UNIVERSITY EXAMINATIONS
2022/2023 ACADEMIC YEAR

SPECIAL/SUPPLIMENTARY EXAMINATIONS
YEAR TWO EXAMINATIONS

FOR THE DEGREE OF
BACHELOR OF SCIENCE IN RENEWABLE ENGERY

COURSE CODE : **REN** 223

COURSE TITLE : **BASIC ELECTRICAL TECHNOLOGY** [B]

DATE: 10 / 8 /2023   **TIME:** 8:00-10:00AM

INSTRUCTIONS TO CANDIDATES

QUESTION ONE (COMPULSORY) [30 MARKS]

a) Define resistivity and state its SI unit of resistivity (2 marks)

b) Define reluctance and state its SI unit. (2 marks)

c) Determine the potential difference across a 4uF capacitor when charged with 5mC. (3 marks)

d) Some copper wire has a resistance of 200 Ω at 20 °C. A current is passed through the wire and the temperature rises to 90 °C. Determine the resistance of the wire at 90 degrees. Take the temperature coefficient of resistance as 0.04/ °C at 0 °C. (5 marks)

e) A magnetic pole face has a rectangular section having dimensions 200mm by 100mm. If the total flux emerging from the pole is 150uWb, calculate the flux density. (4 marks)

f) State Lenz's law. (2 marks)

g) Determine the peak and mean values for a 240V mains supply (6 marks)

h) The current at resonance in a series $L–C–R$ circuit is 100 μA. If the applied voltage is 2mV at a frequency of 200 kHz, and the circuit inductance is 50 μH, find:
   i. the circuit resistance (3 marks)
   ii. the circuit capacitance. (3 marks)

QUESTION TWO   [20 MARKS]

a)

b) A current of 15A flows through a conductor and 20W is dissipated. What p.d. exists across the conductor? (3 marks)

c) A conductor moves with a velocity of 15 m/s to a magnetic field produced between two square-faced poles of side length 2 cm. If the flux leaving a pole face is 5 μWb, find the magnitude of the resulting e.m.f, if the conductor moves at an angle of:
   i. 90° (4 marks)
   ii. 60° (3 marks)

d) A coil of negligible resistance and inductance 100mH is connected in series with a capacitance of 2uf and a resistance of 10Ω across a 50V, variable frequency supply. Determine:
   i. The resonant frequency (3 marks)
   ii. The current at resonance (3 marks)
   iii. The voltages across the coil at resonance (2 marks)
   iv. The Q-factor of the circuit (2 marks)

QUESTION THREE   [20 MARKS]

a) A current of 2mA flows for 10 hours through a 100Ω resistor.
   i. Determine the energy consumed by the resistor. (3 marks)
   ii. Determine the voltage across the resistor (2 marks)

b) Describe a simple experiment to demonstrate electromagnetic induction. (7 marks)

c) Explain four factors that influence the inductance of an inductor (8 marks)

QUESTION FOUR   [20 MARKS]

a) An electric motor uses 2.5MJ when connected to 500V supply for 7 minutes. Find:
   i) the power rating of the motor (3 marks)
   ii) the current taken from the supply. (2 marks)

b) A coil of 3000turns is wound uniformly on a ring of non-magnetic material. The ring has a mean circumference of 400mm and a uniform cross-sectional area of 40mm². Given $\mu_0 = 4\pi \times 10^{-7}$ and the current in the coil is 5A, calculate:
   i. The magnetic field strength (3 marks)

     ii. The flux density   (3 marks)

     iii. The total magnetic flux in the ring   (3 marks)

c) Explain three factors that influence the value e.m.f. induced in a conductor (6 marks)

QUESTION FIVE   [20 MARKS]

a) Differentiate between linear and non-linear devices.   (2 marks)

b) A ceramic capacitor has an effective area of $4cm^2$ separated by 0.1mm of ceramic of relative permittivity 100. Calculate the capacitance of the capacitor in pico-farads. (3 marks)

c) Differentiate the terms below:

     i. r.m.s. value   (2 marks)

     ii. form factor   (2 marks)

     iii. peak factor   (2 marks)

d) An alternating voltage is given by $v = 75 \sin(200\pi t - 0.25)$ volts. Find:

     i. The rms value   (2 marks)

     ii. Angular velocity   (3 marks)

     iii. The frequency   (2 marks)

     iv. The phase angle relative to $75 \sin 200\pi t$ (2 marks)