

LOCATION SWANSEA

LEVEL 6

**EXAMINATION PERIOD
MAY 2015**

LLEOLIAD ABERTAWE

LEFEL 6

**CYFNOD ARHOLIADAU
MAI 2015**

**MODULE CODE: M6X00373
Electrical Machines**

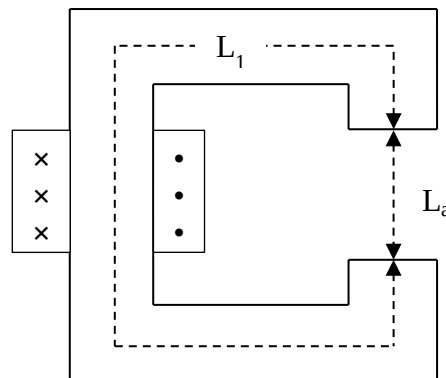
TIME: 2 HOURS

ANSWER ALL QUESTIONS

Formulae and Material Properties on last two pages
Use of rulers and calculators permitted

ANSWER ALL QUESTIONS

- Describe how you would generate a rotating magnetic field from a single phase supply.
[10 marks]
- For the following electromagnet with a cast-iron core it is required that a static flux is established in the air gap of $180\mu\text{Wb}$. Assuming zero flux leakage and no fringing of the flux lines using an electrical analogue, determine the current required in the field generating coil ($N=1000$ turns). The mean length of the core $L_1=420\text{mm}$, the air gap length $L_a=60\text{mm}$ and core cross section of $20\text{mm} \times 20\text{mm}$.
[10 marks]



- Show that the energy in a uniform static magnetic field in an air gap can be given as:

$$W = \frac{B^2 \times Vol}{2\mu_o}$$

And the force of attraction between the poles can be given by:

$$F = \frac{B^2 \times Area}{2\mu_o}$$

[6 marks]

- For the electromagnet described in question 2, determine the energy stored in the magnetic field in the gap and also the force of attraction between the two poles.
[2 marks]
- A straight conductor lies at right angles to a magnetic field of flux density 0.75T such that 150mm of its length lies within the field. If the conductor forms part of a closed circuit having a total resistance of 0.08Ω and a potential difference of 2.4V calculate the force on the conductor.
[2 marks]

6. Assuming a constant rotational speed and a uniform magnetic field, show that the induced e.m.f. in a coil can be given as:

$$emf = NBA\omega \sin(\omega t)$$

[8 marks]

7. A coil of 200 turns with a coil of width 50mm and active depth of 300mm rotates in a uniform magnetic field between the poles of a magnet with an air gap flux density of 0.25T. If the coil rotates at a speed of 3000rpm calculate:

a) The maximum e.m.f. induced in the coil.

[3 marks]

b) The maximum amount of flux cutting the coil.

[2 marks]

8. A rectangular coil wound with 150 turns of wire has a mean width of 15mm and a mean axial length of 20mm. When situated in a uniform magnetic field of 450mT, the current in the coil is 25.4mA. Calculate:

a) The force acting on one side of the coil.

[3 marks]

b) The maximum torque experienced by the coil.

