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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).
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1	Student Number	RAM 20849142
2	Title of Examination Paper	Electrical Power
3	Module Code	GOEE5000
4	Date and Time of Examination	14/05/2026 01:32
5	Examination Venue	Tycoch
6	Seat Number	
7	Number of Answer Books handed in	1

Complete, fold and seal
(see note 2 below)

SURNAME: RAMADHAN

FORENAME(S): NARTIMAN

List the numbers of the questions you have attempted	Office Use
Q1	20 ✓
Q2	16 ✓
Q3	18 ✓
Q4	10 ✓
Total	64/100

12

64%

(Gweler yr ochr arall am y fersiwn Cymraeg)

Q1

$$a. \quad V = 240 \angle 0^\circ \text{ V}$$

$$Z_1 = 1.3j \, \Omega$$

$$Z_2 = 5 + 0.7j \, \Omega$$

$$Z_3 = 2 + 0.8j \, \Omega$$

$$P_f = ?$$

$$Z_T = Z_1 + Z_2 + Z_3$$

$$= (1.3j) + (5 + 0.7j) + (2 + 0.8j)$$

$$= 7 + 2.8j \, \Omega$$

or

$$= 7.5 \angle 21.8^\circ \, \Omega$$

show workings.

$$P_f = \cos \theta$$

$$= \cos (21.8)$$

$$= 0.92 \text{ lagging}$$

Q120/25Q1a4/5

b.

$$S = ? , P = ? , Q = ?$$

Q16

$$R = 20 \Omega$$

$$Z_T = R + \frac{Z_1 Z_2}{Z_1 + Z_2}$$

$$Z_1 = 0 - 10j \Omega$$

$$Z_2 = 60 + 30j \Omega$$

$$= 20 + \frac{(0 - 10j)(60 + 30j)}{(0 - 10j) + (60 + 30j)}$$

$$V = 230 \angle 0^\circ \text{ V}$$

$$= 20 + \frac{-600j - 300j^2}{60 + 20j}$$

$$= 20 + \frac{300 - 600j}{60 + 20j}$$

$$= 20 + \frac{670.8 \angle -63.4^\circ}{63.2 \angle 18.4^\circ}$$

$$= 20 + 10.6 \angle -81.8^\circ \Omega$$

$$= 30.6 \angle -81.8^\circ \Omega$$

8/10

$$\text{or } Z_T = 4.36 - 30.2j \Omega$$

$$I = \frac{V}{Z_T} = \frac{230 \angle 0^\circ}{30.6 \angle -81.8^\circ} = 7.5 \angle 81.8^\circ \text{ A}$$

E.C.F

$$\text{or } I^* = 7.5 \angle -81.8^\circ \text{ A}$$

$$S = VI^*$$

$$= (230 \angle 0^\circ)(7.5 \angle -81.8^\circ)$$

4/4

$$= 1725 \angle -81.8^\circ \text{ VA} \quad \text{or } S = 246 - 1707.3j$$

E.C.F

$$P = 246 \text{ (KW)} \quad 1/2$$

$$Q = -1707.3 \text{ (j) VAR} \quad 1/2$$

Q2

$$a. \quad Z = 20 - 15j \, \Omega$$

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

1. Calculate Phase voltage V_{ab} , V_{bc} , V_{ca}

$$V_{ab} = V_p \angle 0^\circ \checkmark$$

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

$$V_{bc} = V_p \angle -120^\circ \checkmark \quad 2/2$$

$$= 330 \angle 0 - 120^\circ \checkmark$$

$$= 330 \angle -120^\circ \checkmark \text{ units.}$$

$$V_{ca} = V_p \angle 120^\circ \checkmark$$

$$= 330 \angle 0^\circ + 120^\circ \checkmark$$

$$= 330 \angle 120^\circ \checkmark \text{ units.}$$

Q2

16/25

Q2a

12/13

2. calculate phase currents I_{ab} , I_{bc} , I_{ca}

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

$$= \frac{330 \angle 0^\circ}{20 - 15j} = \frac{330 \angle 0^\circ}{25 \angle -36.8^\circ} = 13.2 \angle +36.8^\circ \text{ A}$$

$$I_{bc} = \frac{V_{bc}}{Z_{bc}} = \frac{330 \angle -120^\circ}{25 \angle -36.8^\circ} = 13.2 \angle -83.2^\circ \text{ A}$$

$$I_{ac} = \frac{V_{ac}}{Z_{ac}} = \frac{330 \angle 120^\circ}{25 \angle -36.8^\circ} = 13.2 \angle 156.8^\circ \text{ A}$$

3. calculate the ~~line~~ line currents I_a , I_b , I_c

$$\begin{aligned} I_a &= I_{ab} \sqrt{3} \angle -30^\circ \\ &= (13.2 \angle +36.8^\circ)(\sqrt{3} \angle -30^\circ) \\ &= 22.8 \angle -66.8^\circ \text{ A} \end{aligned}$$

$$\begin{aligned} I_b &= I_a \angle -120^\circ \\ &= 22.8 \angle -66.8 - 120^\circ \\ &= 22.8 \angle -186.8^\circ \text{ A E.C.F} \end{aligned}$$

$$\begin{aligned} I_c &= I_a \angle 120^\circ \\ &= 22.8 \angle -66.8 + 120^\circ \\ &= 22.8 \angle 53.2^\circ \text{ A E.C.F} \end{aligned}$$

