TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATION FOR:

DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING (DEEE2)

ELECTROMAGNETISM II

EEP 2104

END OF SEMESTER EXAMINATION

SERIES: MAY 2016

TIME: 2 HOURS

DATE: Pick DateSelect MonthPick Year

Instructions to Candidates

You should have the following for this examination

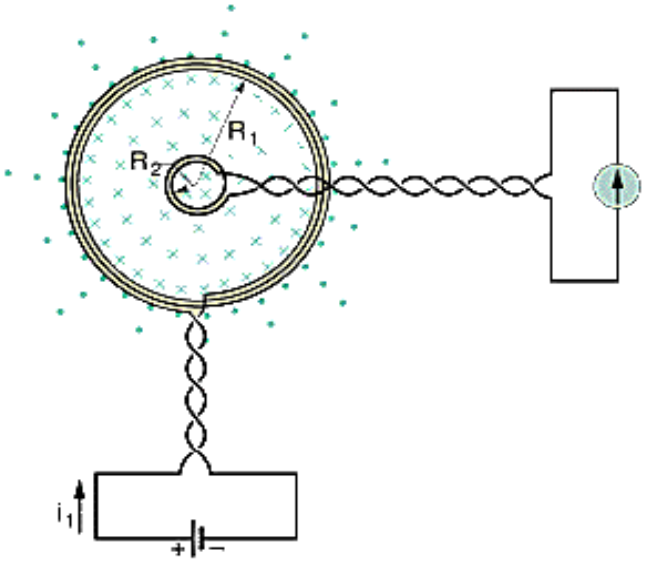
-Answer Booklet, examination pass and student ID

This paper consists of **five** Questions;. Attempt any THREE Questions.

Do not write on the question paper.

QUESTION ONE

(a) Two circular flat coils are co-axial as shown in the diagram. The smaller (secondary) coil has 25 turns and diameter 20 mm. The larger (primary) coil has 200 turns and diameter 40 mm. Find the mutual inductance of the two coils, assuming the magnetic field of the primary coil is uniform through the secondary coil. (4 marks)



b. State **TWO** factors that affect the force on a current carrying conductor. (2 marks)

c. A conductor carries a current of 40mA at a right angle to a magnetic field having a flux density of 2.5T. Calculate the force on the conductor in Newtons per meter length. (3 marks)

d. With the aid of a diagram describe the operation of a loudspeaker. (8 marks)

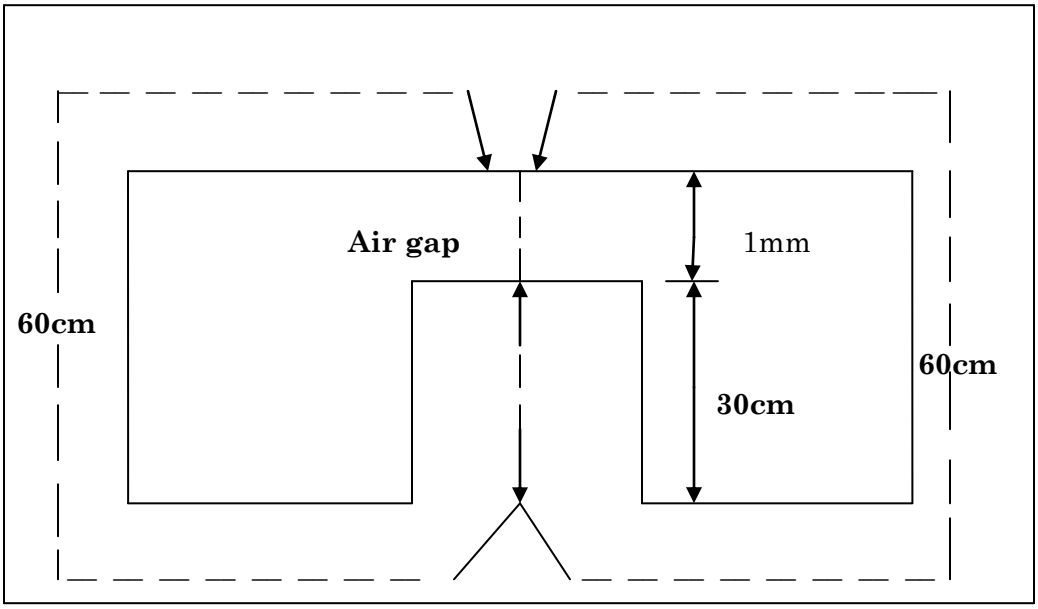
e. State **three** differences between magnetic and electrical circuits. (3 marks)

QUESTION TWO

(i) A cast steel electromagnet in fig.2 has the magnetization characteristic given in Table 1. The cross-sectional area is 25cm^2. A coil of 10000 turns is wound on its central limb. Determine the current that the coil should carry to produce a flux of 2.5m Wb in the air gap. (8 marks)

Table 1

Flux density Wb/m^2	0.2	0.5	0.7	1.0	1.2
Magnetic field strength Hat/m	300	540	650	900	1150



