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Module: Analytical Methods (ACHA4000, ACMA4006)

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Mathematics EXAM

$$a) (i) AB = \begin{pmatrix} 1+0+0 \\ 2-8+0 \\ -1+8+0 \end{pmatrix}$$

$$\begin{array}{ccc} 1 & 2 & 3 \\ -4 & 1 & 0 \\ 0 & 7 & 2 \end{array} \quad \begin{array}{ccc} & 2 & \\ 1 & 0 & 7 \\ 8 & 8 & \\ -7 & 2 & 0 \end{array}$$

(a) (i)

$$AB = \begin{pmatrix} 1 & 16 & 7 \\ -30 & 61 & 20 \\ -22 & -12 & -21 \end{pmatrix}$$

$$BA = \begin{pmatrix} -16 & 22 & 16 \\ -2 & 8 & -1 \\ 0 & 60 & 49 \end{pmatrix}$$

(ii)

$$AC = \begin{bmatrix} 11 & 15 \\ 32 & 115 \\ -43 & 9 \end{bmatrix}$$

(iii)

$$A+B = \begin{bmatrix} 2 & 2 & 5 \\ -2 & 9 & 7 \\ -7 & 9 & 2 \end{bmatrix}$$

(iv) $A+D$, cannot calculate

(v) BD cannot calculate

(vi) $2D$

$$\begin{bmatrix} 4 & 24 \\ 4 & 10 \end{bmatrix}$$

$$(b) \begin{pmatrix} 5 & 1 & 2 \\ 1 & -1 & 1 \\ 2 & 5 & 2 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 32 \\ 10 \\ 13 \end{pmatrix}$$

$\uparrow$
 A

$$|A| = 5(-2-5) - 1(2-2) + 2(5-2)$$

$$|A| = -29$$

$$(A_1) \begin{pmatrix} 32 & 1 & 2 \\ 10 & -1 & 1 \\ 13 & 5 & 2 \end{pmatrix} \quad (A_1) = 32(-2-5) - 1(20-13) + 2(30+13)$$

$$|A_1| = -105$$

$$(A_2) \begin{pmatrix} 5 & 32 & 2 \\ 1 & 10 & 1 \\ 2 & 13 & 2 \end{pmatrix} \quad |A_2| = 5(20-13) - 32(2-2) + 2(13-20)$$

$$|A_2| = 21$$

$$(A_3) \begin{pmatrix} 5 & 1 & 32 \\ 1 & -1 & 10 \\ 2 & 5 & 13 \end{pmatrix} \quad |A_3| = 5(-13-30) - 1(13-20) + 32(5+2)$$

$$|A_3| = 98$$

$$x = \frac{|A_1|}{|A|} = \frac{-105}{-29} \Rightarrow$$

$$x = 3.62$$

$$y = \frac{21}{-29}$$

$$y = -0.72$$

$$z = \frac{98}{-29}$$

$$z = -3.38$$

(C) |A| Coefficient matrix

Question Two - Complex Numbers:-

(a) $z_1 + z_2$ $(1+7j)$ $(2-5j)$

$$1+7j + 2-5j$$

$$(1+2j)$$

(ii) $z_1 - z_3 = (1+7j) - (-2+3j)$

$$1+7j - (-2+3j)$$

$$(3+4j)$$

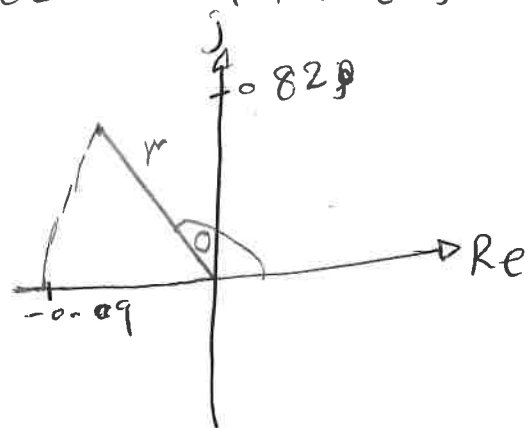
(iii) $\frac{z_1}{z_2} = \frac{1+7j}{2-5j} \Rightarrow \frac{1+7j}{2-5j} \cdot \frac{2+5j}{2+5j}$

