.To find summation of the series using C+iS method.

		CO3	Illustrate laplace transform
		CO4	Solve differential equations with constant coefficients by making use of Laplace Transforms.
		CO5	Solve problems based on Fourier series . Identify the odd and even functions and to deduce half range series.
13	MATHEMATICS FOR COMPETITIVE EXAMINATION-II	CO1	Analyse and solve the problems based on simple interest and compound interest.
		CO2	Apply short tricks on solving time and work problems
		CO3	Making use of the concept of time and distance while solving problems
		CO4	Utilize Chain rule
		CO5	Find solutions for pipes and Cistern problem
14	FUNDAMENTALS OF STATISTICS-II	CO1	Explain the theory of Attributes
		CO2	Illustrate about index numbers and to determine the weighted index numbers.
		CO3	Analyse and predict consumer price index numbers
		CO4	Evaluate Time series
		CO5	Apply curve fitting for straight line ,parabola and exponential curve
15	LINEAR ALGEBRA	CO1	Explain the definitions and general properties of vector spaces. Also to explain subspace. They know where to apply fundamental theorem of homomorphism.
		CO2	Determine the span of a set and to check whether the given set is Linearly dependent or not. Also to find basis and dimensions.
		CO3	Illustrate and apply Rank Nullity theorem. Explain the definitions and examples of inner product space. Apply Gram Schmidt Orthogonalization process.

		CO4	Construct matrices and also to summarize the elementary transformations.Determine the Inverse of matrix and rank of a matrix. To make use ofCayley Hamilton Theorem.
		CO5	Determine Eigen Values and Eigen Vectors. Identify bilinear forms and quadratic forms.Also To deduce Diagonal form from Quadratic form.
16	REAL ANALYSIS	CO1	Explain about Metric spaces and to construct an open ball .Also to interpret interior
		CO2	Interpret about closed sets and to find closure. To determine limit points. Analyze about complete metric space.Discuss about Cantor's intersection theorem and Baire's Category theorem.
		CO3	Summarize continuity. Illustrate about uniform continuity.
		CO4	Explain about connectedness and to deduce the connected subsets of R .To obtain the relationship between connectedness and continuity
		CO5	Illustrate about compactness and to find the connected subsets of R.Illustrate and make use of Heine Borel Theorem .To determine the relationship between compactness and continuity.
17	STATICS	CO1	Explain the forces acting at a point and to apply the parallelogram law of forces, Triangle law of forces and Lami's theorem.
		CO2	Interpret parallel forces and moments. Analyse the resultant of two parallel forces and the resultant of two unlike unequal parallel forces.ToapplyVarigon's theorem.
		CO3	Summarize equilibrium of three forces acting on a rigid body and to illustrate three coplanar forces theorem and to make use of the above theorem to solve problems

		CO4	Explain about laws of friction.Also to determine the angle of friction and Illustrate about the equilibrium of a particle and to make use of the concepts to solve the problems.
		CO5	Interpret the equilibrium of strings.To deduce the equation of catenary and its geometrical properties.
18	INTEGRAL TRANSFORMS AND Z TRANSFORMS	CO1	Apply Fourier transforms and to explain the properties.
		CO2	Solve problems on infinite Fourier cosine and Sine Transforms
		CO3	Identify and solve Finite Fourier transfoms
		CO4	Illustrate Z transforms and its properties.
		CO5	Utilize inverse Z transforms to solve difference equations.
19	PROGRAMMING IN C	CO1	Summarize about character set. Classify the keywords and identifiers.Identify the constants, variables and data types.
		CO2	Apply different types of operators and to make use of input and output operators.
		CO3	Compile programs by utilizing decision making and branching statements.Also to apply Decision making and looping statements while develop a program.
		CO4	Make use of one dimensional and two dimensional arrays.Also to utilize Character arrays and strings and its functions while compiling the program
		CO5	Illustrate user defined functions and illustrate the definitions of functions and return values and their types.Also to categorize function call, function declaration.
20	DISCRETE MATHEMATICS	CO1	Illustrate and use the statements,notations and connectives .Construct truth table and utilize conditional and biconditional statements.
		CO2	Analyze and explain Predicate calculus
		CO3	Elaborate Groups and monoids. Also to develop Group codes

