Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Examination Answer Books

12 Pages

Complete, fold and seal
(see note 2 below)

SURNAME: KAZEMI

FORENAME(S): ALEX

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	KAZ 23873625
2	Title of Examination Paper	ELECTRICAL POWER
3	Module Code	GOEE 5000
4	Date and Time of Examination	15/05/2024 10:00 - 12:00
5	Examination Venue	MAIN HALL TYCOCH
6	Seat Number	E4

7	Number of Answer Books handed in	1

List the numbers of the questions you have attempted	Office Use
1	
2	
3	
4	
Q1	25
Q2	25
Q3	23
Q4	11
Total	84/100

L2

84%

(Gweler yr ochr arall am y fersiwn Cymraeg)

Question No

Examiner Only

Q1
25/30

Q1a
5/5

Q1b
20/25

1) a) $Z_T = 6 + j3\Omega + 20\Omega - j15$

$= 26\Omega - j12$

$Z_t = 28.6 \angle -24.8^\circ \Omega$

$I = \frac{V}{Z_T} = \frac{240 \angle 0^\circ V}{28.6 \angle -24.8} = 8.4 \angle 24.8^\circ A$

$P_F = \cos\phi$

$P_F = \cos(24.8^\circ)$ 5

$P_F = 0.9$

b) $Z_t = \frac{-j15(65 + j35)\Omega}{} + 25\Omega$

$= \frac{-j15 + 65 + j35}{}$

$= \frac{-j975 + 525\Omega}{65 + j20\Omega} + 25\Omega$

$= \frac{525 - j975}{65 + j20}\Omega + 25\Omega$

$= \frac{1107.4 \angle -61.7^\circ}{68 \angle 17.1^\circ}\Omega + 25\Omega$ 14

$= 16.29 \angle 43.9^\circ \Omega + 25\Omega$ X

$= 11.7 + j11.3\Omega + 25\Omega$

error carried forward $Z_t = 36.7 + j11.3\Omega$

or

$Z_t = 38.4 \angle 17.1^\circ \Omega$ correct method

Athoiwr yn unig

Pawb y Cwestiwn

Question No.

Examiner Only

V_R

$I_t = \frac{220\ V}{Z_{eq}} = \frac{220\angle 0°\ V}{38.4\angle 17.1°\ \Omega} = 5.7\angle -17.1°\ A$ ✓ ✓ 2

$S = V_R I^* = 220\angle 0°\ V \times 5.7\angle +17.1°\ A$ ✓ ✓

$= 1254\angle +17.1°\ VA$

$S = 1198.6 - j368.7\ VA$ 2 error carried forward

$S = P + jQ$ ✓

$P = 1198.6\ W$ ✓ 1

$Q = -368.7\ VAR$ ✓ 1

Archive in use

Examiner Only

Question No.

Examiner Only

Q2

25/25

Q2a

20/20

2) a) $PF_1 = 0.65$ ✓ $pf = \cos\phi$ ✓

$\phi_1 = \cos^{-1}(0.65) = 49.46°$ ✓ ✓

$S_1 = 120kVA$ ✓

$P = PF \times S$ ✓

$P = 78kW$ ✓ 3

$Q_1 = S \sin\phi$ ✓

$= 120000 \times \sin(49.46°)$ ✓

$= 91.19kVAR$ ✓ 5

$PF_2 = 0.9$ $pf = \cos\phi$ ✓

$\phi_2 = \cos^{-1}(0.9) = 25.84°$ ✓

$P/PF =$ ✓

$S_2 = 78/0.9$ ✓ 4

$S_2 = 86.67kVA$ ✓

$Q_2 = S \sin\phi$ ✓

$= 86670 \times \sin(25.84°)$ ✓

$= 37.8kVAR$ ✓ 2

$Q_C = Q_1 - Q_2$ ✓

$= 91.19 - 37.8$ ✓

$= 53.39kVAR$ ✓ 2

$Q_{CAPACITOR} = \frac{V^2}{X_C}$ ∴ $X_C = \frac{V^2}{Q_{CAPACITOR}} = \frac{(220)^2}{53390}$ ✓

$X_C = 0.91\Omega$ ✓ 2

$X_C = \frac{1}{2\pi fC}$ ∴ $C = \frac{1}{2\pi f X_C}$ ✓ $C = \frac{1}{2\pi \times 50 \times 0.91}$ ✓

$C = 3.5mF$ ✓ 2

CAPACITOR REQUIRED.

Question No.

