Department of Mathematics

SGGDC PILER

Course Objectives and outcomes

Course Code	Course name	Objectives	Outcomes
1-1-112	**Differential Equations**	I. **First order and first degree Equations** ➢ Linear Differential Equations; Differential Equations Reducible to Linear Form; Exact Differential Equations; Integrating Factors; Change of Variables. II. **Differential Equations of first order but not of the first degree :** ➢ Equations solvable for *p*; Equations solvable for *y*; Equations solvable for *x*; Equations that do not contain. x (or y); Equations of the first degree in *x* and *y* – Clairaut's Equation. III. **Higher order linear differential equations-I :**	Students will be able to: ➢ Distinguish between linear, nonlinear, partial and ordinary differential equations. ➢ States the basic existence theorem for 1st order ODE's and use the theorem to determine a solution interval. ➢ Recognize and solve a variable separable differential equation. ➢ Recognize and solve a homogeneous differential equation. ➢ Recognize and solve an exact differential equation. ➢ Recognize and solve a linear

		➢ Solution of homogeneous linear differential equations of order n with constant coefficients; Solution of the non-homogeneous linear differential equations with constant coefficients by means of polynomial operators. ➢ General Solution of f(D)y=0 ➢ General Solution of f(D)y=Q when Q is a function of x. $\frac{1}{f(D)}$ is Expressed as partial fractions. ➢ P.I. of f(D)y = Q when Q= be^{ax} ➢ P.I. of f(D)y = Q when Q is b sin ax or b cos ax. IV. **Higher order linear differential equations-II :** ➢ Solution of the non-homogeneous linear differential equations with constant coefficients. ➢ P.I. of f(D)y = Q when Q= bx^k ➢ P.I. of f(D)y = Q when Q= $e^{ax}V$	differential equation by use of an integrating factor. ➢ Recognize and solve equations of Bernoulli, Ricatti and Clairaut. ➢ Make a change of variables to reduce a differential equation to a known form. ➢ Find particular solutions to initial value problems. ➢ Solve basic application problems described by first order differential equations. ➢ . Use the existence theorem for boundary value problems to determine uniqueness of solutions. ➢ Use the Wronskian to determine if a set of functions is linearly independent. ➢ Build solutions to differential equations by superposition of known solutions.

		➢ P.I. of f(D)y = Q when Q= xV ➢ P.I. of f(D)y = Q when Q= x^mV V. **Higher order linear differential equations-III :** ➢ Method of variation of parameters; Linear differential Equations with non-constant coefficients; The Cauchy-Euler Equation.	➢ Find the complete solution of a non-homogeneous differential equation as a linear combination of the complementary function and a particular solution. ➢ Construct a second solution to a second order differential equation by reduction of order. ➢ Find the complete solution of a homogeneous differential equation with constant coefficients by examining the characteristic equation and its roots. ➢ Find the complete solution of a non-homogeneous differential equation with constant coefficients by the method of undetermined coefficients. ➢ Write a differential equation with constant coefficients in operator form and find the complete

			solution by using an annihilator operator. ➢ Find the complete solution of a differential equation with constant coefficients by variation of parameters. ➢ Solve basic application problems described by second order linear differential equations with constant coefficients. ➢ Solve a Cauchy-Euler Equation.
1-2-112	**Solid Geometry**	I. **The Plane :** ➢ Equation of plane in terms of its intercepts on the axis, Equations of the plane through the given points, Length of the perpendicular from a given point to a given plane, Bisectors of angles between two planes, Combined equation of two planes, Orthogonal projection on a plane.	Students will be able to: ➢ understand geometrical terminology for angles, triangles, quadrilaterals and circles ➢ measure angles using a protractor ➢ use geometrical results to determine unknown angles

