



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 the paper over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners will not read answers written in 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	1708737 ~~1708737~~
2	Title of Examination Paper	Electrical machines
3	Module Code	MGX00373
4	Date and Time of Examination	17/05/19 15:00
5	Examination Venue	1Q310
6	Seat Number	6067
7	Number of Answer Books handed in	1

Complete, fold and seal
(see note 2 below)

SURNAME:

THOMAS

FORENAME(S):

JAMES

List the numbers of the questions you have attempted	Office Use
1	9 9
2	6 6
3	6 6
4	2 2
5	2 2
6	6 6
7	7 9
Total	38 40 80% 1.1.



1. $\Phi = 560 \text{ mwb}$ $B = 56$ Cast

$$N = 1200$$

$$L_1 = 650 \text{ mm}$$

$$L_2 = 90 \text{ mm}$$

$$A = 40 \times 100 \times 10^{-6}$$

$$B = \frac{\Phi}{A} = \frac{560 \times 10^{-6}}{40 \times 100 \times 10^{-6}} = 0.14 \text{ T}$$

from B-H curve.

Cast-iron

$$H = 100 \text{ A/m} \quad \times \quad 300 \text{ At/m}$$

$$\begin{aligned} \text{mmf}_{\text{core}} &= H \cdot l \\ &= 100 \times 650 \times 10^{-3} \\ &= 65 \end{aligned}$$

~~B-H~~

$$H = \frac{B}{\mu_0} = \frac{0.14}{4\pi \times 10^{-7}}$$

$$\begin{aligned} \text{mmf} &= H \cdot l \\ &= \frac{0.14}{4\pi \times 10^{-7}} \times 90 \times 10^{-3} \\ &= 10026.76 \text{ (2dp)} \end{aligned}$$

$$I = \frac{\text{mmf}}{N} = \frac{10026.76 + 65}{1200}$$

$$= 8.41 \text{ A (2dp)}$$

(9)

✓ a

$$2a \quad N = 1600$$

$$A = 150 \times 250 \times 10^{-6}$$

$$B = 0.75$$

$$\text{RPM} = 3000$$

$$\omega = ?$$

$$\text{emf} = ?$$

$$\Phi = ?$$

$$a \quad \omega = 2\pi f$$

$$\omega = 100\pi$$

$$f = \frac{3000}{60} = 50$$

$$\text{emf} = NBA\omega \sin(\omega t)$$

$$\sin(\omega t) = 1$$

$$= 1600 \times 0.75 \times (150 \times 250 \times 10^{-6}) \times 100\pi$$

$$= 4500\pi$$

$$= 14,137.17 \text{ V (2dp)}$$

(3)

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$$b \quad \Phi = BA$$

$$= 0.75 \times (150 \times 250 \times 10^{-6})$$

$$= 0.028 \text{ wb (3dp)}$$

(3)

3



3. Induction motor

Synchronous motor

1. Construction is simple (^{Simple} Easy) ✓
2. Self Starting ✓
3. the induced emf exists in the Rotor so ~~no~~ different power source not needed ✓
4. Speed is under synchronous but never synchronous ✓
5. ^{speed} Control is possible but difficult. X
6. as load increases, the speed drops or decreasing ✓
7. always operate lagging p.f. and p.f. can't be controlled ✓
8. can't be used as a synchronous condenser ✓
9. Phenomenon of hunting is absent. ✓
10. Cheap and maintenance free ✓

Not self starting ✓

Separate power source to excite the rotor. ✓

Speed is synchronous ~~not~~ no matter the load. ✓

Speed control not possible X

as load increases, the load angle increases but keep speed constant and synchronous.

The excitation change will change motor from lagging to leading.

can ~~also~~ be used as a synchronous condenser to improve p.f. ✓

Sensitive to sudden load changes and hunting results.

Not cheap and needs maintenance.

#Both have RMF ✓

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4. $N=1$
 $\theta=90$
 $B=0.45$
 $l=150\text{mm}$
 $R=0.5$
 $V=24$

$$I = \frac{V}{R} \frac{24}{0.5} = 48\text{A}$$

$$F = NBIL \sin \theta$$

$$= 1 \times 0.45 \times 48 \times 150 \times 10^{-3} \times \sin 90$$

$$= 3.24\text{N}$$

②

2

5. 3 pairs.

