



Examination Answer Books

12 Pages

Complete, fold and seal
(see note 2 below)

SURNAME: Kaytiah

FORENAME(S): Baraa

Instructions to Candidates

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either ignore illegible script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
8. Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.

1	Student Number	Kay 17838627
2	Title of Examination Paper	Electrical Power
3	Module Code	FOEE 5000
4	Date and Time of Examination	Tuesday 17th May 2:00pm 2022
5	Examination Venue	
6	Seat Number	03
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
Q1	0
Q2	2
Q3	3
Q4	12
Total	17%

Question one

d) The three phase circuit Determine the current in the neutral line

$$V_{an} = 220 \angle 0^\circ$$

$$V_{bn} = 220 \angle -120^\circ$$

$$V_{cn} = 220 \angle 120^\circ$$

$$Z_T = 24(20 - j10) + (15 + j5)$$

$$Z_T = (37 - j5) = 37.33 \angle -7.69^\circ$$

$$Z = 37.33 \angle -7.69^\circ$$

$$I_T = \frac{V_{an}}{Z} = \frac{220 \angle 0^\circ}{37.33 \angle -7.69^\circ} = 5.89 \angle 7.69^\circ$$

$$S_{line} = 5.89 \angle -7.69^\circ$$

$$Z_T = 24(20 - j10) + (15 + j5) = (37 - j5) = 37.33 \angle -7.69^\circ$$

$$I = \frac{V}{Z} = \frac{220 \angle 0^\circ}{37.33 \angle -7.69^\circ} = 5.89 \angle 7.69^\circ = 5.83 \angle 0.78^\circ$$

$$\text{Real Power} = 5.89$$

$$\text{Reactive power} = -0.78$$

$$V_{line} = (2 - j10) \times I = 10.19 \angle 78.69^\circ \times 5.89 \angle 0.78^\circ$$

$$= 60.01 \angle 77.91^\circ$$

$$\text{Real power} = 60.01$$

$$\text{Reactive power} = j77.91 \text{ var}$$



Q1a

0/15

b = Three Phase Circuit Shown

Replace The circuit with its single-phase equivalent circuit

Line Current I_a from single-phase analysis. The determine the line current I_b and I_c

Q1b

0/10

$$I_a = I_b = I_c = 3A$$

$$I_a =$$

$$V_{an} = 220 \angle 0^\circ$$

x

$$V_{bn} = 220 \angle -120^\circ$$

x

$$V_{cn} = 220 \angle 120^\circ$$

x



Question Two

The Total impedance

$$Z = (20 - j10) + (60 - j30) = 80 - j40 = 89.44 \angle -26.5^\circ$$

$$I = \frac{V}{Z} = \frac{220 \angle 0^\circ}{89.44 \angle -26.5^\circ} = 2.45 \angle 26.5^\circ$$

$$S = VI^* = 220 \angle 0^\circ \times 2.45 \angle -26.5^\circ = 539 \angle -26.5^\circ$$

$$5.39 + j26.5$$

Real power 5.39

Reactive power -26.5

$$V_{load} = (20 - j10) \times I = 22.36 \angle -26.56^\circ \times 2.45 \angle -26.5^\circ$$

~~The total current of the circuit~~

$$S_{load} = V_{load} I = 22.36 \angle -26.56^\circ \times 2.45 \angle -26.5^\circ = 54.7 - j53.06 \text{ VA}$$

Real power 54.7 VA

Reactive Power 53.06 VAR Leading

The total real power is $P_T = P_{line} + P_{load}$

$$P_T = 5.39 + 54.7 = 60.09 \text{ W}$$

The total Reactive Power is

$$Q = Q_{line} + Q_{load}$$

$$Q = -26.5 - 53.06 =$$

$$Q_T = -79.56$$



Question Three

Q3a

3/15The phase voltage V_{ab} , V_{bc} , V_{ca}

$$\begin{aligned} V_{ab} &= V_p \angle 0^\circ \\ V_{bc} &= 2 \\ V_{ca} &= \end{aligned}$$