		II. The Line : ➢ Equation of a line; Angle between a line and a plane; The condition that a given line may lie in a given plane; The condition that two given lines are coplanar; Number of arbitrary constants in the equations of straight line; Sets of conditions which determine a line; The shortest distance between two lines; The length and equations of the line of shortest distance between two straight lines; Length of the perpendicular from a given point to a given line; **III.Sphere :** ➢ Definition and equation of the sphere; Equation of the sphere through four given points; Plane sections of a sphere; Intersection of two spheres; Equation of a circle; Sphere through a given circle; Intersection of a sphere and a line; Power of a point; Tangent	recognize line and rotational symmetries Find the areas of triangles, quadrilaterals and circles and shapes based on these. Geometry helps students to develop their inductive and deductive reasoning skills and to apply these skills in the advanced study of geometric relationships. In this course students will explore the basic concepts and methods of Euclidean Geometry while deepening their understanding about plane and solid geometry. Course topics include reasoning and proof, line and angle relationships, two and three dimensional figures, coordinate plane geometry, geometric transformations, surface area and volume. Core processes include

		plane; Plane of contact; Polar plane; Pole of a Plane; Conjugate points; Conjugate planes; ➢ Angle of intersection of two spheres; Conditions for two spheres to be orthogonal; Radical plane; Coaxial system of spheres; Simplified from of the equation of two spheres. IV. **Cones :** ➢ Definitions of a cone; vertex; guiding curve; generators; Equation of the cone with a given vertex and guiding curve; Enveloping cone of a sphere; Equations of cones with vertex at origin are homogenous; Condition that the general equation of the second degree should represent a cone; Condition that a cone may have three mutually perpendicular generators; ➢ Intersection of a line and a quadric cone; Tangent lines and tangent plane	reasoning, problem solving and communication. Successful completion of this course will earn the student a high school credit and will prepare them for Algebra.

		at a point; Condition that a plane may touch a cone; Reciprocal cones; Intersection of two cones with a common vertex; Right circular cone; Equation of the right circular cone with a given vertex; axis and semi-vertical angle. V. **Cylinders :** ➢ Definition & equation to the cylinder whose generators intersect a given conic and are parallel to a given line; Equation of the Enveloping cylinder and the right circular cylinder with a given axis and radius.	
1-3-112	**Abstract Algebra**	➢ To provide a first approach to the subject of algebra, this is one of the basic pillars of modern mathematics and to study of certain structures called groups, rings, fields and some related structures. **Groups:** ➢ **Binary** Operation – Algebraic	The students who succeeded in this course; ➢ Will be able to define algebraic structures. ➢ Will be able to construct substructures. ➢ Will be able to analyze a given

		structure;semi group-monoid – Group definition and elementary properties Finite and Infinite groups, examples; order of a group. Composition tables, examples **Subgroups :** ➢ Complex Definition – Multiplication of two complexes Inverse of a complex-Subgroup definition – examples-criterion for a complex to be subgroups. Criterion for the product of two subgroups to be a subgroup-union and Intersection of subgroups. **Co-sets and Lagrange's Theorem** ➢ Cosets Definition; properties of Cosets ;Index of a subgroups of a finite groups ;Lagrange's Theorem. **Normal subgroups** ➢ Definition of normal subgroup – proper and improper normal subgroup–Hamilton group – criterion for a subgroup to be a normal	structure in detail. ➢ Will be able to develop new structures based on given structures. ➢ Will be able to compare structures.

		subgroup – intersection of two normal subgroups – Sub group of index 2 is a normal sub group – simple group – quotient group – criteria for the existence of a quotient group. **Homomorphism** ➢ Definition of homomorphism; Image of homomorphism elementary properties of homomorphism; Isomorphism automorphism definitions and elementary properties–kernel of a homomorphism fundamental theorem on Homomorphism and applications. **Permutations and cyclic groups** ➢ Definition of permutation; permutation multiplication ; Inverse of a permutation; cyclic permutations; transposition ; even and odd permutations; Cayley's	

		theorem. **Cyclic Groups :-** Definition of cyclic group; elementary properties ; classification of cyclic groups.	
1-4-112	**Real Analysis**	The student will: ➢ Define the real numbers, least upper bounds, and the triangle inequality. ➢ Define functions between sets; equivalent sets; finite, countable and uncountable sets. Recognize convergent, divergent, bounded, Cauchy and monotone sequences. ➢ Calculate the limit superior, limit inferior, and the limit of a sequence. ➢ Recognize convergence of series. Cauchey's general principle of convergence for series tests for	The student will be : ➢ Apply mathematical concepts and principles to perform numerical and symbolic computations. ➢ Use technology appropriately to investigate and solve mathematical and statistical problems. ➢ Write clear and precise proofs. ➢ Communicate effectively in both written and oral form. ➢ Demonstrate the ability to read and learn mathematics and/or statistics independently.