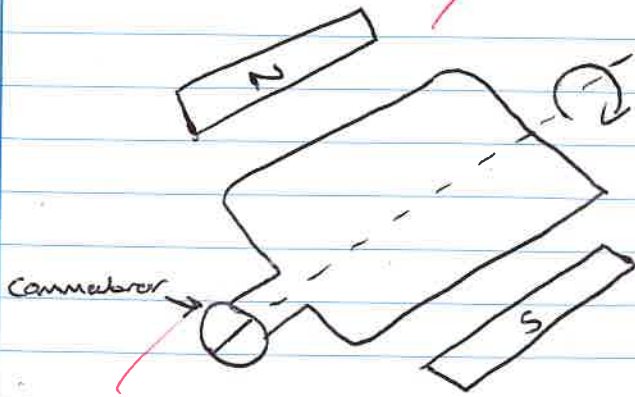
$$\frac{60}{3} = 20 \times 50 = 1000\text{ RPM}$$

②

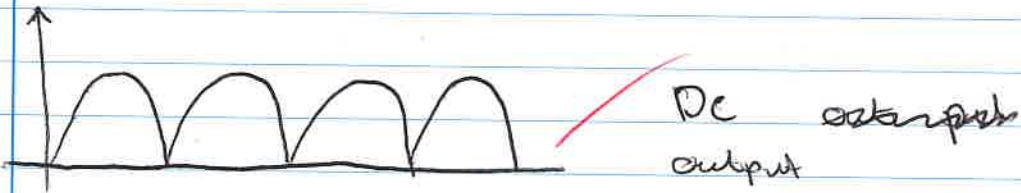
2



6.



The commutator is a single split ring that reverses current every turn to give an DC output



It turns Kinetic Energy to Electric energy

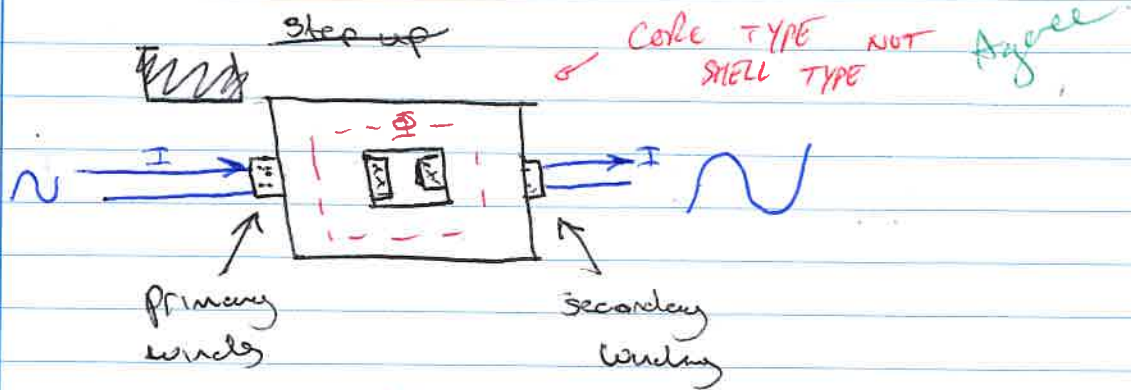
A Dynamo has two fixed magnets and a spinning coil that has current passing through it.

A Dynamo is like a backward DC motor.

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6

7.



$$N_p I_p = N_s I_s$$

$$V_s = V_p \frac{N_s}{N_p}$$

$$I_s = I_p \frac{N_p}{N_s}$$

$$V_L = -N \frac{\partial \Phi}{\partial t}$$

Transformer work by two magnetic coils or known as Faraday law of electromagnetic induction.

The change in current in the primary changes the flux linked to the secondary. (emf induces in secondary)

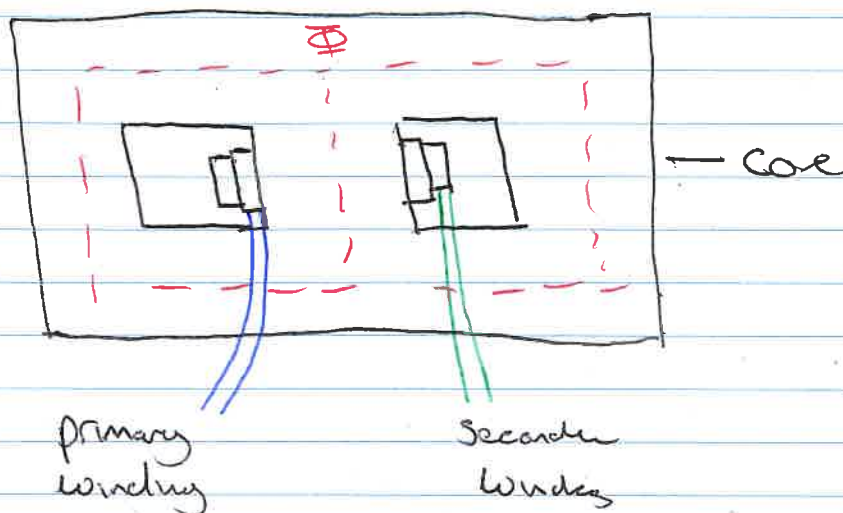
this transformer has losses such as:

- flux
- Heat
- res mag
- eddy currents
- winding losses

(7)

To reduce flux loss a shell transformer can be used.

Shell transformer



A Shell transformer works the same way as the other single phase transformer. The change in current in the primary changes the flux linked in the secondary, to induce emf in secondary.

There is less flux loss in the shell type transformer due to the flux being able to cut straight through the secondary because the two windings are on top of each other.

The flux is like current running ~~there~~ around the core of the transformer.

A voltage ~~error~~ will arise in the primary windings and either can be step up or step down depending on the amount turns in the secondary.

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