



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

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: Davis

FORENAME(S): Rhys

1	Student Number	1708879
2	Title of Examination Paper	Electrical Machines
3	Module Code	M6X00373
4	Date and Time of Examination	17.05.2019 15:00
5	Examination Venue	IQ310
6	Seat Number	9066
7	Number of Answer Books handed in	1

List the numbers of the questions you have attempted	Office Use	
Q1	9	9
Q2	5	5
Q3	5	5
Q4	2	2
Q5	1	1
Q6	5	5
Q7.	6	6
Total	33	33

(Gweler yr ochr arall am y fersiwn Cymraeg)

66%

66% / 1.11

$$Q1 \quad B_{core} = \frac{\phi}{CSA} = \frac{560 \times 10^{-6}}{(40 \times 100 \times 10^{-4})} = 0.14 T$$

$$\begin{aligned} \phi &= 560 \times 10^{-6} \\ N &= 1200 \\ L_1 &= 650 \times 10^{-3} \\ L_2 &= 90 \times 10^{-3} \\ CSA &= (40 \times 100 \times 10^{-6}) \end{aligned}$$

BH curve $H = 50 \times 300 A/m$ Agree?

$$mmf_{core} = 50 \times 650 \times 10^{-3} = 32.5$$

$$H_{gap} = \frac{B_{core}}{\mu_0} = \frac{0.14}{4\pi \times 10^{-7}} = 111408.4602$$

$$mmf_{gap} = 111408.4602 \times 90 \times 10^{-3} = 10026.762$$

$$I = mmf_{total} \div 1200 = \frac{10026.762 + 32.5}{1200}$$

$$I = 8.383 A$$

Q1 = 9

$$Q2. a) emf = NBA\omega [\sin(\omega t)]^1$$

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

$$\begin{aligned} N &= 1600 \\ B &= 0.75 \\ Area &= 0.0375 \\ Rpm &= 3000 \end{aligned}$$

$$\begin{aligned} \omega &= 2\pi f \\ &= 2 \times \pi \times 50 = 314.159 \end{aligned}$$

$$\begin{aligned} \text{max } emf &= 1600 \times 0.75 \times 0.0375 \times 314.159 \\ &= 14137.155 V \end{aligned}$$

3 3

$$\begin{aligned} b) \Phi &= BA \\ &= 0.75 \times 0.0375 \\ &= 0.028 \end{aligned}$$

2 2

units? Agree

Q2 = 5 5
Q2 = 6

$$I = BA \quad f = \frac{RPM}{60}$$

Q4.

$$I = \frac{24}{0.5} = 48$$

$$F = BIL$$

$$F = 0.45 \times 48 \times 150 \times 10^{-3} \\ = 3.24 \text{ N}$$

$$B = 0.45$$

$$P = 0.5$$

$$V = 24$$

$$L = 150 \times 10^{-3}$$

(2)

Q4.2

Q5.

6 pole = 3 pole pair

$$50/3 = 16.6 \text{ Hz}$$

= RPM

?

(1)

Q5.1

Q3.