4. Calculate the Per Phase real Power dissipated in the load

~~404188~~

$$\text{Real Power Per phase} = I_p V_p \cos \theta \checkmark$$

$$= 13.2 \times 330 \cos(36.8) \checkmark$$

$$= 4356 \cos(36.8) \checkmark$$

$$= 3487.9 \text{ W} \checkmark \quad \underline{\underline{313}}$$

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

$$Z_L = 6 - 2j \Omega$$

$$Z_{\text{load}} = 12 + 8j \Omega$$

Q2b

4112

1. V_{bn}, V_{cn}

$$V_{bn} = V_p \angle -120^\circ \Rightarrow V_p = \frac{V_L}{\sqrt{3}} = \frac{220}{\sqrt{3}} = 127 \text{ V}$$

$$= 127 \angle 0 - 120$$

$$= 127 \angle 0^\circ$$

$$= 127 \angle -120^\circ \text{ V} \times$$

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

012

$$= 127 \angle 0 + 120$$

$$= 127 \angle 120^\circ \text{ V} \times$$

2. line voltage V_{ab}, V_{bc}, V_{ca}

If line currents

$$I_a = ??$$

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

$$= (127 \angle 0^\circ) (\sqrt{3} \angle 30^\circ)$$

$$= 219.9 \angle 30^\circ \text{ V}$$

$$V_{bc} = V_{ab} \angle -120^\circ$$

$$= 219.9 \angle 30 - 120^\circ$$

$$= 219.9 \angle -90^\circ \text{ volt}$$

$$V_{ac} = V_{ab} \angle 120^\circ$$

$$= 219.9 \angle 30 + 120$$

$$= 219.9 \angle 150^\circ \text{ V}$$

correct method
E.C.F

3. phase current I_{an}, I_{bn}, I_{cn}

$$I_{an} = \frac{V_{an}}{Z} =$$

$$Z_T = Z_1 + Z_2$$

$$= (6 - 2j) + (12 + 8j) = 18 + 6j \Omega \text{ or } Z_T = 18.9 \angle 18.4^\circ$$

$$I_{an} = \frac{220 \angle 0^\circ}{18.9 \angle 18.4^\circ} = 11.6 \angle -18.4^\circ \text{ A}$$

$$I_{bn} = I_{an} \angle -120^\circ$$

$$= 11.6 \angle -18.4 - 120^\circ$$

$$= 11.6 \angle -138.4^\circ \text{ A}$$

$$I_{cn} = I_{an} \angle 120^\circ$$

$$= 11.6 \angle -18.4 + 120^\circ$$

$$= 11.6 \angle 101.6^\circ \text{ A}$$

Q3Q3

$$Q. \quad S = 120 \text{ KVA} \quad P_{f1} = \cos \theta_1$$

18/25

$$P_{f1} = (0.65) \quad \theta_1 = \cos^{-1}(0.65) = 49.4^\circ$$

Q3a

$$V = 240 \text{ V}$$

$$F = 50 \text{ Hz}$$

$$Q_1 = S_1 \sin \theta_1$$

$$= (120) \sin(49.4) = 91.1 \text{ KVAR}$$

18/20

$$P_{f2} = 0.9$$

$$P = S \cos \theta_1$$

$$C = ?$$

$$= 120 \cos(49.4) = 78 \text{ KW}$$

$$P_{f2} = \cos \theta_2$$

$$\theta_2 = \cos^{-1}(0.9) = 25.8^\circ$$

$$P_{f2} = \frac{P}{S_2}$$

$$S_2 = \frac{P}{P_{f2}} = \frac{78}{\cos(25.8)} = 86.6 \text{ KVA}$$

$$Q_2 = S_2 \sin \theta_2$$

$$= 86.6 \sin(25.8) = 37.6 \text{ KVAR}$$

$$Q_T = Q_1 - Q_2$$

$$= 91.1 - 37.6 = 53.5 \text{ KVAR}$$

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

$$X_C = \frac{V^2}{Q} = \frac{(240)^2}{53.5} = 1076.6 \text{ } \Omega$$

$$C = \frac{1}{2\pi F X_C} = \frac{1}{2\pi (50)(1076.6)} \quad \text{E.C.F.}$$

Correct method.

$$= 2.9 \times 10^{-6}$$

$$\text{or } C = 2.9 \mu\text{F} \quad \text{E.C.F.}$$

1/2

b.

0/5

Q4

Q4

a. $S = 20 \text{ KVA}$

$$V = 400 \text{ V}$$

$$N_1 = 0.2$$

$$N_2 = \frac{10}{1}$$

$$Z_{load} = 10 \angle 30^\circ \text{ or } 8.6 + 5j \Omega$$

$$Z_{line} = 16 + 36j$$

~~that~~

0

Q4a

0/15

b.

$$V_s = 72 \text{ V}$$

$$E_a = K\phi\omega$$

Q4b

$$R_a = 0.12 \Omega$$

$$E_a = V_s - I_a(R_a + R_f)$$

10/10

$$R_f = 0.05 \Omega$$

$$= 72 - (30)(0.12 + 0.05)$$

$$N = 1200 \text{ rev/min}$$

$$= 66.9 \text{ V}$$

2/2

$$I_a = 30 \text{ A}$$

1. EMF (E_a)2. angular speed ω

$$\omega = 2\pi N/60$$

$$= 2\pi(1200)/60$$

2/2

$$= 125.6 \text{ rad/s}$$

3. Mechanical Power

$$P_{\text{mech}} = T_d \omega$$

$$T_d = K\phi I_a$$

$$K\phi = \frac{E_a}{\omega} = \frac{66.9}{125.6} = 0.53$$

4/4

$$T_d = K\phi I_a \Rightarrow T_d = 0.53 \times 30 = 15.9 \text{ N.m}$$

$$P_{\text{mech}} = T_d \omega \Rightarrow P_{\text{mech}} = 15.9 \times 125.6 = 1997 \text{ W}$$

4. calculate T_d

$$T_d = K \phi I_a \checkmark$$

$$= 0.53 \times 30 = 15.9 \text{ N.m}$$

2/2