		CO4	Construct Lattices and special lattices.Analyze and explain Boolean algebra
		CO5	Convert From one form to another form (Decimal,Binary,Octal,Hexadecimal). Evaluate Binary addition,subtraction multiplication and division.
21	COMBINATIONAL MATHEMATICS	CO1	Explain Selections and to find binomial coefficients.Classify ordered selections and unordered selections.
		CO2	Solve pairing problems
		CO3	Explain recurrence and classify the types of relations using generating functions.
		CO4	Illustrate The inclusion and exclusion principles.
		CO5	Construct and solve block designsand square block designs.
22	OPERATIONS RESEARCH -I	CO1	Solve Linear Programming Problem by making use of Graphical method,Simplex method.
		CO2	Interpret the concept of duality.Classify primal and dual problems.Utilizing the concept of duality ,solve problems on dual simplex method.
		CO3	Solve Transportation problems by making use of North – west corner rule,Matrix-Minima method,Vogel's Approximation rule. Evaluate Degeneracy and unbalanced transportation problems.
		CO4	Determine the solution for Assignment problems.
		CO5	Solve sequencing problems.
23	STOCHASTIC PROCESS	CO1	Determine the generating functions .Also to analyze and explain Stochastic Process and specification of stochastic process
		CO2	Interpret Markov Chains .Also to analyzetheclassfication of states and chains.Illustrate the stability of Markov chain.
		CO3	Classify Markov chain with denumberable states and Markov chain with continuous state space.

		CO4	Illustrate Markov Process with discrete state space by using Poisson Process.
		CO5	Elaborate Erlang Process.
24	MATH TYPE USING LATEX	CO1	Type words, sentences and symbols not in the keyboard usingTex
		CO2	Analyze Text environments
		CO3	Type math by making use of spacing rules,equations
		CO4	Type spacing of symbols building new symbols,math alphabets and symbols
		CO5	Write latex documents by making use of abstract,sectioning,cross referencing and Bibliographies.
25	COMPLEX ANALYSIS	CO1	Explain analytic functions and determine the functions of a complex variables and to utilize Cauchy Reimann equations
		CO2	Elaborate Bilinear Transformations and classify the elementarytransformations. Also to find fixed points.
		CO3	Illustrate complex integrations and to make use of Cauchy's Integral Formula
		CO4	Explain Series Expansions and to determine Taylor's Series,Laurent'sSeries.Determine zeros of an analytic function.
		CO5	Determine residues and to make use of Cauchy's Residue Theorem.Also to evaluate definite integrals
26	GRAPH THEORY	CO1	Construct graph and to explain its definition. Determine degrees. Also to perform operations on graph
		CO2	Classify degree sequence and graphic sequence. Illustrate connectedness, compactness and connectivity.

		CO3	Construct Eulerian Graphs and Hamiltonian graphs.Elaborate the characterizations of trees and to find centre of a tree.
		CO4	Interpret Planar graphs and to determine chromatic numbers and chromatic index.
		CO5	Explain Chromatic Polynomials and the properties of digraphs.
27	NUMBER THEORY	CO1	Explain Peano's theorem and to utilize mathematical induction.Also to make use of binomial theorem
		CO2	Illustrate Division Algorithm .Determine GCD .To deduce the Diaphantine equation ax+by=c
		CO3	Intrepret the fundamental theorem of arithmetic.Explain The Sieve of Eratosthenes and to use Goldbach Conjecture.
		CO4	Summarize the basic properties of congruences and to apply Chinese Remainder Theorem
		CO5	Elaborate Fermat's Theorem, Wilson's Theorem and to apply Kraitchik Factorization Method.
28	DYNAMICS	CO1	Illustrate projectiles and to find the equation of path,range and maximum height and time of flight.
		CO2	Elaborate about the collision of elastic bodies.Interpret law of impact and classify direct and oblique impact.
		CO3	Determine simple harmonic motion in a straight line.Summarize the composition of SHM of the same period in the same line and along two perpendicular directions.
		CO4	Interpret motion under the action of central forces.Derive velocity and acceleration in polar coordinates.
		CO5	Obtain the differential equation of central orbit .Also to deduce the pedal equation of central orbit.

