Aminone Oghenevwakpo Alexander MKT 102

19/ENG05/010 Mechatronics Engineering Dr. OYELAMI

1) $M = pi - 6j - 3k$; $N = 4i + 3j - k$, $O = i - 3j + 2k$

a) $M \cdot N = 0$ (perpendicular to each other)

$(pi - 6j - 3k) \cdot (4i + 3j - k) = 0$

$4p - 18 + 3 = 0$

$4p = 15$

$p = 15/4$

b) $M \cdot (P \times O) = 0$, Coplanar.

$$M(P \times O) = \begin{vmatrix} p & -6 & -3 \\ 4 & 3 & -1 \\ 1 & -3 & 2 \end{vmatrix} = 0$$

$P(6-3) + 6(8+1) - 3(-12-3) = 0$

$P(3) + 6(9) - 3(-15) = 0$

$3p + 54 + 45 = 0$

$3p = -99$

$P = -33$

2) $U = 3i + 2j + 5k + 2i - j + 6k + 5i + 2j - 3k$

$U = 10i + 3j + 8k$

$|U| = \sqrt{10^2 + 3^2 + 8^2} = \sqrt{173}$

$|U| = 13.15$

1412NG05/010

$\cos\alpha = \frac{a_x}{|v|} = \frac{10}{13.15}$

$\cos\beta = \frac{a_y}{|v|} = \frac{3}{13.15}$

$\cos\gamma = \frac{a_z}{|v|} = \frac{8}{13.15}$

$e_v = \frac{v}{|v|} = \frac{10i + 3j + 8k}{13.15}$

3) $F = 3ui + u^2 j + (u+2)k, \quad v = 2ui + 3uj + (u-2)k$

$\int_0^1 (F \times v)\,du =$

$F \times v = \begin{vmatrix} i & j & k \\ 3u & u^2 & (u+2) \\ 2u & -3u & (u-2) \end{vmatrix}$

$= i(u^2(u-2) + 3u(u+2)) - j(3u(u-2) - 2u(u+2))$
$+ k(-9u^2 - 2u^3)$
$= i(u^3 - 2u^2 + 3u^2 + 6u) - j(3u^2 - 6u - 2u^2 - 4u) +$
$k(-9u^2 - 2u^3)$
$= i(u^3 + u^2 + 6u) - j(u^2 - 10u) + k(-9u^2 - 2u^3)$
$= \int_0^1 (i(u^3 + u^2 + 6u) - j(u^2 - 10u) + k(-9u^2 - 2u^3))\,du$
$= \left[\left(\frac{u^4}{4} + \frac{u^3}{3} + 3u^2\right)i - \left(\frac{u^3}{3} - 5u^2\right)j + \left(-3u^3 - \frac{u^4}{2}\right)j\right]_0^1$

19/ENG05/010

$$= \left(\frac{1}{4} + \frac{1}{3} + 3\right)i - \left(\frac{1}{3} - 5\right)j + \left(-3 - \frac{1}{2}\right)k$$

$$= \frac{43}{12}i + \frac{14}{3}j - \frac{7}{2}k$$

13-5