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Examination Answer Books

12 Pages

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.

Complete, fold and seal
(see note 2 below)

SURNAME: Alkaram

FORENAME(S): Yacob

1	Student Number	25882786
2	Title of Examination Paper	Electrical Power
3	Module Code	G0E5000
4	Date and Time of Examination	14/05/2024
5	Examination Venue	Grower college Tcho
6	Seat Number	
7	Number of Answer Books handed in	2 1

List the numbers of the questions you have attempted	Office Use
Q1	22 ✓
Q2	13 ✓
Q3	19 ✓
Q4	6 ✓
Total	60/100

(Gweler yr ochr arall am y fersiwn Cymraeg)

60%

a) $z_T = j1.3 + 5 + j0.7 + 2 + j0.8$

$z_T = 7 + j2.8$ $\tan^{-1}\left(\frac{2.8}{7}\right) = \cancel{21.8} 21.8^\circ$
units?

Power factor = $\cos(\theta) \Rightarrow \cos(\cancel{21.8}) = 0.93$
4/5

Power factor 0.93 lagging

Q1

22/25

Q1a

4/5

b) $z_1 = 60 + j30$ $z_2 = 0 - j10$

$z_T = \frac{z_1 z_2}{z_1 + z_2} + 20 \Omega \Rightarrow z_T = \frac{(60 + j30)(0 - j10)}{60 + j30 + 0 - j10} \quad j \times j = -1 \times -1 = 1$

$z_T = \frac{0 - j600 + 0 + 300}{60 + j20} \quad z_T = \frac{300 - j600}{60 + j20} \Rightarrow \frac{670.8 \angle -63.43}{63.25 \angle 18.43}$

$z_T = 10.6 \angle -81.86 \Rightarrow z_T = 1.5 - j10.49 + 20$

$z_T = 21.5 - j10.49$ units? 9/10

$V = I R z \quad I = \frac{V}{z_T} \Rightarrow I = \frac{230 \angle 0}{21.5 - j10.49} \Rightarrow I = \frac{230 \angle 0}{23.7 \angle -26}$

$I = 9.62 \angle 26$ units? 2/2

$S = V_{rms} \times (I_{rms})^* \quad S = 230 \angle 0 \times 9.62 \angle -26 \quad S = 2212.6 \angle -26$
units?

$S = 1992.3 - j971.7 \text{ VA}$ E.C.F. 3/4

$Q = 971.7 \text{ VAR}$

$P = 1992.3 \text{ W}$

$S = P + jQ$?
2/2

Question two

a) phase voltage

$$V_{AB} = 330 \angle 0^\circ \quad \checkmark \quad \underline{2/2}$$

$$V_{BC} = 330 \angle -120^\circ \quad \checkmark$$

$$V_{CA} = 330 \angle 120^\circ \quad \checkmark \quad \text{units?}$$

2) Phase currents

$$Z_D = 20 - j15 \Rightarrow 25 \angle -36.87^\circ$$

$$\hookrightarrow 25 \angle -36.87^\circ$$

$$I_{AB} = \frac{V_{AB}}{Z_D}$$

units!

$$I_{AB} = \frac{330 \angle 0^\circ}{25 \angle -36.87^\circ} = 13.2 \angle 36.87^\circ \quad \checkmark \quad \text{units!} \quad \underline{5/6}$$

$$I_{BC} = \frac{V_{BC}}{Z_D} \Rightarrow \frac{330 \angle -120^\circ}{25 \angle -36.87^\circ} = 13.2 \angle -83.13^\circ \quad \checkmark \quad \text{units?}$$

(-) mark

for no units

$$I_{CA} = \frac{V_{CA}}{Z_D} = \frac{330 \angle 120^\circ}{25 \angle -36.87^\circ} = 13.2 \angle 83.13^\circ \quad \checkmark \quad \text{units!}$$

3) Line current

$$I_a = I_{AB} \sqrt{3} \angle -30^\circ \Rightarrow I_a = 13.2 \angle 36.87^\circ \times \sqrt{3} \angle -30^\circ$$

$$I_a = 22.86 \angle 6.87^\circ \quad \checkmark \quad \underline{1/2} \quad \text{units?}$$

$$I_b = I_{BC} \sqrt{3} \angle -120^\circ \Rightarrow I_b = 13.2 \angle -83.13^\circ \times \sqrt{3} \angle -120^\circ$$

$$I_b = 22.86 \angle -203.13^\circ \quad \checkmark \quad \text{units?}$$

$$I_c = I_{CA} \sqrt{3} \angle 120^\circ \Rightarrow I_c = 13.2 \angle 83.13^\circ \times \sqrt{3} \angle 120^\circ$$

$$I_c = 22.86 \angle 203.13^\circ \quad \checkmark \quad \text{units?}$$

$$a) \tan^{-1}\left(\frac{-15}{20}\right) = -36.87^\circ$$

$$\cos(-36.87^\circ) = 0.8 \quad \checkmark \quad \underline{3/3}$$

$$P = V_{AB} \times I_{AB} \times \cos(-36.8^\circ) \Rightarrow 330 \text{ V} \times 13.2 \text{ A} \times 0.8$$

$$3484.8 \text{ W}$$

$$P = 3484.8 \text{ W} \quad \checkmark$$

Q213/25Q2a11/13

b)

