



# **STAMFORD COLLEGE SCHOOL OF ENGINEERING**

## **FOUNDATION STUDIES IN ENGINEERING**

### **KE 017: VECTOR & MATRICES**

**Date : 5 September 2007 (Wednesday)**

**Time: 9.30 am – 11.40 am**

**Duration: 2 hours + 10 minutes reading time**

#### **Instructions to Candidates:**

- Instructions:
1. SIX questions set.
  2. Answer Any FOUR questions.
  3. All questions carry equal marks.
  4. Maximum marks attainable: 100

Please ensure that this examination paper contains SIX questions on THREE printed pages before you start the examination.

Books, papers or any other written materials are not allowed to be brought into the examination hall. A candidate who violates the examination rules of Stamford College or commits a malpractice will be disqualified from the examination.

Write your Examination Index Number on each page of your answer booklet.

There are two sections in this paper, Section A and Section B. Candidates are required to answer TWO question from Section A and TWO question from Section B.

**SECTION A**

Candidates are required to answer TWO questions from this section.

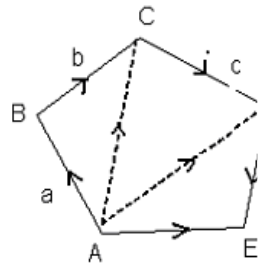
**Question 1**

- (a) (i) Define with the help of examples the scalar and vector quantities. (5 marks)
- (ii) Define the following by giving suitable examples:

- i. Unit vector
- ii. Negative vector
- iii. Co-initial Vectors

(6 marks)

- (b) Find the resultant vector  $\overrightarrow{AF}$  for the following



Values of the vectors are:  
 $a = 2$   
 $b = 4$   
 $c = 6$   
 $d = 5$

(2 marks)

- (c) If  $\vec{a} = (3, 2, -1)$ ,  $\vec{b} = (2, 0, -3)$  and  $\vec{c} = (1, -2, 3)$ , determine the magnitude of the vector  $2\vec{a} + \vec{b} + 3\vec{c}$ . (4 marks)

- (d) If  $\vec{a} = i + j$ ,  $\vec{b} = j + k$  and  $\vec{c} = k + i$ , find the following:

(i)  $\vec{a} \cdot (\vec{b} \times \vec{c})$

(2 marks)

(ii)  $\vec{a} \times (\vec{b} \times \vec{c})$

(3 marks)

(iii)  $(\vec{a} \times \vec{b}) \times \vec{c}$

(3 marks)

(Total = 25 marks)

**Question 2**

- (a) Find the scalar and the vector product of  $\vec{a} = 4i - j + 4k$  and  $\vec{b} = 8i - j + k$ . (5 marks)

- (b) Show that  $\vec{a} = 2i + 3j - 4k$  and  $\vec{b} = 8i - 4j + k$  are perpendicular to each other.

Find  $|\vec{a} \times \vec{b}|$

(7 marks)

- (c) Find the sine and cosine angle between vectors  $2i - j + k$  and  $3i + 4j - k$ .  
(9 marks)
- (d) Find the area of a parallelogram whose adjacent sides are  $i + j - k$  and  $2i - j + k$ .  
(4 marks)  
(Total = 25 marks)

### Question 3

- (a) Find the value of  $\lambda$ , if the vectors  $i + 3j - 2k$ ,  $2i - j + 4k$  and  $3i + 2j + \lambda k$  are coplanar.  
(4 marks)
- (b) Find the position vectors of the points which divide the points A and B whose position vectors are  $2i - 3j + 4k$  and  $3i + 2j + k$  internally and externally in the ratio 2:1.  
(6 marks)
- (c) (i) Find the position vector of the centroid of the triangle formed by the points whose position vectors are (1, 2, 3), (-1, 2, 1) and (3, 5, -1).  
(3 marks)
- (ii) Show that  $(2a + 3b) \times (a + 4b) = 5(a \times b)$   
(4 marks)
- (d) If a, b, and c are vectors, where  $a = 10i - 3j + 5k$ ,  $b = 2i + 6j - 3k$  and  $c = i + 10j - 3k$  verify that  $a \cdot b + a \cdot c = a \cdot (b + c)$ .  
(8 marks)  
(Total = 25 marks)

### SECTION B

Candidates are required to answer **TWO** questions from this section.

### Question 4

- (a) If  $A = \begin{bmatrix} 2 & -2 & -4 \\ -1 & 3 & 4 \\ 1 & -2 & -3 \end{bmatrix}$ , find  $A^2$ .  
(9 marks)
- (b) If  $A = \begin{bmatrix} 2 & 3 \\ 4 & 1 \end{bmatrix}$  and  $B = \begin{bmatrix} 1 & 2 \\ 3 & 1 \end{bmatrix}$ , find  $2A - 3B$ .  
(5 marks)
- (c) If  $A = \begin{bmatrix} 3 & -4 \\ 1 & -1 \end{bmatrix}$ , show that  $A^2 - 2A + I = 0$ .  
(8 marks)

(d) Find the transpose and determinant for  $\begin{bmatrix} 1 & 3 & 0 \\ 4 & 0 & 8 \\ 3 & 2 & 1 \end{bmatrix}$ .

(3 marks)

(Total = 25 marks)

**Question 5**

(a) Solve the following equation using the matrix method :

$$\begin{aligned} x-y-2z &= 3 \\ 2x+y+z &= 5 \\ 4x-y-2z &= 11 \end{aligned}$$

(15 marks)

(b) Solve the following equations using Cramer's rule:

$$\begin{aligned} 4(y-x) &= 5z-22 \\ 3z+4x &= 6y+2 \\ x-3y &= 14-10z \end{aligned}$$

(10 marks)

(Total = 25 marks)

**Question 6**

(a) Find the inverse of the matrix  $\begin{bmatrix} 1 & 2 & 3 \\ 2 & -3 & 1 \\ 3 & 1 & -2 \end{bmatrix}$ .

(12 marks)

(b) If  $A = \begin{bmatrix} 1 & 3 \\ 5 & 7 \end{bmatrix}$  and  $B = \begin{bmatrix} -1 & 2 \\ 3 & -4 \end{bmatrix}$ , find the adj.(AB)

(8 marks)

(c) Find the value of x, y, z, given that  $\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 3 & 1 & 3 \\ 2 & 0 & 2 \\ -5 & 1 & -1 \end{bmatrix} \begin{bmatrix} 2 \\ 4 \\ 3 \end{bmatrix}$

(5 marks)

(Total = 25 marks)

- END OF PAPER -