$$\frac{z_1}{z_2} = \frac{2+5j+(4j)+35j^2}{4+10j-10j-25j^2}$$
$$\frac{2+19j+35j^2}{4-25j^2}$$
$$\frac{-33+19j}{29}$$

$$\frac{z_1}{z_2} = -\frac{33}{29} + \frac{19j}{29}$$

Polar Form

$$x = 0.09 + 0.82j$$



$$r^2 = \sqrt{0.09 + 0.82^2}$$

$$r = 0.82$$

$$\tan^{-1} \frac{0.82}{0.09}$$

$$\theta = \cancel{1.48}^\circ 83.74^\circ$$

$$180^\circ - 38.78^\circ = \cancel{141.22}^\circ 96.26^\circ$$

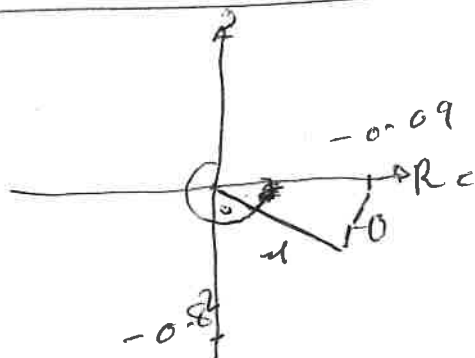
$$r(\cos \theta + j \sin \theta)$$

$$\cancel{0.82(\cos 178.5^\circ + j \sin 178.5^\circ)}$$

$$0.82(\cos 96.26^\circ + j \sin 96.26^\circ)$$

$$x = 0.09 + 0.82j$$

$$r = 0.82$$



$$\tan^{-1} \frac{0.82}{0.09} = 83.74^\circ$$

$$360^\circ - 83.74^\circ = 276.26^\circ$$

$$\cancel{1.48}^\circ$$

$$\cancel{360 - 1.48 = 358.54^\circ}$$

$$\cancel{0.82(\cos 358.54^\circ + j \sin 358.54^\circ)}$$

$$0.82(\cos 276.26^\circ + j \sin 276.26^\circ)$$

$$(B) \quad 11x^2 + 3x = -17$$

$$11x^2 + 3x + 17 = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4(A)(C)}}{2A}$$

$$x = \frac{-3 \pm \sqrt{(3)^2 - 4(11)(17)}}{3 \times 11}$$

$$x = -3 \pm \sqrt{\frac{9 - 748}{33}}$$

$$x = -3 \pm \sqrt{\frac{-739}{33}}$$

$$x = -3 \pm \sqrt{\frac{-1 \cdot 739}{33}}$$

$$\boxed{-1 = j}$$

$$\boxed{j^2 = -1}$$

$$x = -3 \pm \sqrt{\frac{739}{33}}$$

$$x = \frac{-3 \pm \sqrt{27 \cdot 18}}{33} \Rightarrow$$

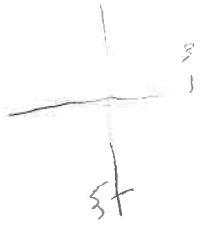
$$\frac{-3}{33} + \frac{27 \cdot 18j}{33}$$

$$\boxed{xc = 0.09 + 0.82j}$$

$$\frac{-3}{33} - \frac{27 \cdot 18}{33} = \boxed{x = 0.09 - 0.82j}$$

$$x = \frac{-3 \pm 27 \cdot 18j}{33}$$

$$(c) (3 - 5j)^3$$



$$r^2 = 3^2 + 5^2 \Rightarrow r = \sqrt{9 + 25}$$

$$r = 5.83$$

$$\tan^{-1} \frac{5}{3} = 59.04$$

$$360^\circ - 59.04^\circ = 300.96$$

$$5.83^3 (\cos 3(300.96) + j \sin 3(300.96))$$

$$\cancel{6.27} \quad 6733.08 (\cos 1504.8 + j \sin 1504.8)$$

$$2867.66 + 6094.08j$$

(5)