



TECHNICAL UNIVERSITY OF MOMBASA

SCHOOL OF ENGINEERING & TECHNOLOGY

DEPARTMENT MECHANICAL AND AUTOMOTIVE ENGINEERING

UNIVERSITY EXAMINATION FOR:

BACHELOR OF TECHNOLOGY IN MECHANICAL AND AUTOMOTIVE ENGINEERING

TEE 1221: PRINCIPLES OF ELECTRICAL TECHNOLOGY

END OF SEMESTER EXAMINATION

SERIES: AUGUST, 2024

TIME: 2 HOURS

DATE: AUGUST, 2024

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

Do not write on the question paper.

Question ONE (Compulsory)

- (a) Differentiate between primary and secondary cells (2 marks)
- (b) (i) Describe renewable energy source
(ii) State any TWO renewable energy sources (3 marks)
- (c) (i) State Ohm's law
(ii) An electric kettle has a resistance of $30\ \Omega$ and connected to a 240V supply.
Determine:
(I) The current that flow
(II) The power rating of the kettle (4.5 marks)
- (d) (i) State Kirchhoff's laws
(ii) Use Kirchhoff's laws to determine the currents flowing in each branch of the network shown in Fig. Q1.

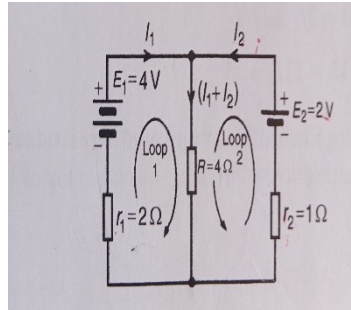


Fig. Q1

(e) A coil has a resistance of 4Ω and inductance of 9.55Mh . Calculate:

- (i) The reactance
- (ii) The impedance
- (iii) The current taken from a 240V , 50 Hz supply
- (iv) The phase angle between the supply voltage and current. **(8.5 marks)**

QUESTION TWO

- (a)
 - (i) Describe capacitance
 - (ii) A $3\mu\text{F}$ capacitor is charged to 400V .
 - (I) Determine the energy stored in the capacitor
 - (II) Calculate the average power developed if this energy is dissipated in a time of $10\mu\text{s}$. **(5 marks)**
- (b)
 - (i) Describe Magnetic flux and reluctance
 - (ii) A closed magnetic circuit of cast steel contains a 6cm long path of cross-sectional area 1cm^2 and a 2cm path of cross-sectional area 0.5cm^2 . A coil of 200 turns is wound around the 6cm length of the circuit and a current of 0.4 A flows. Determine the flux density in the 2cm path, if the relative permeability of the cast steel is 750 . **(9.5 marks)**
- (c)
 - (i) State the Flemming's left hand rule
 - (ii) A conductor 350mm long carries a current of 10A and is at right-angle to a magnetic field lying between two circular pole faces each of radius 60mm . If the total flux between the pole faces is 0.5mWb , calculate the magnitude of the force exerted on the conductor. **(5.5 marks)**

QUESTION THREE

- (a)
 - (i) State the laws of electromagnetic induction
 - (ii) The wingspan of a metal aeroplane is 36m . If the aeroplane is flying at 400km/h , determine the e.m.f. induced between its wing tips. Assume the vertical component of the earth's magnetic field is $40\mu\text{T}$. **(6.5 marks)**
- (b)
 - (i) Define inductance
 - (ii) Differentiate between self and mutual inductance
 - (iii) An e.m.f. of 1.5kV is induced in a coil when a current of 4 A collapses uniformly to zero in 8ms . Determine the inductance of the coil. **(8.5 marks)**

- (c) (i) State the maximum power transfer theorem
 (ii) A d.c. source has an open-circuit voltage of 30V and an internal resistance of $1.5\ \Omega$. State the value of load resistance that gives maximum power dissipation and determine the value of this power. **(5 marks)**

QUESTION FOUR

- (a) (i) Describe the root mean square value of an alternating current
 (ii) Calculate the r.m.s value of a sinusoidal current of maximum value of 20 A. **(2 marks)**
- (b) Draw the circuit diagram of a full- wave rectifier. **(3.5 marks)**
- (c) A coil of inductance 318.3mH and negligible resistance is connected in series with a $200\ \Omega$ resistor to a 240V, 50Hz supply. Calculate:
 (i) the inductive reactance of the coil,
 (ii) the impedance of the circuit,
 (iii) the current in the circuit,
 (iv) the p.d. across each component
 (v) the circuit phase angle **(9 marks)**
- (d) A coil of resistance $5\ \Omega$ and inductive reactance $12\ \Omega$ is connected across a supply voltage of $52\angle 30^\circ$ volts. Determine the active power in the circuit . **(5.5 marks)**

QUESTION FIVE

- (a) (i) Describe generation of three- phase supply
 (ii) Using a sketch differentiate between star and delta connections. **(8.5 marks)**
- (b) Three coils each having resistance $3\ \Omega$ and inductive reactance $4\ \Omega$ are connected in star and delta to a 415V, 3-phase supply. Calculate for each connection:
 (i) the line and phase voltages
 (ii) the phase and line currents. **(11.5 marks)**