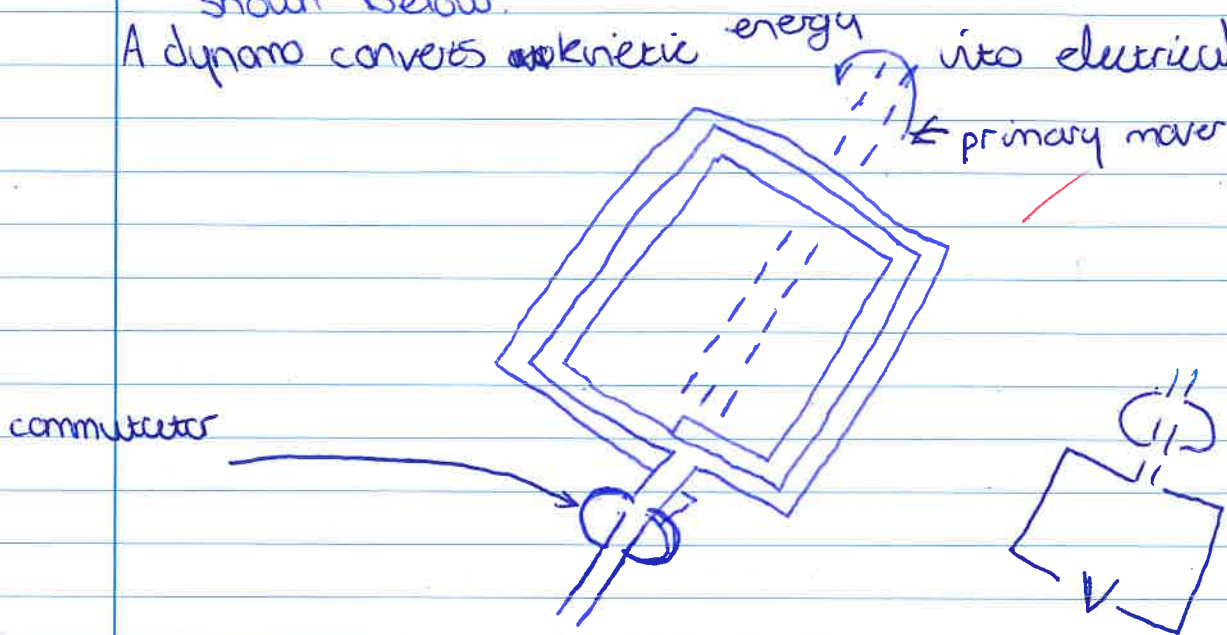
- A synchronous motor is not self starting whilst induction motors are. Therefore a synchronous motor needs a DC power source connected to the rotor to excite it whilst an Induction ^{motor} only requires a AC signal to generate a rotating magnetic field. ~~and to get excited~~ the squirrel cage.
- A synchronous motor speed can't be controlled whilst in an induction motor it can but is difficult.
- A synchronous motor are very expensive and require a constant maintenance plan whilst induction motors are cheaper and require little to no maintenance.
- A synchronous motor can operate at ~~the~~ synchronous speed whilst an induction motor never reaches synchronous speed as it lags behind. This is known as slip.
- In a synchronous motor the stator spins? around the rotor which cuts the lines of flux created by the magnetic field.
- An induction motor has a squirrel cage stator which have angled fins. These fins are angled to improve efficiency. By having angled fins no torque is lost because a part of the fin is always cutting the lines of flux.

Q3 5
10S
Agree

Q6.

A dynamo is a DC generator and its principle is shown below.

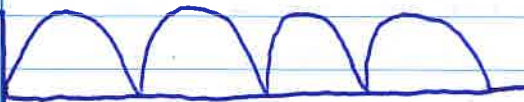
A dynamo converts ~~mechanic~~ kinetic energy into electrical energy.



An alternating AC signal can be converted to a DC signal using a rectifier.

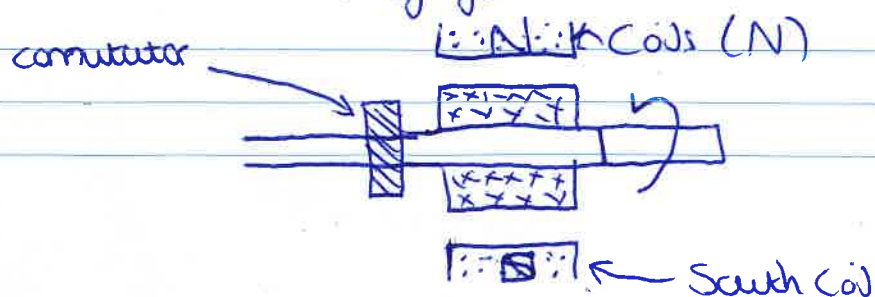
A more efficient way is to replace the slip rings with a split ring which is called a commutator.

The arrangement of the connections to the split ring are reversed so that as the voltage changes the polarity of the coils change. This results in only half AC waveforms as shown below.