(ii) Show that the energy density of a magnetic field is given by:

$$U = \tfrac{1}{2}\frac{B^2}{\mu_0} \text{ J/m}^3 \text{ given } B = \mu_0 nI \text{ and self inductance } L = \mu_0 n^2 IA$$

(4 marks)

(iii) A solenoid with 1000 turns has a length of 300 mm and a diameter of 10 mm. A current of 0.5 A flows through it and the magnetic field is assumed uniform inside the solenoid. Find the magnetic energy density inside the solenoid. (2 marks)

(iv) Calculate the force exerted on a charge of $2 \times 10^{-18} C$ travelling at 2×10^{6} m/s perpendicular to a field of density$2 \times 10^{-7} T$. (3 marks)

(v) State **THREE** comparisons between magnetic circuit and electrical circuit. (3marks)

QUESTION THREE

(i) A 20V emf is applied to a series combination of a 5kΩ resistor and a 4mH inductor. Find

(a) The equilibrium value of the energy stored in the magnetic field, and

(b) How many time constants pass before the energy stored reaches its one third of its equilibrium value. (5 marks)

(ii) With the aid of a diagram describe the operation principle of a transformer. (4 marks)

(iii) A coil of resistance 200Ω is placed in a magnetic field of 1m Wb. The coil has 150 turns and a galvanometer of 400Ω resistance is connected in series with it. Find the average emf and the current, if the coil is moved in 0.02 seconds from the given field to a field of 0.2mWb. (5 marks)

(iv) The field coils of a 4 pole dc generator each having 500 turns, are connected in series. When the field is excited, there is a magnetic flux of 0.02Wb/pole. If the field circuit is opened in 0.01 second and residual magnetism is 0.002Wb/pole, calculate the average voltage which is induced across the field terminals. In which direction is this voltage directed relative to direction of current. (4 marks)

(v) State the Faradays laws of electromagnetic induction. (2 marks)

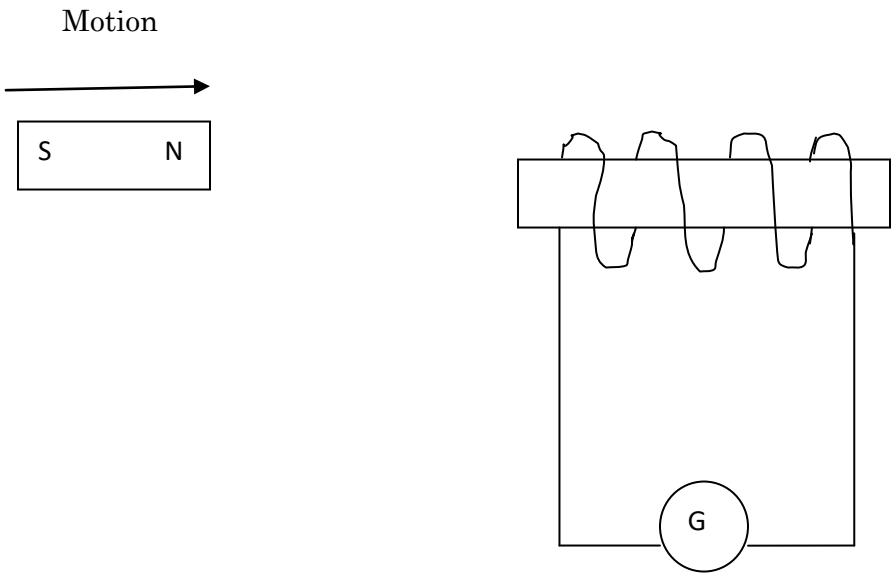
QUESTION FOUR

(i) Draw a diagram of a simple moving coil instrument and explain its operation. (6 marks)

(ii) Show that the emf induced in a coil is given by:

$e = -N\frac{d\phi}{dt}$ Volt (4 marks)

(iii) (a) Determine the direction of the induced current in the circuit of figure 1 (2 marks)



(b) State the rule used. (1 mark)

(iv) A conductor 1.2m long is carrying a current of 25A and is placed in a magnetic field of uniform flux density of 0.6wb/m^2. Calculate the mechanical force of the conductor when the conductor is placed at:

a. Right angles to the magnetic field.
b. 60^0 to the perpendicular to the magnetic field.
c. Parallel to the magnetic field. (4 marks)

(v) Explain THREE requirements for operation of an analogue instrument. (3 marks)

QUESTION FIVE

a. State Lenz's law. (2 marks)
b. With the aid of a well labeled diagram, describe the operation of a simple ac generator. (8 marks)
c. Starting from $e = 2Blusin\theta$, show that maximum emf of a coil of N turns is given by:

$$E_m = 2\pi BAnN$$ (4 marks)

d. A coil of 100 turns is rotated at 1500r/min in a magnetic field having a uniform density of 0.05T, the axis of rotation being at right angles to the direction of the flux. The mean area per turn is 40cm^2. Calculate :

(i) The frequency.
(ii) Period.
(iii) The maximum value of the generated emf.
(iv) The value of generated emf when the coil has rotated through 30^0 from the position of zero emf. (6 marks)