Examiner Only

3 b) i) $Z_L = 10\Omega + 5\Omega + j2\Omega + 50 + j40$

$= 65 + j42$

$= 77.39 \angle 32.87° \Omega$

$PF = \cos\phi$

$PF = 0.84.$ 3

Q2b

5/5

ii) $X_C = \frac{1}{2\pi fC}$ $\therefore$ $C = \frac{1}{2\pi f X_C}$

$C = \frac{1}{2\pi \times 1500 \times 114} = 0.93\mu F$ 2

Answer in ink

Off y Question

Δ - Δ

Question No

Examiner Grey

Q3
23/30

Q3a
15/15

3) a) i) $V_{ab} = V_p \angle 0°$ ✓
$V_{bc} = V_p \angle -120°$ ✓
$V_{ca} = V_p \angle +120°$ ✓

$V_{ab} = 220 \angle 0°$ V ✓
$V_{bc} = 220 \angle -120°$ V ✓
$V_{ca} = 220 \angle +120°$ V ✓ 5

ii) $Z_\Delta = 10 - j5\ \Omega$ ✓
$= 11.2 \angle -26.6°\ \Omega$ ✓

$I_{AB} = \frac{V_{ab}}{Z_\Delta} = \frac{220 \angle 0°}{11.2 \angle -26.6°} = 19.6 \angle 26.6°$ A ✓

$I_{BC} = \frac{V_{bc}}{Z_\Delta} = \frac{220 \angle -120°}{11.2 \angle -26.6°} = 19.6 \angle -93.4°$ A ✓

$I_{CA} = \frac{V_{ca}}{Z_\Delta} = \frac{220 \angle +120°}{11.2 \angle -26.6°} = 19.6 \angle 146.6°$ A ✓ 5

iii) $I_a = I_{AB}\sqrt{3} \angle -30°$ ✓

$I_a = 19.6 \angle 26.6° \times \sqrt{3} \angle -30°$ ✓

$= 33.9 \angle -3.4°$ A ✓ 5

~~$I_b = I_a \angle -120°$~~
~~$I_{bc} = I_b \angle 26.6 - 120°$~~
~~$I_b =$~~

$I_b = I_a \angle -120°$ ✓
$I_b = 33.9 \angle -3.4 - 120°$
$I_b = 33.9 \angle -123.4°$ A ✓

$I_c = I_a \angle +120°$ ✓
$I_c = 33.9 \angle -3.4 + 120°$
$I_c = 33.9 \angle 116.6°$ A ✓

Y - Y

Question No

Examiner Only

Q3b

8/15

b) i) $V_{ab} = \sqrt{3}\, V_p \angle 30°$ ✓

$V_p = \frac{400 \angle -30°}{\sqrt{3}} = 230.9 \angle -30°\ V$ ✓ ✓ ✓ 2

ii) $Z_Y = 6 + j6\ \Omega$ ✓

$Z_Y = 8.5 \angle 45°\ \Omega$ ✓ ✓ 4

$I_p = \frac{V_p}{Z_Y} = \frac{230.9 \angle -30°}{8.5 \angle 45°} = 27.2 \angle -75°\ A$ ✓ ✓

iii) $pF = \cos\phi$ ✓

~~$pF = \cos(\quad$~~

$pF = \cos(-15°)$ 1

$pF = 0.97$

iv) $P = IV$

~~$P = 27.2 \angle -75°\ A \times 230.9$~~

$P = 27.2 \times 230.9$

$P = 6.28\,kW$ per phase ✓ 2

v) Total $P = 6.28 \times 3$ ✓

Total $P = 18.84\,kW$ 2

correct method
error carried
forward

Arholwr yn unig

Rhif y Cwestiwn

240V no load 3A +1500 rev/min $R_a = 0.2\Omega$

Full load = 30 A

4) a) $V = 240V$

$V = E + I_a R_a$ ✓

$E = V - I_a R_a$ ✓

$E = 240 - 3 \times 0.2$ ✓

$E = 239.4V$ ✓

$\omega = 2\pi N / 60$ ✓

$\omega = \frac{2\pi \times 1500}{60}$ ✓

$\omega = 157.1$ rad/sec ✓

Q4 11/15

Q4a 10/10

$E = K\phi\omega$ ✓

$K\phi = \frac{E}{\omega} = \frac{239.4}{157.1}$ ✓

$K\phi = 1.5$ ✓

$E_{\text{full load}} = V - I_a R_a$ ✓

$= 240 - 30 \times 0.2$ ✓

$E = 234V$ ✓

10

$E = K\phi\omega$ ✓

$\omega = \frac{E}{K\phi} = \frac{234}{1.5}$ ✓ ✓

$= 156$ rad/sec ✓

$\omega = 2\pi N / 60$

$N = \frac{\omega \times 60}{2\pi}$

$N = \frac{156 \times 60}{2\pi}$ $N = \frac{9360}{2\pi}$ ✓ $N = 1489.7$ rev/min ✓

FULL LOAD SPEED = 1489.7 rev/min. ✓

Question No.

Examiner Only

b) i) 4 : 1 $\quad \frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{I_2}{I_1}$ ✓

$\frac{V_1}{V_2} = \frac{N_1}{N_2} \quad \frac{440}{V_2} = \frac{4}{1}$ ✓

$V_2 = \frac{440}{4} = 110V$ ✓

$P = I \times V$ ✗

$P = 20 \times 110$ ✗

$P = 2200W$

ii) $\frac{V_1}{V_2} = \frac{I_2}{I_1}$

$\frac{440}{110} = \frac{20}{I_1}$ ✓

$I_1 = 4 \times 20$

$I_1 = 80A$ ✗

Q4b

4/5