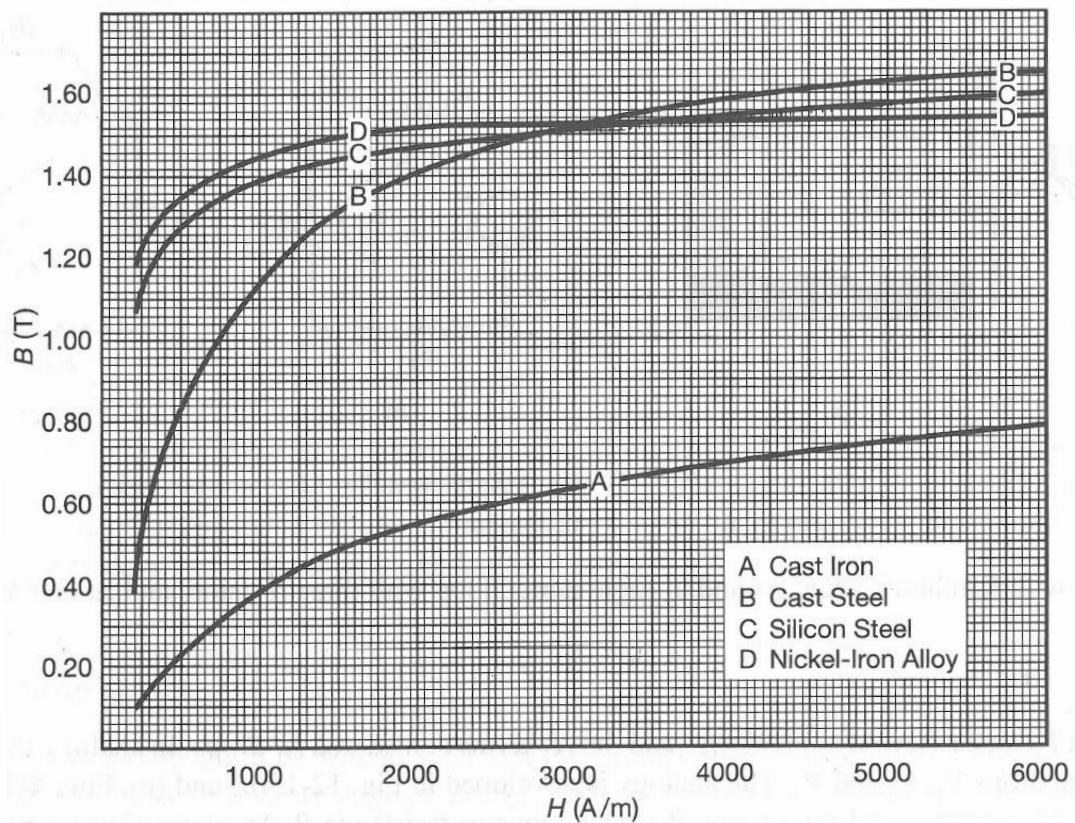
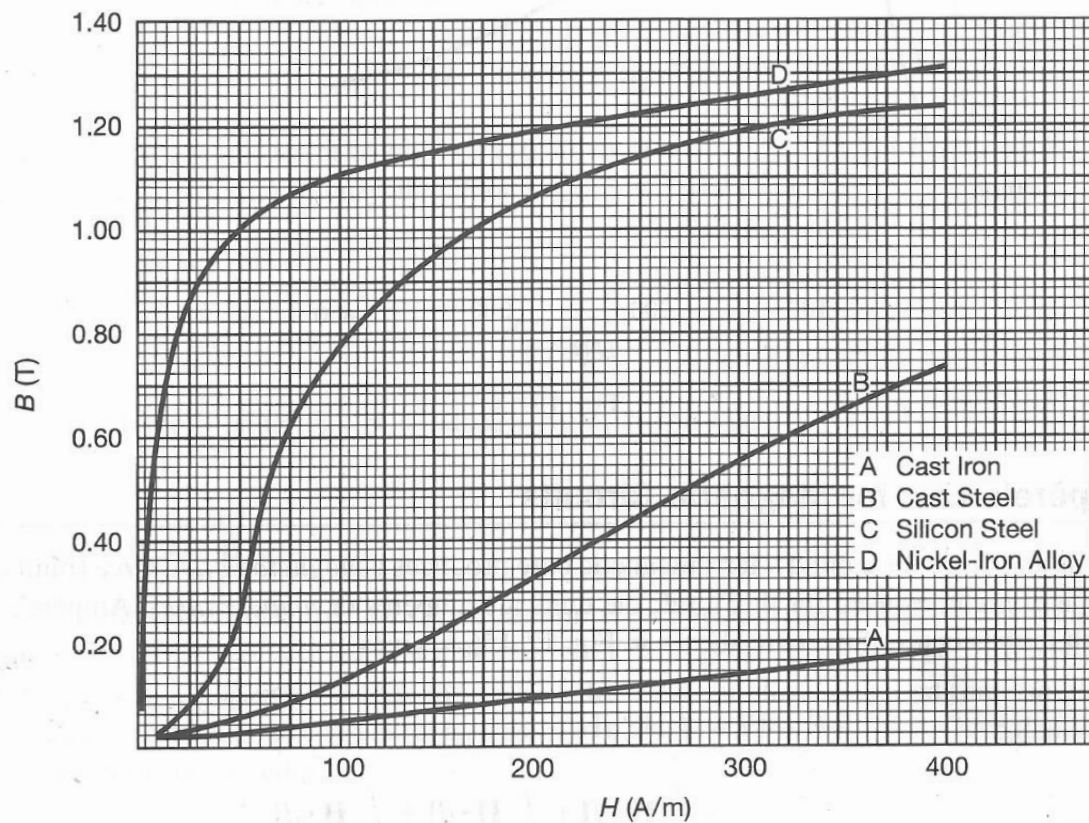
[2 marks]

c) Illustrate the coil positions corresponding to maximum and minimum torque.

[2 marks]

9. Describe the working principles of a self-starting synchronous motor.

[10 marks]



$\delta_{mm} = \frac{661}{\sqrt{f\mu_r\sigma}}$	$\theta = \frac{x}{\delta} \times 57.3$	
$B = \mu H$	$\mu_r = \frac{\mu}{\mu_o}$	$\mu_o = 4\pi \times 10^{-7}$
$W = \frac{1}{2} \int_{vol} B \cdot H dv$	$NI = \oint \vec{H} \cdot \vec{\partial l}$	$\mu_o \iint J \cdot \partial s = \oint \vec{B} \cdot \vec{\partial l}$
$B = \frac{\Phi}{A}$	$V_L = -N \frac{\partial \Phi}{\partial t}$	$V_L = -L \frac{\partial I}{\partial t}$
$mmf = N \cdot I$	$mmf = H \cdot l$	$R_m = \frac{l}{\mu A}$
$R_m = \frac{mmf}{\Phi}$	$F = NBll \sin \theta$	$\tau = F \times w$