		convergence of series, Series of Non-Negative Terms. 1. P-test 2. Cauchey's n^{th} root test or Root Test. 3. D'-Alemberts' Test or Ratio Test. 4. Alternating Series – Leibnitz Test. ➢ Real valued Functions, Boundedness of a function, Limits of functions. Some extensions of the limit concept, Infinite Limits. Limits at infinity. No. Question is to be set from this portion.Continuous functions, Combinations of continuous functions, Continuous Functions on intervals, uniform continuity. ➢ The derivability of a function, on an interval, at a point, Derivability and continuity of a function, Graphical meaning of the Derivative, Mean value Theorems; Role's Theorem, Lagrange's Theorem, Cauchhy's	

		Mean value Theorem ➢ Riemann Integral, Riemann integral functions, Darboux theorem. Necessary and sufficient condition for R – integrability, Properties of integrable functions, Fundamental theorem of integral calculus, integral as the limit of a sum, Mean value Theorems.	
1-5-125	Ring Theory and Vector Calculus	Student should understand from **Ring Theory** ➢ The relation between roots and coefficients of a polynomial; elementary symmetric functions; complex roots of unity; and solutions by radicals of cubic and quadratic equations. ➢ The characteristic of a field and the prime subfield.	The student will be compute and analyze: ➢ Scalar and cross product of vectors in 2 and 3 dimensions represented as differential forms or tensors, ➢ The vector-valued functions of a real variable and their curves and in turn the geometry of such curves including curvature, torsion and the Frenet-Serre frame and intrinsic geometry,

		➢ Factorization and ideal theory in the polynomial ring ; ➢ The structure of a primitive field extension. Field extensions and characterization of finite normal extensions as splitting fields.The structure and construction of finite fields. Counting field homeomorphisms; the Galois group and the Galois correspondence. Radical field extensions. ➢ Soluble groups and solubility by radicals of equations. **Vector Calculus:** ➢ Vector Differentiation, Ordinary derivatives of vectors, Differentiability, Gradient , Divergence, Curl operators, Formulae Involving these operators. ➢ Line Integral, Surface Integral, and Volume integral with examples. ➢ Theorems of Gauss and Stokes,	➢ Scalar and vector valued functions of 2 and 3 variables and surfaces, and in turn the geometry of surfaces, ➢ Gradient vector fields and constructing potentials, ➢ Integral curves of vector fields and solving differential equations to find such curves, ➢ The differential ideas of divergence, curl, and the Laplacian along with their physical interpretations, using differential forms or tensors to represent derivative operations, ➢ The integral ideas of the functions defined including line, surface and volume integrals - both derivation and calculation in rectangular, cylindrical and spherical coordinate systems and understand the proofs of each instance of the

		Green's theorem in plane and applications of these theorems.	fundamental theorem of calculus, and ➢ Examples of the fundamental theorem of calculus and see their relation to the fundamental theorems of calculus in calculus 1, leading to the more generalized version of Stokes' theorem in the setting of differential forms.
1-5-126	**Linear Algebra**	➢ Use computational techniques and algebraic skills essential for the study of systems of linear equations, matrix algebra, vector spaces, Eigen values and eigenvectors, orthogonality and diagonalization ➢ Use visualization, spatial reasoning, as well as geometric properties and strategies to model, solve problems, and view solutions, especially in R^2	➢ Apply mathematical methods involving arithmetic, algebr a, geometry, and graphs to solve problems. ➢ Represent mathematical information and communicate mathematical

