



TECHNICAL UNIVERSITY OF MOMBASA

SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF MECHANICAL ENGINEERING
UNIVERSITY EXAMINATION FOR:
BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EEE 4221: ELECTRICAL ENGINEERING I (CIRCUITS AND NETWORKS)

END OF SEMESTER EXAMINATION

SERIES: APRIL 2025. TIME: 2 HOURS. DATE: APRIL 2025.

Instructions to Candidates

The paper consists of five questions. Answer Question one and any other two.

Do not write on the question paper.

Question ONE.

(a)(i). Define electrical power rectification and explain the meaning of the following terms.

(I). Form Factor. (II). Rectifier efficiency.

(ii). With the aid of a diagram, explain the operation of a half wave un controlled rectifier circuit connected to a resistive load through a step down transformer.

(iii). A half wave rectifier is supplied with an RMS voltage of 230V at 50Hz. If the load resistance is 10 K Ω , determine the following.

(I). Average and RMS output voltage. (II). Rectifier Form Factor. **(10 Marks).**

(b)(i). Define a magnetic circuit, hence state any two of its applications.

(ii). State the meaning of the following terms as related to magnetism.

(I). Permeability. (II). Tesla.

(iii). With the aid of a diagram, explain the construction and operation of an electromagnet. Explain how the magnetic polarities can be determined. **(9 Marks).**

(c)(i). Define Ohm's law and explain the meaning of electrical resistance.

(ii). Draw a two parallel resistance circuit connected to a DC voltage source and derive the expression for current distribution in the resistors.

(iii). For the circuit of figure Q 1, Determine the following.

(I). Total circuit resistance and supply current. (II). Prove that the BCDB loop voltage is zero.

(11 Marks).

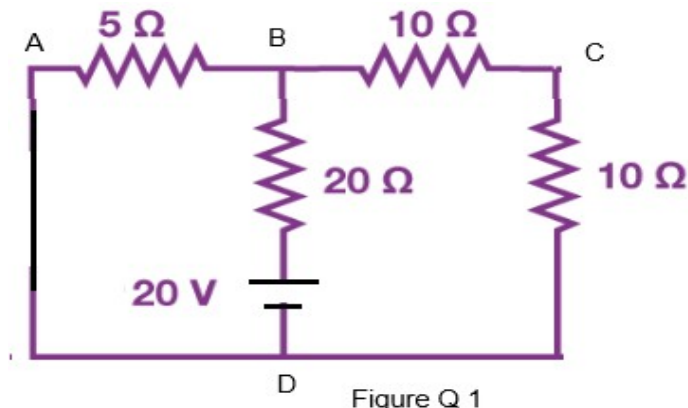


Figure Q 1

Question TWO.

(a)(i). Define the right-hand grip rule of electromagnetism.

(ii). With the aid of a diagram, Explain how an electromagnet can be used for hauling scrap metals of varying weights. **(9 Marks).**

(b)(i). Explain the meaning of the following terms as used with magnetic circuits.

(I). Magnetic flux density. (II) Magnetic Reluctance.

(ii). Figure Q2 shows a magnetic circuit with the following data.

Section A Length = 20 cm, Section B Length = 15 cm and Section C Length = 10 cm. If the relative permeability of the material is 150 and the coil with 500 turns carries a current of 15 amperes, determine,

(I). Total circuit reluctance and magnetic flux. (II). Section C magnetomotive force and flux density.

(11 Marks).

