

WOLLO UNIVERSITY COLLEGE OF NATURAL SCIENCE
PHYSICS DEPARTMENT
ASSIGNMENT II ON MATHEMATICAL METHODS OF PHYSICS II
(Phys 2032)

Answer the following questions accordingly

1. Using the angular momentum operators L_x, L_y, L_z in Cartesian coordinates, show that the commutation relations between them can be generalized by

$$\vec{L} \times \vec{L} = i\hbar\vec{L}$$

2. Prove that

$$\vec{\nabla}(\vec{F} \cdot \vec{G}) = \vec{F} \times (\vec{\nabla} \times \vec{G}) + \vec{G} \times (\vec{\nabla} \times \vec{F}) + (\vec{F} \cdot \vec{\nabla})\vec{G} + (\vec{G} \cdot \vec{\nabla})\vec{F}$$

3. Prove that

$$\int_{1,2}^{3,4} (6xy^2 - y^3)dx + (6x^2y - 3xy^2)dy$$

is independent of the path joining the points (1, 2) and (3, 4)

4. Given a scalar field in Cartesian coordinate system

$$\phi(x, y, z) = 2x^2y - xz^3$$

Compute the Laplacian of ϕ in

- (a) Cartesian
- (b) Cylindrical
- (c) Spherical

coordinate systems