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1i). Linear dependence of vectors occurs when the scalars in a linear combination are not all equal to zero.

i.e $\alpha_1 u_1 + \alpha_2 u_2 + \alpha_3 u_3 + \ldots + \alpha_n u_n = 0$

1ii). Linear combination of vectors is a mathematical method of combining vectors using addition and scalar multiplication.

i.e $\alpha_1 v_1 + \alpha_2 v_2 + \alpha_3 v_3 + \ldots + \alpha_m u_m$

2). $U\alpha + V\beta + W\gamma = (a,b,c)$

$$\begin{bmatrix} 1 \\ 0 \\ -1 \end{bmatrix} \alpha + \begin{bmatrix} 2 \\ 1 \\ 3 \end{bmatrix} \beta + \begin{bmatrix} 1 \\ 1 \\ -4 \end{bmatrix} \gamma = \begin{bmatrix} a \\ b \\ c \end{bmatrix}$$

$\alpha + 2\beta + \gamma = a$ .....(i)

$\beta + \gamma = b$ .....(ii)

$-\alpha + 3\beta - 4\gamma = c$ .....(iii)

From equ (ii)

$\beta = b - \gamma$ .....(iv)

Put equ (iv) into (i) and (iii)

$\alpha + 2(b - \gamma) + \gamma = a$

$\alpha + 2b - 2\gamma + \gamma = a$

$\alpha + 2b - \gamma = a$

$\alpha - \gamma = a - 2b$ .....(v)

For equ (iii)

$-\alpha + 3(b - \gamma) - 4\gamma = c$

$-\alpha + 3b - 3\gamma - 4\gamma = c$

$-\alpha + 3b - 7\gamma = c$

$-\alpha - 7\gamma = c - 3b$ .....(vi)

Compare equs (v) and (vi) by addition

$\alpha - \gamma = a - 2b$

$-\alpha - 7\gamma = c - 3b$

$-8\gamma = a - 2b + c - 3b$

$-8\gamma = a - 5b + c$

$$\gamma = \frac{(a - 5b + c)}{-8}$$

$$\gamma = -\frac{(a - 5b + c)}{8}$$

$$\gamma = \frac{-a + 5b - c}{8}$$

Put γ in (ii)

$$\beta + \left(\frac{-a + 5b - c}{8}\right) = b$$

$$\beta = b - \left(\frac{-a + 5b - c}{8}\right)$$

$$\beta = b + \frac{a - 5b + c}{8}$$

$$\beta = \frac{8b + a - 5b + c}{8}$$

$$\beta = \frac{a + 3b + c}{8}$$

Put β and γ into equ (i)

$$\alpha + 2\left(\frac{a + 3b + c}{8}\right) + \left(\frac{-a + 5b - c}{8}\right) = a$$

$$\alpha + \left(\frac{a + 3b + c}{4}\right) + \left(\frac{-a + 5b - c}{8}\right) = a$$

$$\alpha = a - \left(\frac{a + 3b + c}{4}\right) - \left(\frac{-a + 5b - c}{8}\right)$$

$$\alpha = a - \frac{a - 3b - c}{4} + \frac{a - 5b + c}{8}$$

$$\alpha = \frac{8a + 2(-a - 3b - c) + a - 5b + c}{8}$$

$$\alpha = \frac{8a - 2a - 6b - 2c + a - 5b + c}{8}$$

$$\alpha = \frac{7a - 11b - c}{8}$$

$$\left(\frac{7a - 11b - c}{8}\right)U + \left(\frac{a + 3b + c}{8}\right)V + \left(\frac{-a + 5b - c}{8}\right)W$$

3). – Commutativity of vector addition

- Associativity of vector addition
- Identity element of addition
- Inverse element of addition