1) Phase voltage

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

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

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

2/2

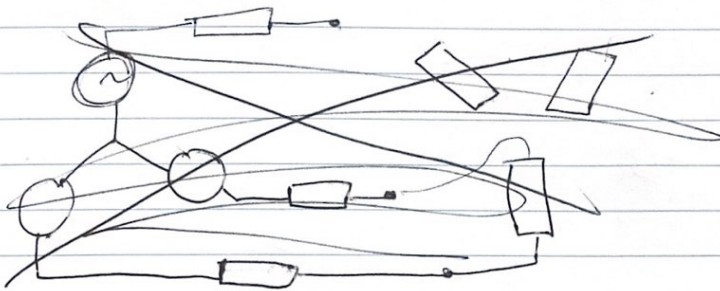
units L

Q2b2/12

2) Line voltage

$$Z_L = 6 - j2 \Rightarrow Z_L = 6.3 \angle -18.43^\circ$$

$$V_{AB} = \sqrt{3} V_p \angle 30^\circ$$



$$V_{AB} = \sqrt{3} \angle 30^\circ \times 6.3 \angle -18.43^\circ$$

$$V_{AB} = 10.9 \angle 11.57^\circ$$

$$V_{BC} = \sqrt{3} \angle -90^\circ \times 6.3 \angle -18.43^\circ$$

* 0/2

$$V_{BC} = \sqrt{3} \angle -120^\circ \times 6.3 \angle -18.43^\circ = 10.9 \angle -138.43^\circ$$

$$V_{CA} = \sqrt{3} \angle 120^\circ \times 6.3 \angle -18.43^\circ = 10.9 \angle 101.57^\circ$$

3) Phase current

$$I_{AN} = \frac{V_{AB}}{Z_A + j18} \Rightarrow I_{AN} = \frac{10.9 \angle 11.57^\circ}{14.4 \angle 33.69^\circ}$$

$$Z_A = 12 + j8 \Rightarrow 14.4 \angle 33.69^\circ$$

$$I_{AN} = 0.76 \angle -22.12^\circ$$

0/34) 05) 0

Question three

$$S = 120 \text{ KVA} \quad \text{pf} = 0.65 \quad V = 240 \text{ V} \quad 50 \text{ Hz}$$

$$\text{pf} = 0.9$$

Q319/25

$$Q_c = Q_1 - Q_2 \quad \cos^{-1}(0.65) = 49.46^\circ \quad \underline{\underline{3/3}}$$

$$P_1 = S_1 \times \cos(49.46) \Rightarrow P_1 = 120 \times \cos(49.46) = \cancel{78} \text{ 78 kW}$$

$$Q_1 = S_1 \times \sin(49.46) \Rightarrow Q_1 = 120 \times \sin(49.46) = 91.19 \text{ KVAR} \quad \underline{\underline{5/5}}$$

$$S_2 = \frac{P_1}{\cos(\theta)} \quad \cos^{-1}(0.9) = 25.84^\circ$$

Q3a18/20

$$S_2 = \frac{78}{\cos(25.84)} \Rightarrow S_2 = \frac{78}{\cos(25.84)} = 86.67 \text{ KVA} \quad \underline{\underline{4/4}}$$

$$Q_2 = S_2 \sin(25.84) \Rightarrow Q_2 = 86.67 \times \sin(25.84) = 37.78 \text{ KVAR} \quad \underline{\underline{2/2}}$$

$$Q_c = Q_1 - Q_2 \Rightarrow Q_c = 91.19 - 37.78 = 53.41 \text{ KVAR}$$

$$X_c = \frac{V^2}{Q_c} \quad Q_c = 53.41 \times 10^3 \quad Q_c = 53410 \text{ units?} \quad \underline{\underline{1/2}} \quad \text{units?}$$

$$X_c = \frac{(240)^2}{53410} \quad X_c = 1.078 \text{ units?} \quad \underline{\underline{1/2}}$$

$$C = \frac{1}{2\pi f X_c} \Rightarrow C = \frac{1}{2\pi \times 50 \times 1.078} \quad C = 2.95 \text{ mF} \quad \underline{\underline{2/2}}$$

5) The reasons why a high power factor rating is very important is a industrial ~~environment~~ environment is the efficiency of the system. The lower the power factor the worse it is for electrical systems. ~~which~~ will lead to higher repair cost and ~~low~~ life span of the machinery.

Q3b1/51/5

~~$S_{13} = 20 \text{ kVA}$~~

b)

$$1) E_a = V_s - (R_a \cdot I_a)$$

$R_c = 0.12$

$R_f = 0.05$

$I_a = 30 \text{ A}$

1200 rpm

$E_a = 72 - (0.12 - 0.05 \cdot 30)$

$E_a = 77.38 \text{ V}$

$V = 72 \text{ V}$

0.12

Q46/25Q4b6/10

$$2) \omega = \frac{\text{rpm}}{60} \cdot 2\pi \Rightarrow \frac{1200}{60} \cdot 2\pi = 125.66 \text{ rad/sec}$$

$$3) k\phi = \frac{E_a}{\omega} \Rightarrow \frac{77.38}{125.66} = 0.62$$

2/2

$P_m = T_d \omega$

E.C.F

correct method.

3/4

$$T_d = k\phi \cdot i_a \Rightarrow T_d = 0.62 \times 30 = 18.6 \text{ N.m}$$

E.C.F

$$P_m = 18.6 \times 125.66 = 2337.28 \text{ rad/sec.}$$

E.C.F

1/2

Question 4

$$a) S_B = 20 \text{ KVA}$$

$$Z_{\text{Line}} = 18 + j36 \quad Z_{\text{load}} = 10 \angle 30^\circ$$

Q4 a

$$Z_{\text{line}} = V_1 = 400 \quad \frac{1}{5} \quad j0$$

0/15

$$\frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{I_2}{I_1}$$

$$\frac{V_1}{V_2} = \frac{1}{5} \quad \frac{400}{V_2} = \frac{1}{5} \quad V_2 = 2000$$