TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATION FOR:

DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING

EEP 2102: ELECTROMAGNETICSM I

SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: SEPTEMBER 2018

TIME: 2 HOURS

DATE: September 2018

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 **Question ONE and ANY other TWO questions.**

$\varepsilon_0 = \frac{1}{36\pi} \times 10^{-9}\ F/m\ ;\ \mu_0 = 4\pi \times 10^{-7}\ H/m$

Do not write on the question paper.

Question ONE

(a) Define mathematically and in words the following magnetic terms indicating units for each.

(i) Magnetic flux density vector $\bar{B}$ (ii) Permeability of free space μ_0 (6 marks)

(b) Draw the approximate magnetic field lines for the following current pairs. (4 marks)

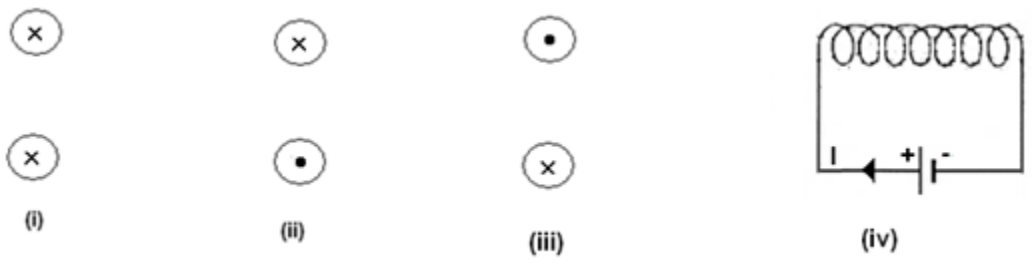

Fig. Qu. 2(b)

(c) (i) A conductor 60cm long is situated at right-angles to a magnetic field. Calculate the flux density of the magnetic field if a current of 13A produces a force on it of 5.6 N. (4 marks)

(ii) Using appropriate sketches describe the principle of operation of a loudspeaker. (6 marks)

Question TWO

(a)` Define the following magnetic terms and explain the practical importance of each indicating units .

(i) Magnetic flux ϕ (ii) magnetizing force (6 marks)

(b) (i) Using an appropriate sketch explain the process of creating a B-H curve for a given magnetic material.

(ii) What do we learn from the shape of the B-H curve with reference to a given material? (4 marks) (6 marks)

(c) (i) An iron ring of mean diameter 20 cm is uniformly wound with 4000 turns of wire. When a current of 0. 5A is passed through the coil a flux density of 0.8T is set up in the iron. Find (I) the magnetizing force and (II) the relative permeability of the iron under these conditions.

(ii) A mild steel ring has a radius of 50mm and a cross-sectional area of 600mm2. A current of 0.25A flows in a coil wound uniformly around the ring and the flux produced is 0.5mWb. If the relative permeability at this value of current is 200 find (I) the reluctance of the mild steel and (II) the number of turns on the coil. (8 marks)

Question THREE

(a) (i) State Faraday's law of electromagnetic induction. (ii) State Lenz's law

(iii) Using an appropriate sketch describe the basic mechanism of power generation. (7 marks)

(b) (i) Distinguish between self and mutual inductance

(ii) A conductor of length 30 cm is moved at 750 mm/s at right-angles to a uniform flux density of 1.5T. Determine the emf induced in the conductor.

(iii) A 30 cm long conductor moves at a uniform speed of 8 m/s through a uniform magnetic field of flux density 1.3T. Determine the current flowing in the conductor when (I) its ends are open-circuited, (II) its ends are connected to a load of 15 ohms resistance. (8 marks)

(c) A generating coil on a former 150mm long has 150 turns and rotates in a 1.3 T magnetic field. Calculate the maximum emf generated if the coil, having a diameter of 80 mm, rotates at 300 rev/min. (5 marks)

Question FOUR

(a) (i) Explain briefly any THREE factors which affect the inductance of an inductor.

(ii) Describe the main application of a choke in AC circuits.

(iii) Inductance is often undesirable in a circuit. Describe one way in which it may be reduced to a minimum. (8 marks)

(b) (i) Calculate the value of the energy stored when a current of 50mA is flowing in a coil of inductance 300mH.

(ii) The energy stored in the magnetic field of an inductor is 80 J when the current flowing in the inductor is 3A. Calculate the inductance of the coil. (4 marks)

(c) In the device shown in Fig. Qu.(4c), when the current in the primary coil of 8000 turns increases linearly from 1A to 6A in 150 ms, an emf of 15V is induced into the secondary coil of 500 turns, which is left open circuited. Determine: (I) the mutual inductance of the two coils, (II) the reluctance of the former, and (III) the self-inductance of the primary coil. (8 marks)

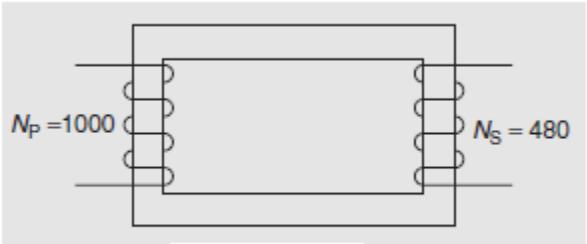

Fig. Qu. (4c)

Question FIVE

(a) Explain using appropriate sketches how capacitors are applied in the following situations:

(i) AC rectification (ii) Frequency tuning

(b) (i) Define electric field strength $\boldsymbol{E}$ and state its unit

(ii) Define permittivity $\boldsymbol{\varepsilon}$ distinguishing between $\boldsymbol{\varepsilon_0}$, $\boldsymbol{\varepsilon_r}$ (9 marks)

(c) (i) The charge on the plates of a capacitor is 6mC when the potential between them is 2.4 kV. Determine the capacitance of the capacitor.

(ii) Two parallel rectangular plates measuring $20\ cm \times 40\ cm$ carry an electric charge of $0.2\ \mu C$. Calculate (I) The electric flux density.

(II) If the plates are spaced 5mm apart and the voltage between them is 0.25 kV determine the electric field strength.

(iii) Find the energy stored in a $10\ \mu F$ capacitor when charged to $2\ kV$. (8 marks)

(d) (i) Name two practical examples where capacitance is present, although undesirable.

(ii) Three $3\ \mu F$ capacitors are connected in series. Determine the equivalent capacitance. (3 marks)