29	NUMERICAL METHODS	CO1	Obtain solution for numerical algebraic and Transcendental equations by making use of various methods.
		CO2	Find finite difference for first and higher order differences. To classify forward and backward differences.
		CO3	To apply interpolation formula in Newton's Forward and backward, Guass Forward and backward formula.
		CO4	Make use of numerical differentiation and integration in Newton's forward &backward differences for differentiation.Also to utilize Trapezoidal rule and Simpson's 1/3 and 3/8 rule
		CO5	Solve Difference equations and to determine the order and degree of difference equation.Solve linear difference equation and find complementary function and to deduce particular Integral of the function.
30	ASTRONOMY	CO1	Explain Spherical Trigonometry .Also to elaborate the fundamental of spherical trigonometry,thesine,the cosine, four parts and Napier's formula.
		CO2	Imagine the celestial sphere,Illustrate about the rising and setting of a star. Identify and Classify circumpolar stars and morning,evening stars.
		CO3	Imagine Earth and to explain refraction. Deduce Tangent formula and Cassini's formula.
		CO4	Illustrate Geocentric parallax and Heliocentric parallax
		CO5	Elaborate Kepler's laws. Also to classify True anomaly,mean anomaly and eccentric anomaly and to obtain the relationship between them.

31	FUZZY MATHEMATICS	CO1	Explain Crisp sets and fuzzy sets and illustrate the characteristics and significance of Paradigm Shift.
		CO2	Elaborate the Additional properties of α cuts and the extension principle for fuzzy sets.
		CO3	Perform fuzzy set operations.Also to determine fuzzy complements , fuzzy intersections and fuzzy unions.
		CO4	Determine fuzzy numbers and Linguistic variables.Apply arithmetic operations on intervals and on fuzzy numbers.Construct lattice of fuzzy numbers.
		CO5	Analyze and classify fuzzy decision making ,individual decision making, Multi person decision making problems.
32	MATHEMATICAL MODELLING	CO1	Illustrate mathematical modelling through ODE. Classify and elaborate linear growth , non-linear and growth decay problems,Compartmentmodels,Dynamic problems and geometrical problems.
		CO2	Explain population dynamics, Epidemics.Anlayze the compartment models in economics,medicines,arms race bullets and international trade.
		CO3	Explain mathematical modelling problem through second order ODE.
		CO4	Illustrate mathematical modelling through difference equation.
		CO5	Explain mathematical modelling through graphs.
33	OPERATIONS RESEARCH-II	CO1	Interpret the games and strategies. Solve two persons zero sum games.Make use of mixed strategies and dominance property.
		CO2	Analyze the replacement of items that deteriorate with time. Illustrate replace montage of a machine taking money value into consideration and elaborate the replacement of items that completely fail suddenly and Staffing problems.

		CO3	Explain the queueing models and to classify into (M/M/1:FCFS),(M/M/1:∞/FCFS),(M/M/S:/FCFS)
		CO4	Compose network scheduling using PERT/CPM. Explain the rules of network construction.Make use of PERT calculation.
		CO5	Analyse and solve inventory control problems.
34	CODING THEORY	CO1	Analyze and illustrate basic assumptions and correcting ,detecting error patterns.Also to interpret effects of error correction and detection.
		CO2	Elaborate linear codes and illustrate the bases for C and C+ generating matrices on coding
		CO3	Illustrate parity check matrices and determine the equivalent codes
		CO4	Explain some bounds for codes and classify perfect codes,hamming codes, extended codes, the extended Golay code and decode them.
		CO5	Summarize about polynomials and words,cycliccodes.Make use of polynomial encoding and decoding
35	PROGRAMMING IN C++	CO1	Illustrate and make use of the concepts of tokens, expressions and control structures
		CO2	Utilize the functions in C++ and to apply it while writing programs
		CO3	Interpret constructors and destructors
		CO4	Explain and apply operator overloading while writing programs
		CO5	Make use of inheritance and classes to compile a program

