

Syllabus template

Semester: 2	
Programme : Mathematics	
Course : Vector Algebra and Geometry	
Paper code: C1MT230211T	Credits:4
Hours/week : 4	
Category: Core/MDC/SEC/VAC : Core	
Theory / Practical / Composite : Theory	
No of Modules : 2	
<p>Course Overview: This course primarily deals with two cognitive modules, viz,(a)Vector Algebra & (b) Geometry</p> <p>In Module I Students can learn free and localized vectors; Parallelogram law of vector addition and method of resolution; Linear dependence and independence of vectors; dot and cross product of two vectors; Scalar and vector triple products; Coplanarity and non-coplanarity of vectors using scalar triple product; Use of Cramer's rule in solving linear equations through vector methods; Volume of a tetrahedron, moment of a force about a point and that about a line and also resultant of forces acting on a rigid body as direct applications of vector algebra.</p> <p>In Module II two parts exist-(i) 2D Geometry deals with affine transformations of coordinates involving rotations and translations-their properties and quantities invariant under them; general second-degree equation in two variables and methods to reduce it to canonical form using method of invariants. Identification and classification of conic sections.Tangent and normal to a non-degenerate conic (in Cartesian and polar form).(ii) 3D Geometry includes <i>Sphere</i>: [Definition as a surface generated by revolving a semicircle about its bounding diameter; Equation of a sphere passing through three non-collinear points.Tangent plane to a sphere and condition of tangency. Intersection of two spheres – radical plane and circle of intersection.]; <i>Cone and Cylinder</i>: [Defined as surfaces generated by a variable straight line (generator) satisfying certain conditions; Guiding curve and generator equations; general equation of cone and cylinder; Right circular cone and cylinder as special types.]; Introduction to familiar <i>conicoids</i>.</p>	
Course Outcomes:	
1. Understand and Apply Vector Algebra:Grasp fundamental operations of vectors including addition, scalar and vector products, and their geometric interpretations. Solve problems involving linear dependence, coplanarity, and resultant of forces using vector methods.	
2. Apply vector concepts to physical and geometric problems such as torque, moment, and equilibrium of forces.	
3. Learn affine transformations and their properties under rotations and translations. Knowledge of invariants. Understand and classify the general equation of the second degree and reduce it to canonical form using invariants. Analyze geometric properties of conic sections through tangent and normal equations.	
4. Understand and derive the general equations of a sphere, Recognising sphere as a surface of revolution; Tangent plane, and intersection of spheres.	
5. Explore cone and cylinder geometry as surfaces generated by straight lines under specific conditions.	

6. Informal introduction to some familiar conicoids and their geometric shapes.

Prerequisites: Elementary ideas of Vector algebra and ideas of straight lines and circles of 10+2 level Co-ordinate Geometry.

SYLLABUS

UNIT/Module	CONTENT	NUMBER OF CLASSES	CO Mapping	COGNITIVE LEVEL
I.	Free and bound vectors, Resultant of two or more co-initial free vectors, Parallelogram law of addition; method of resolution , linear dependence - independence of vectors and related problems. Recapitulation of dot and cross product of two vectors , Scalar and Vector triple product, connection of scalar triple product with Cramer's rule of solving system of linear equations.	8	CO1	K1,K2
II.	Co planarity and non-co planarity of vectors from the viewpoint of scalar triple product. Problems on product of three vectors .Volume of a tetrahedron, Moment of a force about a point and that about a line, Resultant of a finite number of forces acting on a rigid body .	8	CO1,CO2	K2,K3
III.	Affine transformation of co-ordinates in a plane-rotations and translations. Commutativity of two translations and of two rotations in a plane, non-commutativity of a rotation and a translation . Invariants under affine transformations- distance b/w two points ; area of a triangle ;angle between two straight lines in a plane. General second-degree equation in two variables and	8	CO3	K2

	curves represented by it-non-degenerate and degenerate conic.			
IV.	Central and non-central conic: problems on finding center when it exists . Reduction of general second- degree equation in two variables to the canonical form by the method of invariants. Identification of the nature of curves represented. Tangent and normal to a non-degenerate conic (given in Cartesian and polar form)	8	CO3	K3,K5
V.	Sphere as a surface generated by revolving a semicircle about its bounding diameter- General form of the equation of a sphere passing through three non-collinear points. Tangent plane to a sphere. Condition of tangency . Intersection of two spheres: radical plane and circle of intersection. Equation of any sphere passing through the circle of intersection of two given spheres.	8	CO4	K2,K3
VI.	Cone & Cylinder as surfaces generated by a variable straight line: guiding curve and generator -general equation of a cone & cylinder. Right circular cone and right circular cylinder as special types Necessary and sufficient condition for a homogeneous second-degree equation in three variables representing a cone with vertex at the origin (statement only). Necessary and sufficient condition for such a cone to have three mutually perpendicular	8	CO5	K3,K4

	generators (statement only) Illustrative examples [2]. General form of the equation of the tangent plane to a cone & cylinder (problem solving)			
VII.	Familiarity with the standard equation of conicoids like ellipsoid, paraboloid and hyperboloids and their geometrical shapes.	4	CO6	K1
Text Books				
1. S.L. Loney – The Elements of Coordinate Geometry				
2. Robert J.T. Bell – An Elementary Treatise on Coordinate Geometry of Three Dimensions				
3. Ghosh & Maity – Vector Analysis				
Suggested readings				
1. A. Dey -Vector Geometry & Elements of Calculus [Pearson,India]				
2. R.M. Khan – Analytical Geometry of Two and Three Dimensions and Vector Analysis				
Web Resources				
1. https://www.cuemath.com/geometry-formulas/				
2. https://www.scribd.com/document/325691152/Analytical-Geometry-2D-and-3D-P-R-Vittal				
3. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SMT1303.pdf				
Evaluation : Theory CIA: 20+5+5=30 Semester Exam: 70				
Paper Structure for Theory Semester Exam Module : 2 questions each of 10 marks out of a set of 4 questions from Module I & 5 questions each of 10 marks out of a set of 9 questions from Module II				

Course outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive levels
CO1	Understand and grasp fundamental operations of vectors including addition, scalar and vector products, and their geometric interpretations. Solve problems involving linear dependence, coplanarity, resultant of forces by vector methods.	K2,K3
CO2	Apply vector concepts to physical and geometric problems such as torque, moment, and equilibrium of forces.	K3
CO3	Learn affine transformations and their properties under rotations and translations. Knowledge of invariants. Understand and classify the general equation of the second degree and reduce it to canonical form using invariants. Analyze geometric properties of conic sections through tangent and	K3,K4

	normal equations.	
CO4	Understand and derive the general equations of a sphere, Recognising sphere as a surface of revolution; Tangent plane, and intersection of spheres.	K2,K3
CO5	Explore cone and cylinder geometry as surfaces generated by straight lines under specific conditions	K2,K5
CO6	Informal introduction to some familiar conicoids and their geometric shapes.	K1