



TECHNICAL UNIVERSITY OF MOMBASA

SCHOOL OF ENGINEERING
ELECTRICAL DEPARTMENT
UNIVERSITY EXAMINATION FOR:
BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING.
EEE 4314: POWER ELECTRONICS 1
SPECIAL/SUPPLEMENTARY EXAMINATION
SERIES: July 2025. TIME: 2 HOURS.

Instructions to Candidates

You should have the following for this examination

Answer Booklet, examination pass and student ID.

This paper consists of FIVE questions. Answer compulsory question one and any other two.

Do not write on the question paper.

Question ONE.

- (a). (i). Explain the operational difference between controlled and un-controlled rectification.
(ii). State any two disadvantages of un-controlled rectifiers over controlled types.
(iii). State and explain the advantage of using a controlled power supply system in a radio repair workshop.
(iv). A half wave controlled rectifier is supplied with a 150V supply at 50 Hz. Calculate the average output power for a firing of 45 degrees if the rectifier is loaded with a $10\ \Omega$ resistor. **(10 Marks).**
- (b). (i). Draw and explain the operation of an ON/OFF AC voltage controller. **(10 Marks).**
(ii). Derive the RMS output voltage expression for the circuit of (bi). **(10 Marks).**
(c)(i). State the need for Cyclo-converters in industries.
(ii). Explain how a Cyclo-converter can be operated as 3:1 frequency converter.
(iii). State any two advantages of modern Cyclo-converter circuits. **(10 Marks).**

Question TWO.

- (a)(i). State any two merits of a full wave controlled AC to DC converters over half wave.
(ii). Briefly explain how AC to DC conversion is necessary in the following applications.
(I). HVDC Transmission. (II). Electroplating. **(7 Marks).**

(b). (i). With the aid of a circuit diagram, explain the operation of a full wave controlled power rectification.

(ii). Derive the RMS output voltage expression for the circuit of (b) (i). **(9 Marks).**

(c). A full wave controlled rectifier circuit is supplied with a maximum voltage supply of 240V (RMS) at 50Hz. If the load is a 25 k Ω resistor the Thyristors are fired at $\alpha = 45$ degrees, determine the following.

(I). RMS output voltages and current. (II). RMS input and output powers.

(III). Rectifier efficiency. **(4 Marks).**

Question THREE.

(a)(i). Define an Electronic Cyclo-converter, hence differentiate between a step up and a step down Cyclo-converters.

(ii). Explain why cyclo-converters employ full wave controlled rectifiers instead of full wave UN-controlled rectifiers in their operation. **(4 Marks).**

(b) (i). Draw a single phase Cyclo converter circuit and explain how it can operate as a 4:1 frequency ratio converter.

(ii). Using appropriate Cyclo converter wave forms, derive the Rms output voltage expression for the Cyclo converter. **(10 Marks).**

(c). A Cyclo converter operating with frequency ratio of 3:1 has an input of 240 V (Max) at 60 Hz. If the load is a series RL type of a 15 Ω resistor and 80 mH, determine for a firing angle of $\alpha = 45$ degrees,

(i). Impedance of the circuit. (ii). Rms output voltage for cyclo converter. **(6 Marks).**

Question FOUR.

(a) (i). State the operational difference between a Diac and a Thyristor, hence state one application for each.

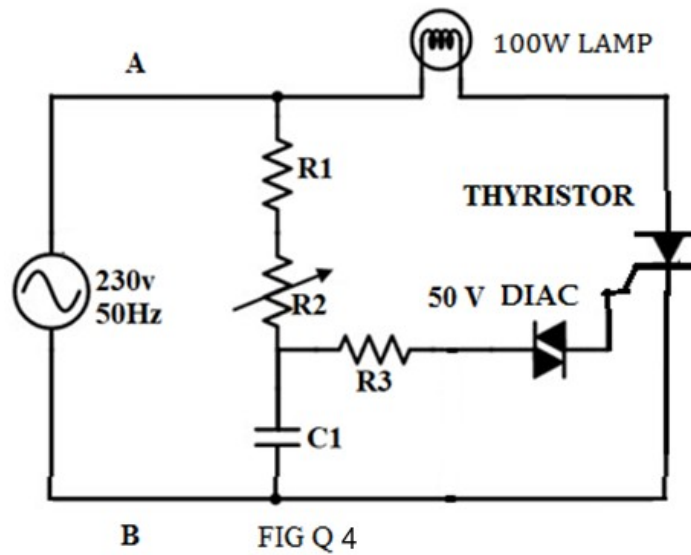
(ii). Explain the meaning of the following terms as related to Thyristors.

(I). Firing angle. (II). Burst firing. **(7 Marks).**

(b)(i). With the aid of a diagram, explain the construction and operation of a Thyristor using a forward bias method without the use of a gate.

(ii). Identify the circuit of figure Q 4 and explain how it operates.

(iii). For the circuit of figure Q 4 breaks down at 50 V, Calculate, (I). Thyristor firing angle and RMS (II). Output voltage across the lamp. (III). RMS current through the lamp. **(13 Marks).**



Question FIVE.

(a)(i). Explain the meaning of the following terms as used with DC to AC power converters.

(I). Harmonic Voltage. (II). Switching frequency.

(ii). State any two required properties for a switch to be used in inverter operations.

(iii). Explain the basic principles of an uninterruptable power supply and the significance of an inverters in this process. **(11Marks).**

(b)(i). Identify the circuit of figure Q5 and explain how it works.

(ii). Determine for the circuit of figure Q5 given apply to be 50V and the load to 150Ω,

(I). RMS output voltage at fundamental frequency. (II). Average and RMS output power Voltage.

(9 Marks).