PROGRAMME NAME : ***M.Sc MATHEMATICS***

PROGRAMME OUTCOMES

PO – 1	Knowledge	Capable of demonstrating comprehensive disciplinary knowledge gained during course of study
PO – 2	Research Aptitude	Capability to ask relevant/appropriate questions for identifying, formulating and analyzing the research problems. and to draw conclusions from the analysis.
PO – 3	Communication	Ability to communicate effectively on general and scientific topics with the scientific community and with the society at large
PO – 4	Problem Solving	Capability of applying knowledge to solve scientific and other problems
PO – 5	Individual and Team Work	Capable to learn and work effectively as an individual, and as a member or leader in diverse teams, in multidisciplinary settings
PO – 6	Investigation of Problems	Ability of critical thinking, analytical reasoning and research based knowledge including design of experiments, analysis and interpretation of data to provide conclusions.
PO – 7	Modern Tool usage	Ability to use and learn techniques, skills and modern tools for scientific practices.
PO – 8	Science and Society	Ability to apply reasoning to assess the different issues related to society and the consequent responsibilities relevant to the professional scientific practices
PO – 9	Life-Long Learning	Aptitude to apply knowledge and skills that are necessary for participating in learning activities throughout life
PO – 10	Project Management	Ability to demonstrate knowledge and understanding of the scientific principles and apply these to manage projects

SL. NO.	COURSE NAME	COURSE OUTCOME	
1	ALGEBRA - I	CO 1	Demonstrate competence with the basic ideas of algebra including the concepts of counting principle and Homomorphisms
		CO 2	Understand the concept of Cayley's theorem and about Solvable group
		CO 3	Able to demonstrate about the permutations and Accounting principle
		CO 4	Appreciate the significance of Sylow's theorem and Galois theory
		CO 5	Acquire the knowledge of direct products, finitely generated abelian groups
2	ANALYSIS - I	CO 1	Understand the need of metric spaces, compact sets and connected sets.
		CO 2	Able to recognize the convergence of sequence of functions.
		CO 3	Analyze the root test, ratio test, power series, absolute convergence and algebra of series.
		CO 4	Interpret knowledge about the concept of limits and continuity of functions.
		CO 5	Able to know another equally important main ideas namely differentiation and make use of the study of velocity and acceleration of continuous paths.
3	ANALYTIC NUMBER THEORY	CO 1	Study the basic concepts of elementary number theory
		CO 2	Explain several arithmetical functions and construct their relationships
		CO 3	Apply algebraic structure in arithmetical functions
		CO 4	Demonstrate various identities satisfied by arithmetical functions
		CO 5	Determine the application to $\mu(n)$ &$\Lambda(n)$ and several equivalent form of prime number theorem

4	OPERATIONS RESEARCH	CO 1	Be able to build and solve Transportation and Assignment problems using appropriate method
		CO 2	Learn the constructions of network and optimal scheduling using CPM and PERT
		CO 3	Ability to construct linear integer programming models and solve linear integer programming models using branch and bound method
		CO 4	Understand the need of inventory management
		CO 5	To understand basic characteristic features of a queuing system and acquire skills in analyzing queuing models
5	ORDINARY DIFFERENTIAL EQUATIONS	CO 1	Develop ways of finding explicit solutions of second order linear equations and understand the nature and properties
		CO 2	Recall an algebraic function and create attention to the general homogeneous second order linear equation.
		CO 3	Confront the theoretical side of the problem, adapt to the technical task of defining the Legendre polynomial and build their special properties
		CO 4	Make use of many important applications of Legendre polynomials to mathematical physics.
		CO 5	Specialize the linear system
6	ALGEBRA - II	CO 1	Demonstrate competence with the basic ideas of algebra including the concepts of ideals and quotient Rings.
		CO 2	Understand the concept of the Particular Euclidean ring.
		CO 3	Able to demonstrate about the Polynomial rings over Commutative rings.
		CO 4	Appreciate the significance Radicals
		CO 5	Acquired the knowledge of direct sum of rings

7	ANALYSIS - II	CO 1	Construct the integration of real valued functions on intervals.
		CO 2	Explain the integration of vector valued functions and make use of geometric interest with application.
		CO 3	Explain a new mode of convergence, pointwise convergence with integration ,equicontinuous function and pointwise bounded sequence.
		CO 4	Developing properties of polynomials and deriving properties of function represented by power series.
		CO 5	Explain the algebraic completeness of the complex field, its generalization and its conclusion.
8	ADVANCED CALCULUS	CO 1	Understand the difference between a multiple integral and an iterated iterated integrals and move from one to the other
		CO 2	Organise with functions whose range of values will be points in m space, for some specific choice of m such as 2 or 3.
		CO 3	Use linear and affine transformation as local approximations to a general transformation.
		CO 4	Deviate from the older traditional approach and adopt one which is of greater significance of applications in analysis.
		CO 5	Show how to translate between the language and notation of the system of differential forms and that of vector analysis.
9	DIFFERENTIAL GEOMETRY	CO 1	Interpret the geometric character of curves in Space (R3)
		CO 2	Explain the nth order of a curve and a surface, Develop the plane of curvature at a point of the surface
		CO 3	Build the concept of a surface and fundamental forms
		CO 4	Explain the intrinsic and non intrinsic properties of a surface
		CO 5	Analyse the properties of a surface relative to the Euclidean space in which it is embedded

