MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ENGINEERING TECHNOLOGY

UNIVERSITY WRITTEN ASSESSMENT

ACADEMIC YEAR 2023/2024
FIRST YEAR FIRST SEMESTER ASSESSMENT FOR INTERNAL EXAMINATION

UNIT CODE: ENG/OS/PO/CC/03/6

UNIT TITLE: APPLY ELECTRICAL PRINCIPLES

DURATION: 2 HOURS

INSTRUCTION TO CANDIDATES:

1. Answer ALL questions in Section A and any other THREE questions in Section B
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

SECTION A: COMPULSORY (40 MARKS)

Take: $\boldsymbol{\mu_0 = 4\pi \times 10^{-7} H/m}$

$\boldsymbol{\epsilon_0 = 8.854 \times 10^{-12} F/m}$

1. define 'S1 UNITS' (1 mark)
2. List TWO electrical instruments you would use to measure current in an electric circuit. (2 marks)
3. A charge of 240 coulombs is transferred in 2 minutes in an electric circuit, what is the amount of current flowing through it? (3 marks)
4. State ohms law? (2 marks)
5. Calculate power dissipated by a resistor of 10Ω when a current of 2A passes through it? (2 marks)
6. A current of 2A flows for 10 hours through a 100Ω resistor. What is the energy consumed by the resistor in watt hour? (3 marks)
7. Some copper wire has a resistance of 200Ω at 20^0C. A current is passed through the wire and the temperature rises to 90^0C. Calculate the resistance of the wire at 90^0C, correct to the nearest ohm, assuming that the temperature coefficient of resistance is 0.004Ω/^{0}C at 0^0C. (4 marks)
8. Explain two ways of generating alternated current. (4 marks)
9. Define the following terms (6 marks)
   i. Peak value
   ii. Inductor
   iii. Capacitance
10. List any THREE applications of capacitor (3 marks)
11. For the arrangement shown in Figure (a) find;
    a) The equivalent capacitance of the circuit (4 marks)
    b) The voltage across QR (2 marks)
    c) The charge on each capacitor (4 marks)

SECTION B – ANSWER ANY THREE QUESTIONS IN THIS SECTION 60marks

12. a) An altering voltage is given by $v = 75sin(200\pi - 0.25)$volts. Calculate: (8 marks)
    i. The amplitude;
    ii. The peak-to peak value
    iii. The r.m.s value
    iv. The periodic time
    v. The frequency
    vi. The phase angle (in degrees and minutes) relative to $75sin200\pi$

b) A coil of resistance 8Ω and inductance 2H is connected to a 20-k supply. Calculate;

i. The final steady value of the current;
ii. The time constant of the coil
iii. The initial rate of exchange of current in the coil
iv. The energy stored in the coil when the current reaches its final value
v. Sketch a graph showing the current from 0 to 1s (12 marks)

13. a) Define the following terms (6 marks)

i. Electromotive forces
ii. Magnetics field strength
iii. Reluctance

b) A mild-steel ring having a cross-sectional area of $500mm^2$ and a mean circumference of 400mm has a coil of 200 turns wound uniformly around it. Taking mild-steel permiabity to be 380, Calculate; (4 marks)

i. The reluctance of the ring
ii. The current required to produce a flux of $800\mu Wb$ in the ring

c) A magnetic circuit comprises three parts in series each of uniform cross-sectional area (c.s.a). They are:

i. A length of 80mm and c.s.a $50mm^2$
ii. A length of 60mm and c.s.a $90mm^2$
iii. An air gap of length 0.5mm and c.s.a $150mm^2$

A coil of 4000 turns is wound on part (b) and the flux density in the air-gap is 0.3T. Assuming that all the flux passes through a given circuit and that the relative permeability $\mu_r$is 1300, estimate the coil current to produce such a flux density. (10marks)

14. a) State the Kirchhoff's laws. (4 marks)

b) Use superposition theorem in the figure (b) to calculate the currents of each branch of the network (8 marks)

c) Use Kirchhoff's law in figure (c) to calculate the currents of each branch of the network. (8 marks)

15. a) State two causes of hysteresis losses (2 marks)

b) Define the term transient in relation to dc supply. (2 marks)

c) With a well labelled diagram, describe the working principle of hysteresis loop. (8 marks)

d) Use figure (d) to calculate; (8 marks)

i. The value of resistor R_x such that the total power dissipated in the circuit is 2.5Kw
ii. The current flowing in each of the 4 resistors