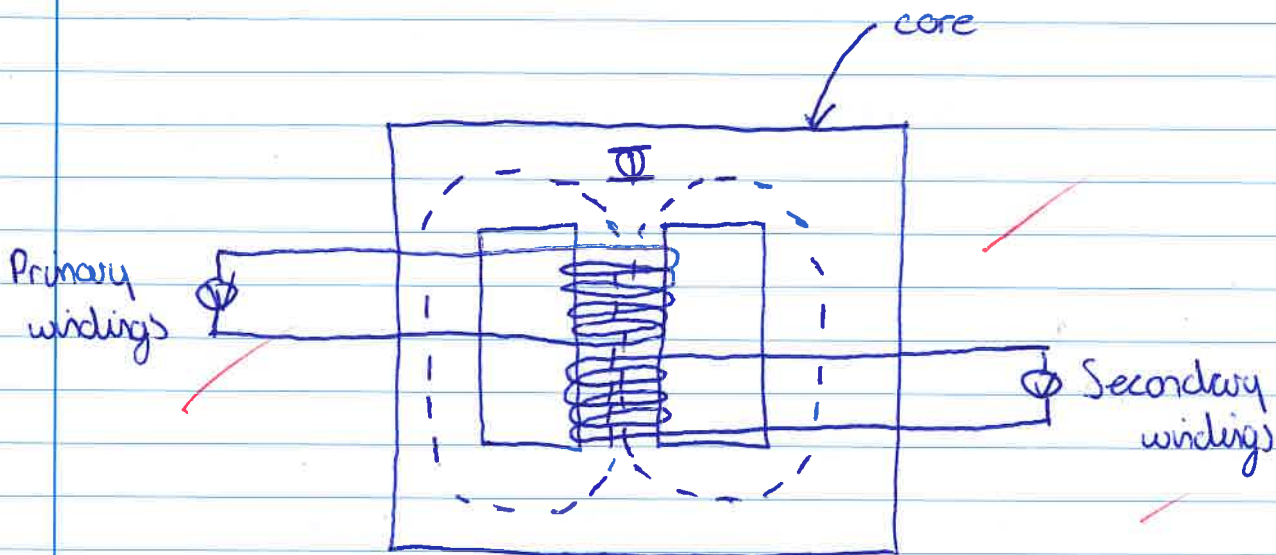
This signal could then be smoothed to give a solid DC output.

The efficiency of the dynamo could be improved by adding more coils to cut the lines of flux.





Q7. Shell Type Single Phase Transformer



$$V_L = -N \frac{d\phi}{dt}$$

$$N_p I_p = N_s I_s$$

~~The primary windings induce a current~~

~~The rate of change of flux~~

The primary ~~voltage~~ windings create a magnetic field within the core. The flux can't escape because the core is magnetic so it directs the flux to the secondary windings. The secondary windings then become induced. To determine the voltage on the secondary windings is due to the rate of change of the flux that hit the winding turns. The voltage is then multiplied by how many turns are within the windings.

than what? induced.

The shell type is a lot more efficient because it has less losses such as eddy currents ~~and heat~~ which result in heat because the lines of flux are directed through the coils. Another way to improve the efficiency is to laminate the core joints so no magnetism losses can occur.

Agreed

6

6

Q1 Question 1 - Check

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

$$\begin{aligned}\Phi &= 560 \times 10^{-6} \\ N &= 1200 \\ L_1 &= 650 \times 10^{-3} \\ L_2 &= 90 \times 10^{-3} \\ CSA &= (40 \times 100 \times 10^{-6})\end{aligned}$$

BH curve = 50

$$mmf_{core} = 50 \times 650 \times 10^{-3} = 32.5$$

$$H_{gap} = \frac{B_{core}}{\mu_0} = \frac{0.14}{4\pi \times 10^{-7}} = 111408.4602$$

$$mmf_{gap} = 111408.4602 \times 90 \times 10^{-3} = 10026.76141$$

$$I = mmf_{total} / N = 8.38 A$$

Q2.

Check

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

$$\omega = 2\pi f$$

$$= 2 \times \pi \times 50 = 314.159$$

$$N = 1600$$

$$A_{core} = 0.0375$$

$$B = 0.75$$

$$Rpm = 3000$$

$$a) = emf = NBA\omega$$

$$= 1600 \times 0.75 \times 0.0375 \times 314.159$$

$$= 14157.167$$

$$b) = \Phi = NBA$$

$$= 0.75 \times 0.0375 = 2.8125 \times 10^{-3}$$