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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.**

1	Student Number	
2	Title of Examination Paper	Power + MACHINES
3	Module Code	SGEE5006
4	Date and Time of Examination	9.30 4/5/23
5	Examination Venue	DRAMA CSG HALL
6	Seat Number	21
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
1	25
2	16
3	16
Total	57

MARK
AGREED

(Gweler yr ochr arall am y fersiwn Cymraeg)

1

a.

- (i) The two types of losses are hysteresis loss and Eddy current

Hysteresis loss can be minimized by the choice of the core material. The losses are proportional to the BH loop. The narrower the loop, the lower the losses.

Eddy currents are setup in the core due to ~~then~~ the changing magnetic flux. To minimize this the core is laminated. The laminations are insulated from each other.

(ii)

$$|E_2| = 4.44 f n_2 \phi_{\max}$$

$$N_2 = \frac{200}{4.44 \times 60 \times 0.075} = 10 \text{ turns}$$

$$N_1 = 10 \times \frac{5500}{200} = 275 \text{ turns}$$

b.

(i)

FOR M1

$$|S1| P_1 = 5.5 \times 0.78 = 4.29 \text{ KW}, Q_1 = \sqrt{5.5^2 - 4.29^2} = 3.44 \text{ KVAR}$$

FOR M2

$$|S2| P_2 = 15.2 \times 0.85 = 12.92 \text{ KW}, Q_2 = \sqrt{15.2^2 - 12.92^2} = 8 \text{ KVA}$$

$$\text{Single Phase Loads, } P_3 = 3.5 \times 3 = 10.5 \text{ KW}$$

$$\text{Total } P = P_1 + P_2 + P_3 = 4.29 + 12.92 + 10.5 = 27.71 \text{ KW}$$

$$\text{Total } Q = Q_1 + Q_2 = 3.44 + 8 = 11.44 \text{ KVA}$$

$$\text{Totals} = \sqrt{27.71^2 + 11.44^2} = 29.98 \text{ KVA}$$

$$I_{\text{line secondary}} = \frac{29980}{\sqrt{3} \times 2000} = 86.54 \text{ A} \\ \sqrt{3} \times 2000 = 41.21 \text{ A} \quad \checkmark$$

$$I_{\text{line primary}} = \frac{29980}{\sqrt{3} \times \frac{5500}{11000}} = 3.15 \text{ A} \\ \sqrt{3} \times \frac{5500}{11000} = 1.57 \text{ A} \quad \checkmark$$

(ii)

$$\text{Power factor} = \frac{P}{S}$$

$$= \frac{27.71}{29.98} \approx$$

$$= 0.92 \text{ lagging.} \quad \checkmark$$

13

2

2.

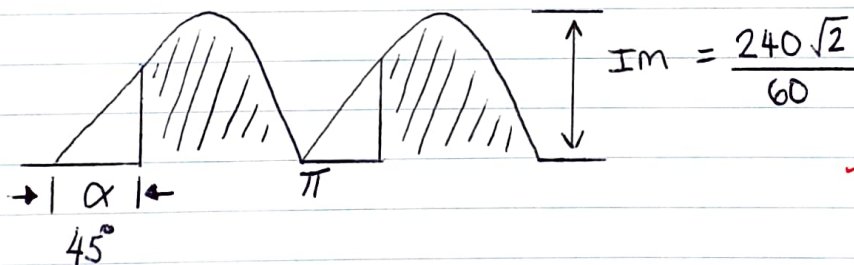
- a.
(i) The di/dt rating of a thyristor indicates the maximum rate of rise of current, when triggered causing unequal current distribution, resulting in hot spots in the devices junctions and device failure ✓

The dv/dt rating is the maximum rate of rise of the anode-cathode voltage when not triggered. ✓

- (ii) The di/dt to which the device is subjected to can be limited by using an inductor in series. ✓

The dv/dt can be controlled by adding an in series RC 'snubber' network which is connected to the device across the anode and cathode. ✓

- b.
(i)



(ii) $I_{RMS}^2 = \frac{\text{Power dissipated}}{\text{Heater Resistance}} = \frac{870}{60} = 14.5^2$

$I_{RMS} = \sqrt{14.5}$
 $= 3.808A$ ✓

(iii) Where $I_m = \frac{V_m}{R}$

3.

- (i) $R_a = 0.48 \Omega$, $T_L = 68 \text{ Nm}$, $b = 0.02 \text{ Nm/rad/s}$, 2100 rpm , 250 V , 74.5 A

$$\omega_m = 2\pi \times \frac{2100}{60} = 219.9 \text{ rad/s} \quad \checkmark$$

$$T_m = T_L + b\omega_m \\ = 68 + 0.02 \times 219.9 = 72.4 \text{ Nm} \quad \checkmark$$

Since $T_m = K_m I_a$
 $K_m = T_m / I_a$
 $K_m = 72.4 / 74.5$
 $= 0.972 \quad \checkmark$

⑤
✓

ALSO $V_a = E_a + I_a R_a$
 $250 = E_a + 74.5 \times 0.48$
 $250 = E_a + 35.76$
 $E_a = 250 - 35.76$
 $E_a = 214.24 \quad \checkmark$

Since $E_a = K_e \omega_m$
 $K_e = E_a / \omega_m$
 $K_e = 214.24 / 219.9$
 $= 0.974 \text{ V/RAD/S} \quad \checkmark$

③
✓

- (ii) Load is increased to 80 Nm

$$T_m = T_L + b\omega_m \\ 0.972 I_a = \frac{80 + 0.02 \omega_m}{0.972} \quad (1)$$

ALSO $V_a = E_a + R_a I_a$
 $250 = 0.974 \omega_m + 0.48 I_a \quad (2)$

Subbing (1) into (2)

$$250 = 0.974\omega_m + 0.48 \left(\frac{80 + 0.02\omega_m}{0.972} \right)$$

$$250 = 0.974\omega_m + 39.51 + \cancel{0.015\omega_m} - 0.0098\omega_m$$

$$\omega_m = \frac{250 - 39.51}{0.974}$$

$$\omega_m = 216.11 \text{ rad/s}$$

$$I_a = \frac{80 + 0.02 \times 216.11}{0.972}$$

$$I_a = \cancel{88.97A} \quad 86.75A \quad \checkmark$$

8
✓