

# JEE Problems in Linear Algebra

**Abstract**—A collection of problems from JEE mains papers related to linear algebra are available in this document.

1.  $\mathbf{A} = \begin{pmatrix} a_1 \\ a_2 \\ a_3 \end{pmatrix}$  is a solution of

$$\begin{pmatrix} 1 & -8 & 7 \\ 9 & 2 & 3 \\ 1 & 1 & 1 \end{pmatrix} \mathbf{x} = \mathbf{0} \quad (1)$$

such that  $\mathbf{A}$  lies on the plane

$$(1 \ 2 \ 1)\mathbf{x} = 6. \quad (2)$$

Find  $2a_1 + a_2 + a_3$ .

2. For any two  $3 \times 3$  matrices  $A$  and  $B$ , let  $A + B = 2B^T$  and  $3A + 2B = I_3$ . Which of the following is true?

- a)  $5A + 10B = 2I_3$ .
- b)  $10A + 5B = 3I_3$ .
- c)  $2A + B = 3I_3$ .
- d)  $3A + 6B = 2I_3$ .

3. If the line,

$$L_1 : \frac{x_1 - 3}{1} = \frac{x_2 + 2}{-1} = \frac{x_3 + \lambda}{-2} \quad (3)$$

lies in the plane

$$(2 \ -4 \ 3)\mathbf{x} = 2, \quad (4)$$

find the shortest distance between  $L_1$  and

$$L_2 : \frac{x_1 - 1}{12} = \frac{x_2}{9} = \frac{x_3}{4} \quad (5)$$

4. Given

$$\mathbf{A} = \begin{pmatrix} 1 & 1 & 0 \end{pmatrix} \quad (6)$$

$$\mathbf{B} = \begin{pmatrix} 0 & 3 & 4 \end{pmatrix} \quad (7)$$

and

$$\mathbf{B}_1 \parallel \mathbf{A} \quad (8)$$

$$\mathbf{B}_2 \perp \mathbf{A} \quad (9)$$

$$\mathbf{B} = \mathbf{B}_1 + \mathbf{B}_2, \quad (10)$$

find  $\mathbf{B}_1 \times \mathbf{B}_2$ .

5. Find the distance between the point  $(1 \ -5 \ 9)^T$  from the plane

$$(1 \ -1 \ 1)\mathbf{x} = 5, \quad (11)$$

along the line  $x_1 = x_2 = x_3$ .

6. The line

$$L : \frac{x_1 - 3}{2} = \frac{x_2 + 2}{-1} = \frac{x_3 + 4}{3} \quad (12)$$

lies in the plane

$$(l \ m \ -1)\mathbf{x} = 9, \quad (13)$$

Find  $l^2 + m^2$ .

7. Let  $\mathbf{A}, \mathbf{B}, \mathbf{C}$  be three unit vectors such that

$$\mathbf{A} \times (\mathbf{B} \times \mathbf{C}) = \frac{\sqrt{3}}{2} (\mathbf{B} + \mathbf{C}). \quad (14)$$

If  $\mathbf{B}$  is not parallel to  $\mathbf{C}$ , then find the angle between  $\mathbf{A}$  and  $\mathbf{B}$ .

8. Find the range of the shortest distance between the lines

$$L_1 : \frac{x_1}{2} = \frac{x_2}{2} = \frac{x_3}{1} \quad (15)$$

$$L_2 : \frac{x_1 + 2}{-1} = \frac{x_2 - 4}{8} = \frac{x_3 - 5}{4} \quad (16)$$

9. Find the distance of the point  $(1 \ -2 \ 4)^T$  from the plane passing through the point  $(1 \ 2 \ 2)^T$  and perpendicular to the planes

$$(1 \ -1 \ 2)\mathbf{x} = 3 \quad (17)$$

$$\text{and } (2 \ -2 \ 1)\mathbf{x} = -12. \quad (18)$$

10. In  $\triangle ABC$ , right angled at  $A$ ,

$$\mathbf{A} = \begin{pmatrix} 3 \\ 1 \\ -1 \end{pmatrix}, \mathbf{B} = \begin{pmatrix} -1 \\ 3 \\ p \end{pmatrix}, \mathbf{C} = \begin{pmatrix} 5 \\ q \\ -4 \end{pmatrix} \quad (19)$$

sketch the point  $\begin{pmatrix} p \\ q \end{pmatrix}$