MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

UNIVERSITY ORDINARY EXAMINATION

2023/2024 ACADEMIC YEAR

FIRST YEAR **SECOND** SEMESTER EXAMINATION FOR BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONICS ENGINEERING

EET 108: CIRCUIT THEORY I

DURATION: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

1. Answer Question one and any other two questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE (30 MARKS)

a) Define the following terms giving units of each.
   i. Capacitance (2marks)
   ii. Resistance (2marks)

b) State the Faraday's laws of electromagnetic induction (2marks)

c) Explain how the following faults occurs in a simple cell stating how each can be minimized.
   i) Local action
   ii) Polarization (4marks)

d) Prove that the equipment resistance of number of resistors connected in parallel across a source supply is given by $R = \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots + \frac{1}{R_n}\right)^{-1}$ (3marks)

e) A current I Amperes flows in an iron ring of constant permeability _____, mean circumference (Meters and cross-sectional area Am^2. The ring is uniformly _____with N turns of a coil. If the reluctance of the ring is s, derive an expression for the inductance L of the coil. (6marks)

f) The resistance of a coil of aluminium wire at 18^oc is 200$\boldsymbol{\Omega}$. The temperature of the wire is increased and the resistance rise to 240$\boldsymbol{\Omega}$. If the temperature coefficient of resistance of aluminium is $0.0039/^oc$ at 18^oc, determine the temperature to which the coil has risen. (4marks)

g) For the following circuit, determine
   i. Total capacitance (3marks)
   ii. Voltage across the 3mF capacitor (2marks)
   iii. Energy stores in the 3mf capacitor (2marks)

_____

SECTION TWO: ANSWER ANY TWO QUESTIONS

QUESTION TWO (20 MARKS)

a) Two parallel rectangular plates measuring 20cm by 40cm carry an electric charge of 0.2_____

i. Calculate the flux density (3marks)

ii. If the plates are spaced 5mm apart and the voltage between them is 0.25kV, determine the electric field strength (2marks)

b) The following three impedances are connected in series across a 40v, 20KHZ supply:

A resistance of 8$\boldsymbol{\Omega}$

A coil of inductance 130mH and 5$\boldsymbol{\Omega}$ resistance

A 10$\boldsymbol{\Omega}$ resistor in series with a 0.25mf capacitor

Calculate

i. The circuit current (3marks)

ii. The circuit phase angle (2marks)

iii. The voltage drop across each impedance (2marks)

c) Sketch a labelled diagram of a lec_____ dry cell and explain the purpose of

i. Manganese dioxide

ii. Ammonium chloride (8marks)

QUESTION THREE (20 MARKS)

a) State

i. Notron's theorem

ii. Superposition Theorem (6marks)

b) Determine the currents in each branch in the following network using

i. Kirchhoff's laws

ii. Superposition theorem (14marks)

_____

QUESTION FOUR (20 MARKS)

a) An alternating voltage is given by $282.8 \sin 314t \ volts$ Determine

i. The r.m.s voltage (2marks)

ii. The frequency (2marks)

iii. The instantaneous value of voltage when t=4ms (2marks)

b) A mild steel ring has a radius of 50mm and across-sectional area of 400m2. A current of 0.5A flows in a coil would uniformly around the ring and the flux produced is 0.1mWb. If the relative permeability at this value is 200. Determine

i. The reluctance of the mild steel

ii. The number of turns on the coil. (8marks)

c) Use Th_____ theorem to determine the current flowing and the power dissipated in the 4**Ω** resistor shown in the following figure

_____

d)