Skill Enhancement Course 1

Course Code: 1MTMSEC1 (Credit: 3, Lectures: 45 Hours; Full Marks: 75)

Course Name: Geometry and Vectors

Course Outcome: In geometry, students will learn about orthogonal transformations, the classification of conics, pair of straight lines, pole and polar, conjugate points and lines, conjugate diameters, as well as various geometric objects like spheres, cones, cylinders, ellipsoids, hyperboloids, and paraboloids. They will also study vectors, vector products, and solving vector equations. This course develops the skill of spatial visualisation and geometric reasoning, which are essential for understanding and solving problems in differential equations and mechanics.

Course Content:

Unit – I (2-Dimensional Geometry)

1. Orthogonal transformation of coordinate axes**:** translation, rotation and their combinations, invariance.
2. General equation of second degree in two variables, reduction to canonical form, classification of conics, position of axes and their lengths.
3. Pair of straight lines
4. Polar equations of straight line, circle and conic, equations of chord, tangent, normal and chord of contact of a conic.
5. Poles, polar, conjugate points and conjugate lines, conjugate diameters.

Unit – II (Vector Algebra)

1. Scalar triple product, vector triple product-Recapitulations
2. Product of four vectors.
3. Applications of vector algebra in geometry and physical problems.
4. Vector equations of straight lines and planes, signed distance of a point from a plane, volume of a tetrahedron, shortest distance between two skew lines.
5. Vector equations and their solutions.

Unit – III (3-Dimensional Geometry)

1. Sphere**:** general equation, circle, sphere through the intersection of two spheres, radical plane, tangent, normal.
2. Cone**:** general homogeneous second-degree equation, section of cone by a plane as a conic and as a pair of straight lines, condition for three perpendicular generators, reciprocal cone, right circular cone.
3. Cylinder, tangent plane to a cylinder, enveloping cylinder.
4. Ellipsoid, hyperboloid, paraboloid**:** canonical equations only.
5. General equation of second degree in x, y, z; nature of quadrics (by matrix method).

References

1. Coordinate Geometry – S. L. Loney.
2. Coordinate Geometry of Three Dimensions – Robert J. T. Bell.
3. Analytic Geometry ─M. C. Chaki.

4. Advanced Analytical Geometry ─ J. G. Chakravorty, P. R. Ghosh
5. Analytical Geometry and Vector Algebra- R. M. Khan
6. Vector Analysis – Barry Spain.
7. Vector Analysis – Louis Brand.
8. Vector and Tensor Analysis – Spiegel (Schaum).
9. Elementary Vector Analysis – C. E. Weatherburn (Vol. I & II).