The Open University of Sri Lanka
Department of Mathematics
B.Sc/B.Ed. Degree Programme
Open Book Test (OBT) - 2024/2025
Applied Mathematics - Level 03
ADU3300/ADE3300– Vector Algebra
Duration: - One Hour

Date: 07.09.2024   **Time: 09:00 a.m. – 10:00 a.m.**

Answer **All** questions.

1.   a) Consider the vectors $\underline{a} = 3\underline{i} + 4\underline{j}$ and $\underline{b} = 2\underline{i} - \underline{j}$.

  (i) Show that any vector that is coplanar with vectors $\underline{a}$ and $\underline{b}$ can be represented as

  $\underline{r} = \lambda\underline{a} + \mu\underline{b}$ where λ and μ are scalars. If $\underline{a}$, $\underline{b}$ and $\underline{c} = 5\underline{i} + 2\underline{j}$ are coplanar

  vectors, determine the values of λ and μ.

  (ii) Determine whether the vectors $\underline{a}$ and $\underline{b}$ are linearly independent.

  b) Show that the angle between the vectors $2\underline{i} - 2\underline{j} + \underline{k}$ and $\underline{i} + 2\underline{j} + 2\underline{k}$ is $\pi/2$.

  c) In triangle ABC, let D and E be points on sides AB and AC respectively, such that

  $AD = \frac{1}{3}AB$ and $AE = \frac{1}{3}AC$. Prove that the line segment DE is parallel to BC and

  has one-third of its magnitude.

2.   a) Find the equation of the line through the point $(2, -7, -3)$ and parallel to the vector

  $-\underline{i} + \underline{j} + 2\underline{k}$. Verify that the point $(-2, -3, 5)$ is on the line.

  b) With respect to a fixed origin O the lines l_1 and l_2 are given by the equations

  $$l_1 : \underline{r} = 3\underline{i} + \underline{j} - \underline{k} + \lambda\left(3\underline{i} + 6\underline{j} + 9\underline{k}\right)$$
  $$l_2 : \underline{r} = 2\underline{i} + 5\underline{j} + 0\underline{k} + \mu\left(-2\underline{i} + 2\underline{j} - 2\underline{k}\right)$$

  Show that the lines l_1 and l_2 interest at the point $(4, 3, 2)$.

  c) Given that $\underline{a}$ and $\underline{b}$ are unit vectors that are perpendicular to each other, find the

  value of m such that the two vectors $5\underline{a} + 3\underline{b}$ and $m\underline{a} - 2\underline{b}$ are perpendicular

  to each other.

  d) If $\underline{a} = 2\underline{i} + 2\underline{j} + \underline{k}$ and $\underline{b} = \underline{i} + 3\underline{j} + 2\underline{k}$ find a unit vector whose direction is

  perpendicular to the directions of both $\underline{a}$ and $\underline{b}$.

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