10	RESEARCH METHODOLOGY AND STATISTICS	CO 1	Discuss the information of the sections in a dissertation or thesis
		CO 2	Discuss the distributions of two random variables, conditional Distributions and expectations, independent random variables and its generalizations
		CO 3	Build the Gamma and Chi-Square Distributions and Normal Distributions
		CO 4	Classify the distributions of Functions of Random Variables and define three additional distributions of statistical inference
		CO 5	Build an alternative procedure around the concept of the moment generating - function of a distribution and establish the central limit theorem
11	CLASSICAL MECHANICS	CO 1	Distinguish between the external force acting on the particles due to sources outside the system and internal forces on all other particles in the system.
		CO 2	Work with many vector forces and accelerations and deal with two scalar functions.
		CO 3	Emphasize that configuration space has no necessary connection with the physical three-dimensional space. extend Hamilton's principle to cover certain types of nonholonomic systems.
		CO 4	Discuss the problems of two bodies moving under the influence of a mutual central force as an application of the Lagrangian formulation.
		CO 5	Solve the orbital equation for motion in a central inverse-square force law in a fairly straightforward manner with results that can be stated in simple closed expressions.

12	PARTIAL DIFFERENTIAL EQUATIONS	CO 1	Find the fundamental difference between Pfaffian differential equations in two variables and those in a higher number of variables.
		CO 2	Find the general solution of a linear partial differential equation and indicate how such a general solution may be used to determine the integral surface which passesthrough a given curve.
		CO 3	Able to solve the nonlinear partial differential equation.
		CO 4	Able to solve linear partial differential equations of the second order.
		CO 5	Able to extend the characteristic curves of a second - order linear differential equation in two independent variables to the case where there are n independent variables.
13	PYTHON PROGRAMMING	CO 1	Give mathematical model for real world problems
		CO 2	Design algorithms for mathematical models, analyse the efficiency and correctness of algorithms.
		CO 3	Design implementable programs in Python.
		CO 4	Define and demonstrate the use of functions and looping using Python.
		CO 5	Design and implement a program to solve a real-world problem.
14	ADVANCED ALGEBRA - I	CO 1	Construct the process to develop the fundamental notations of linear dependence, basis and dimensions.
		CO 2	Develop the concepts about linear transformation and matrix theory
		CO 3	Discover the existence of linear transformation in similarities
		CO 4	Identify the theorems about linear transformations, canonical form of matrices and fundamental properties of matrices
		CO 5	Classify the behaviour of Hermitian, Unitary and Normal transformations.

15	GRAPH THEORY	CO 1	Demonstrate the concept of different structures and types about graphs and explain its applications
		CO 2	Determine the properties of trees and applications in network and study the concepts of connections in graphs
		CO 3	Acquire the knowledge about Euler Tours, Hamilton Cycles and matchings in Graphs
		CO 4	Analyze the concept of edge coloring ,independent sets and cliques in Graphs
		CO 5	Explain the concept of vertex colorings
16	MEASURE AND INTEGRATION	CO 1	Establish the basics for Lebesgue measurable functions and the Lebesgue integral.characterise on inner approximation by closed sets and on outer approximation by open sets.
		CO 2	Establish results regarding the approximation of measurable functions by simple functions and by continuous functions.
		CO 3	Exhibit a uniform bounded sequence of Riemann integrable functions on a closed, bounded interval can converge pointwise to a function that is not Riemann integrable.
		CO 4	Provide a characterization of the class of functions on closed, bounded intervals that may be expressed as the difference of increasing functions.
		CO 5	Abstract the most important properties of Lebesgue measure on the real line in the absence of any Topology.

