



**Instructions to candidates**

**Duration:** One(01) hour

**Number of questions:** Three(03) Essay Questions

**Mark allocation:** 150 mark

Use standard symbols without definition.

Scientific calculators are allowed.

**Answer TWO(02) questions ONLY.**

1.

- a. Find the magnitude and direction cosines of the vector  $6i - 2j + 12k$ . (05 mark)
- b. Find the unit vector, which is parallel to the vector  $2i - j + k$ . (04 mark)
- c. If  $A = i + 2j - k$ ,  $B = 2i + 3j + k$ , determine
- the scalar product  $(A \cdot B)$  (04 mark)
  - the vector product  $(A \times B)$  (05 mark)
  - the cosine of the angle between  $A$  and  $B$ . (06 mark)
- d. If  $A = i + 2j + 3k$ ,  $B = 2i - j + 4k$ , and  $C = 3i + j - 2k$ , determine
- the scalar triple product  $A \cdot (B \times C)$  (08 mark)
  - the vector triple product  $A \times (B \times C)$ . (08 mark)
- e. Determine whether the three vectors  $A = 2i + 3j + k$ ,  $B = i - 2j + 2k$  and  $3i + j + 3k$  are coplaner. (10 mark)

2.

- a. If  $A = x^2y i + (xy + yz) j + xz^2 k$ ,  $B = yz i - 3xz j + 2xy k$ , and  $\phi = 3x^2y + xyz - 4y^2z^2 - 3$ ; determine, at the point  $(1, 2, 1)$ ;
- the gradient of  $\phi$  (i.e.,  $\nabla\phi$ ) (06 mark)
  - the divergence of  $A$  (i.e.,  $\nabla \cdot A$ ) (06 mark)
  - the curl of  $A$  (i.e.,  $\nabla \times A$ ) (07 mark)
  - grad div  $A$  (08 mark)
  - curl curl  $A$ . (08 mark)

b. Determine the directional derivative of  $\phi = xe^y + yz^2 + xyz$  at the point  $(2, 0, 3)$  in the direction of  $A = 3i - 2j + k$ . (15 mark)

3.

a. Evaluate to one decimal place the integral of  $\int_C (xyz + 4x^2y) dr$  along the curve  $C$  with parametric equations  $x = 2u, y = u^2, z = 3u^3$  between  $A = (2, 1, 3)$  and  $B = (4, 4, 24)$ . (25 mark)

b. If  $F = xy i + yz j + 3xyz k$ , evaluate  $\int_C F \cdot dr$  between  $A(0, 2, 0)$  and  $B(3, 6, 1)$ , where  $C$  has the parametric equations  $x = 3u, y = 4u + 2$  and  $z = u^2$ . (25 mark)

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