		and R^3, as well as conceptually extend these results to higher dimensions. ➢ Critically analyze and construct mathematical arguments that relate to the study of introductory linear algebra. ➢ Use technology, where appropriate, to enhance and facilitate mathematical understanding, as well as an aid in solving problems and presenting solutions Communicate and understand mathematical statements, ideas and results, both verbally and in writing, with the correct use of mathematical definitions, terminology and symbolism ➢ Work collaboratively with peers and instructors to acquire mathematical understanding and to formulate and solve problems and present solutions	reasoning symbolically an d verbally. Interpret and analyze numerical data, mathematical concepts, and identify patterns to formulate and validate reasoning. Analyze finite and infinite dimensional vector spaces and subspaces over a field and their properties, including the basis structure of vector spaces, Use the definition and properties of linear transformations and matrices of linear transformations and change of basis, including kernel, range and isomorphism, Compute with the characteristic polynomial, eigenvectors, Eigen

			values and Eigen spaces, as well as the geometric and the algebraic multiplicities of an eigenvalue and apply the basic diagonalization result, ➢ Compute inner products and determine orthogonality on vector spaces, including Gram-Schmidt Orthogonalization, and ➢ Identify self-ad joint transformations and apply the spectral theorem and orthogonal decomposition of inner product spaces, the Jordan canonical form to solving systems of ordinary differential equations.
1-6-112	**Laplace Transforms**	Students will be able to: ➢ Know the definition of the Laplace Transform.	Students will be able to: ➢ Find the Laplace transform of a function by definition

		➢ Calculate the Laplace Transform of basic functions using the definition. ➢ Find the Laplace transform of derivatives and anti-derivatives of functions. ➢ Compute inverse Laplace Transforms ➢ Apply Laplace Transforms to find solutions of initial value problems for linear ODEs. ➢ Write piecewise functions in terms of unit step functions and find their Laplace Transforms. ➢ Solve certain ODEs where the forcing term is given by a piecewise continuous function.	and by use of a table. ➢ Find the inverse Laplace transform of a function. ➢ Write piecewise functions using the unit step function. ➢ Find transforms using the first and second translation theorems. ➢ Find the convolution of two functions and the transform of a convolution. ➢ Find the transforms of derivatives and integrals. ➢ Find the transform of a periodic function. ➢ Solve a basic integro-differential equation using the Laplace transform. ➢ Solve linear differential equations with constant

			coefficients and unit step input functions using the Laplace transform.
1-6-112A	**Integral Transforms**	➢ The course is aimed at exposing the students to learn the Laplace transforms and Fourier transforms. ➢ To equip with the methods of finding Laplace transform and Fourier Transforms of different functions. ➢ To make them familiar with the methods of solving differential equations, partial differential equations, IVP and BVP using Laplace transforms and Fourier transforms.	➢ On successful completion of the course students will be able to recognize the different methods of finding Laplace transforms and Fourier transforms of different functions. ➢ They apply the knowledge of L.T, F.T, and Finite Fourier transforms in finding the solutions of differential equations, initial value problems and boundary value problems.
1-6-112B	**Advanced Numerical Analysis**	**The course strives to enable students to:** ➢ Understand analytical, developmental and technical principles that relate to	Student will be able to: ➢ Understands the nature and operations of Numerical Analysis, demonstrates familiarity with

		Numerical Linear Algebra, Numerical Methods for solving Differential Equations, and Numerical Optimization, develop the academic abilities required to solve problems and applications in Numerical Analysis and/or Numerical Optimization and critically assess relevant aspects of the industry, and demonstrate an ability to initiate and sustain in-depth research in Numerical Analysis or Numerical Optimization.	theories and concepts used in Numerical Analysis, and identifies the steps required to carry out a piece of research on a topic in Numerical Analysis ➢ Expected to recognize and apply appropriate theories, principles and concepts relevant to Numerical Analysis, critically assess and evaluate the literature within the field of Numerical Analysis, analyze and interpret information from a variety of sources relevant to Numerical Analysis. ➢ The ability to compare the computational methods for advantages and drawbacks, choose the suitable computational method among several existing methods, implement the computational methods using any of existing programming languages, testing such methods and compare between them, identify the suitable computational technique for a specific type of problems, and develop the computational method that is suitable for the underlying

			problem. ➢ Compare the viability of different approaches to the numerical solution of problems arising in roots of solution of non-linear equations, interpolation and approximation; numerical differentiation and integration, solution of linear systems.