17	TOPOLOGY – I	CO 1	Demonstrate an understanding of the concepts of topological spaces, construct topologies on a set. Understand the natural generalization of open and closed sets, limit points for the real line and Euclidean space onto the Topological Spaces.
		CO 2	Extend the concept of continuity and various properties of continuous functions; and define a topology on the cartesian products of topological spaces.
		CO 3	Define the metric topology using a metric on the set, give examples for metric topology and prove the properties of any metric topology.
		CO 4	Acquire knowledge of the concepts of separation, connectedness, covering and open covering of a topological space and compactness for a topological space.
		CO 5	Appreciate the importance of a weaker form of compactness called Limit point compactness, local compactness and one-point compactification and identify spaces where Limit point compactness coincides with compactness.
18	ALGEBRAIC NUMBER THEORY	CO 1	Demonstrate competence with the basic ideas of Diophantine and other linear equations.
		CO 2	Solve some special equations of the type x^4+y^4=z^2***z2***
		CO 3	Able to demonstrate about infinite continued functions
		CO 4	Appreciate the significance of approximating irrational numbers
		CO 5	Acquired the knowledge of Unique factorizations
19	CALCULUS OF VARIATIONS AND INTEGRAL EQUATIONS	CO 1	Demonstrate competence with the basic ideas Maxima and Minima
		CO 2	Explain about Constraints and Lagrange's Multipliers Hamilton's principles-Lagrange equations
		CO 3	Demonstrate Relation between differential and integral equations

		CO 4	Appreciate the significance of Fredholm equations with separable kernels
		CO 5	Acquired the knowledge of Iterative methods for solving equations of second kind
20	PYTHON PROGRAMMING – PRACTICALS	CO 1	Write programs using advanced concepts of Python.
		CO 2	Write, Test and Debug Python Programs.
		CO 3	Implement Conditionals and Loops for Python Programs.
		CO 4	Use functions and represent Compound data using Lists, Tuples and Dictionaries.
		CO 5	Read, write and manipulate data from & to files in Python.
21	ADVANCED ALGEBRA - II	CO 1	Build the knowledge with the relation of one field to another
		CO 2	Develop the construction of an extension field K of F in which the polynomial $f(x) \epsilon F[x]$ have all its roots and study the nature of roots of $f(x)$
		CO 3	Study the relationship between the roots of a polynomial with its Galois Group and examine it
		CO 4	Determine the nature of fields having only a finite number of elements
		CO 5	Understand the classification of all division rings R in their centre and satisfy the condition. Also study the Left Division Algorithm and Lagrange's Theorem
22	COMPLEX ANALYSIS	CO 1	Extend Calculus to Complex domain.
		CO 2	Develop the fundamentals of point set Topology and Metric Space.
		CO 3	Distinguish between definite and indefinite integrals. familiar with the theory of definite integrals of real continuous functions.
		CO 4	Able to study the local properties of an analytic function in great detail.
		CO 5	Classify the isolated singularities of analytic functions.

23	FUNCTIONAL ANALYSIS	CO 1	Make use of the uniform boundedness theorem in the conjugate of an operator on a Banach Space.
		CO 2	Able to determine the natural imbedding of N in N**
		CO 3	Examine the properties of the mapping from the operator on a normed linear space to its conjugate. understand the importance of operators such as self adjoint and normal operators
		CO 4	Able to focus on fixed but arbitrary Hilbert space.
		CO 5	Analogy between the set of all operators on Hilbert space and the set of all complex numbers.
24	TOPOLOGY - II	CO 1	Demonstrate understanding of the concepts of countable, First countable space, Second countable space, Lindelof space, Separable space and Regular space.
		CO 2	Appreciate the concepts of normal space and derive normality from other spaces, and understand the Urysohn Lemma and completely regular definition.
		CO 3	Prove the Urysohnmetrization theorem, Imbedding theorem, Tietze extension theorem and explain the relation between Tietze extension theorem and Urysohn Lemma.
		CO 4	Prove elementary properties of locally finite collection and metrizable spaces, with understanding of Maximality with respect to the finite intersection property and the Tychonoff theorem.
		CO 5	Explain Baire spaces, complete metric space, compact Hausdorff spaces and the relation between these spaces.Apply theoretical concepts in topology to understand some applications.

25	PROJECT	CO 1	Differentiate primary and secondary data and questionnaire
		CO 2	Explain about research methodology
		CO 3	Read articles and write a new article.
		CO 4	Know about the bibliography
		CO 5	Know how to write dissertations and present a paper in conferences.