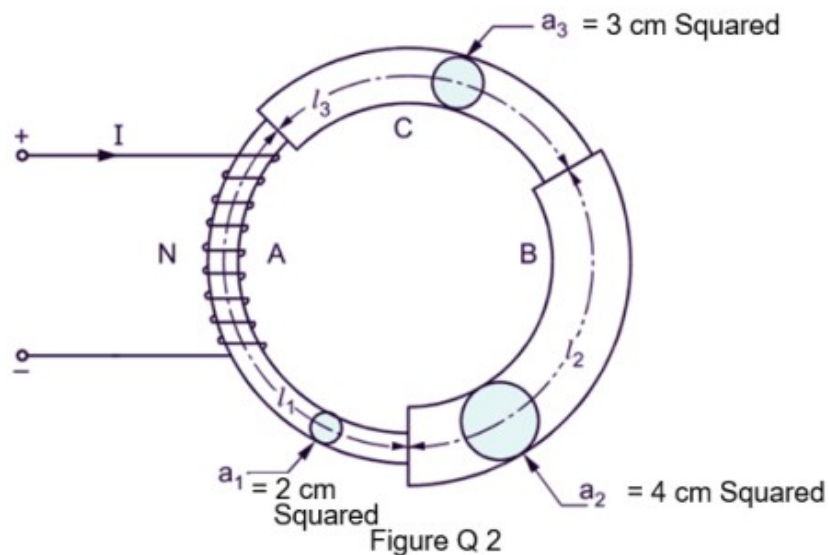


Figure Q 2

Question THREE.

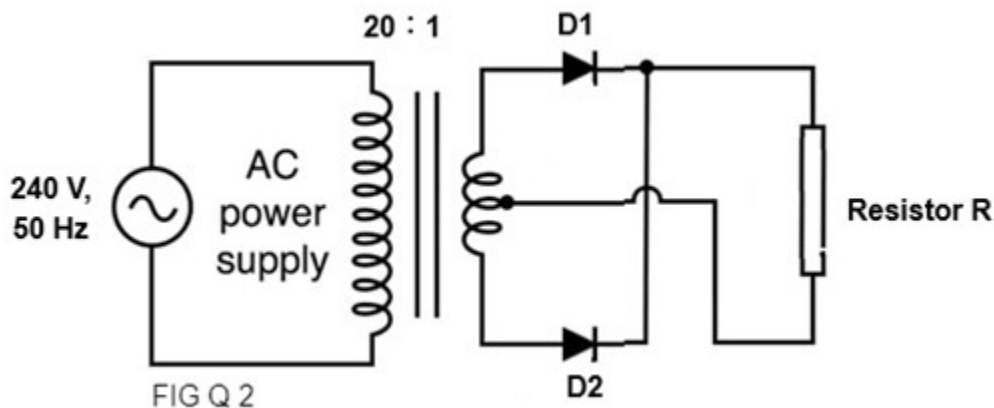
(a). (i). Define controlled AC power rectification and state the advantage of the circuit..

(ii). State the meaning of the following terms as used with AC to DC converters.

(I). Firing Angle. (II). Ripple Factor .

(7 Marks).

- (b). (i). Identify the circuit of figure Q 3 and explain its operation.
(ii). explain the operational behavior of the circuit if diode D 2 experiences an open circuit fault. **(8.5 marks).**
- (c). The transformer used in the circuit of figure Q 3 a ratio of 20:1 and delivers power to the load resistance of 10 k Ω . Determine the following.
(i). Average and RMS output voltage. (ii). RMS output Current and power. **(4.5 Marks).**



Question FOUR.

- (a) (i). Distinguish between active and reactive powers as far as ac circuits is concerned.
(ii). Explain the meaning of the following terms as relating to series AC circuits.
(I). Impedance. (II). Resonance Condition . **(8 Marks).**
- (b)(i).With the aid of a diagram and appropriate components,explain how a resonance condition can be achieved in a series AC circuit.
(ii). A series circuit is made of a 150 Ω resistor in series with an inductance of 0.637H. If the power supply is rated at 240V at 50 Hz, Determine,
(I).Circuit impedance and current. (II).The potential difference across the inductance and reactive power.

(12 Marks).

Question FIVE.

- (a)(i).Define capacitance of a capacitor and state any two applications of capacitors.
(ii).State the meaning of following capacitor parameters.
(I).Electric Charge. (I).A Dielectric. **(6 Marks).**
- (b)(i).Draw a basic circuit diagram made of two series capacitors connected to a power supply and use it to derive its total capacitance expression.
(ii).Explain the effect of temperature change on capacitance of a capacitor. **(9 Marks).**

(c).A combinational capacitor circuit charged by a single DC source is shown in in figure Q 5. Calculate the following,

(I).Total circuit capacitance. (II). Charge through capacitor C1 and C4. (III). Voltage across C 4.

(5 Marks).