$$V_{ab} = 330 \angle 0^\circ \text{ V}$$

$$V_{bc} = 330 \angle 0^\circ$$

$$V_{ab} = 330 \angle 0^\circ \text{ V}$$

$$V_{bc} = 330 \angle 0^\circ \times$$

$$V_{ca} = 330 \angle 0^\circ \times$$

Q3b

0/10ii) The phase current I_{ab} , I_{bc} , I_{ca}

$$V_{an} = 330 \angle 330^\circ$$

$$V_{bc} = 330 \angle 330^\circ - 0^\circ = 0^\circ$$

$$V_{ca} = 330 \angle 0^\circ + 330^\circ = 330 \angle 0^\circ \times$$

The phase current I_{ab} , I_{bc} , I_{ca}

$$Z_a = 20 - j15 = 25 \angle -36.86^\circ$$

$$I_{ab} = \frac{V_{ab}}{Z_a} =$$

The phase voltage $V_{an} = 330 \angle 0^\circ$

$$V_{ab} = \sqrt{3} \angle 330^\circ = 330 \sqrt{3} = 571 \times$$

$$V_{bc} = \sqrt{3} \angle -330^\circ = 330 \sqrt{3} = 571 \times$$

$$V_{ca} = V_{an} \sqrt{3} \angle +330^\circ = 330 \sqrt{3} = 571 \times$$

The phase current I_{ab} , I_{bc} , I_{ca}

$$20 - j15 = 25 \angle -36^\circ$$

if the voltage $330 \angle 0^\circ$ the line voltage is

$$I_{AB} = \frac{V_{AB}}{Z_{\Delta}} = \frac{571 \angle 60.0^\circ}{25 \angle -36^\circ} = 22.84 \angle 24^\circ$$

$$I_{BC} = \frac{V_{BC}}{Z_{\Delta}} = \frac{571 \angle -80.0^\circ}{25 \angle -36^\circ} = 22.84 \angle -116^\circ$$

$$I_{CA} = \frac{V_{CA}}{Z_{\Delta}} = \frac{571 \angle -180^\circ}{25 \angle -36^\circ} = 22.84 \angle -216^\circ$$

$$I_A = I_{AB} \sqrt{3} \angle -30^\circ$$

$$I_A = 22.84 \sqrt{3} \angle -30^\circ = 39$$

$$I_A = 39.56 \angle -60^\circ$$

$$I_B = I_{BC} \sqrt{3} \angle -30^\circ$$

$$I_B = 22.84 \sqrt{3} \angle -116^\circ - 30^\circ =$$

$$I_B = 39.56 \angle -146^\circ$$

$$I_C = 22.84 \sqrt{3} \angle -216^\circ - 30^\circ$$

$$I_C = 22.84 \sqrt{3} \angle -246^\circ - 30^\circ$$

$$I_C = 39.56 \angle -276^\circ$$

Question four



Question four

~~2200 KVA~~~~power factor = 0.85~~

~~$P = \cos \phi = 31.78$~~

~~reactive~~

Power factor = $\cos \phi = 0.6$ ✓

$\cos^{-1} = 0.6 = 53.13$ ✓

$S_1 = 100 \text{ KVA}$ ✓

$Q_1 = S_1 \sin \phi$ ✓

$Q = 100 \sin(53.13) = 79.99 \text{ KVAR}$ ✓

$P = S_1 \cos(\phi)$ ✓

$P = 100 \cos(53.13) = 60.00 \text{ KW}$ ✓

The new power factor is 0.85

$\text{PF}_2 = \cos \phi_2$ ✓

$\cos \phi_2 = 0.85 = 0.99$ ✓

$S_2 = \frac{P}{\text{PF}_2} = \frac{60}{0.99}$ ✓

$S_2 = 60.60 \text{ KVA}$ ✓

$Q_2 = S_2 \sin \phi_2$ ✓

$Q_2 = 60.60 \sin(0.99)$ error carried forward

$Q_2 = 1.047 \text{ units?}$ $Q_1 - Q_2 = ?$ ✓

$$X_C = 0.0 \text{ } \Omega$$

$$X_C = \frac{1}{2\pi f C} = \frac{1}{2\pi \times 50 \times 0.85}$$

$$C = 8.744 \times 10^{-3} \text{ F}$$

$$C = 3744 \text{ } \mu\text{F}$$

