

PAPER – IV GEOMETRY

TIME: 3 hours

Max. Marks: 100

UNIT-I

The Axes of Plane Sections: Circular sections, Axes of central sections of a central conicoid, Axes of any section of a central conicoid, Axes of section of a paraboloid, Circular sections, Umblics.

UNIT-II

Generating Lines, The section of a surface by a tangent plane, Systems of generators of a central hyperboloid, Locus of the points of intersection of perpendicular, generators, The projection of generators, Generators' of the hyperbolic paraboloid.

Confocal Conicoids: The three confocals through a point, - Elliptic coordinates, confocal touching a given plane, confocal touching a given line, The parameter of the confocals through a point on a central conicoid, The normals. The self polar tetrahedron, The axes of an enveloping cone, The equation to the conicoid.

UNIT-III

Tensors; Transformation of coordinates, Contravariant and covariant vectors, second order tensors, Higher order tensors. Addition, subtraction and multiplication of tensors, Contraction, Quotient Law, symmetric and skew symmetric tensors: Conjugate symmetric tensors of the second order, Fundamental tensor, Associated tensors, Christoffel symbols, Transformation law of Christoffel symbols, Covariant differentiation of vectors and tensors.

UNIT-IV

Conoids; Equation to a conoid, surface in general, The degree of a surface, tangents and tangent planes, The inflexional tangents; the equations $\zeta=f(\xi,\eta)$. The indicatrix and representation by parameters. Curves in space, Equation to a curve, The tangent and its direction cosines, The normal plane-, contact of a curve and surface, Osculating plane, Principal normal and binormal curvature, torsion, spherical indicatrices, frenet's formulae, signs of the curvature and torsion, formula for direction cosines of the principal normal and binormal, radius of torsion the relation $\sigma = + \eta \tan \alpha$ Circle of curvature, The osculating sphere and coordinates in terms of the arc.

UNIT-V

Envelopes: Envelopes of a system of surfaces with one parameter and its relation with characteristic, The edge of regression and its relation with characteristic, Envelope of a system of surfaces with two parameters and its relation with characteristic, skew and developable surface, Tangent plane to a ruled surface, Generators of developable surface, envelope of a plane with one parameter: criterion for $\zeta = f(\xi,\eta)$ to represent a developable surface and properties of a generator of a skew surface.

Curvature of surfaces, Curvature of normal sections through elliptic and hyperbolic points, Umblics, Curvature of an oblique section, radius of curvature of a given section through any point of a surface, Principal radii at a point of an ellipsoid: Lines of curvature of an ellipsoid, Lines of curvature on a developable surface, Normals to a surface at points of a line of a curvature, Lines of curvature on a surface of revolution, Principal radii and lines of curvature through a point of the surface, determination of umblics, Curvature at points of a generator of a skew surface, The measure of curvature at a point and expressions for the measure of curvature, Curvilinear coordinates, Linear element principal radii and lines of curvature.

Books recommended:

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| 1. L. Robert, J-T.Bell | : Coordinate Geometry of the three dimensions. |
| 2. Bansal & Sharma | : Differential Geometry. |
| 3. B.Spain | : Tensor Calculus. |
| 4. J.L.Bansal | : Tensor Analysis. |