



TECHNICAL UNIVERSITY OF MOMBASA

SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRICAL CAL ENGINEERING
BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING
EEE 4415: POWER ELECTRONICS.

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. Answer Question one and any other two questions.

Do not write on the question paper.

Question ONE.

(a)(i). Explain principles of power rectification, hence differentiate between controlled and un-controlled rectification.

(ii). State any two applications of a controlled rectifier circuit.

(iii). A full wave un-controlled rectifier circuit uses a transformer with a step down ratio of 10 :1 and supplies power to a resistive load of 25 Ω . If the input power supply is 240V at 50 Hz.

Determine,

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

(b) (i). Define and explain the role of cyclo converters in industries, hence state any two of its applications.

(ii). With the aid of appropriate diagrams, explain how a Cyclo converter can be used to operate as 3:1 frequency transformer. **(12 Marks).**

(c)(i). Explain the meaning of the following terms as used with inverters.

(I). Harmonic frequency. (II). Inverters efficiency.

(ii). Explain the contribution of inverters in domestic solar power supply systems.

(iii). A full bridge single phase inverter is connected to 150 VDC power supply and serves a resistive load of 4.8 Ω , determine,

(I). The RMS output load voltage at fundamental frequency. (II). RMS Output Power. **(8 Marks).**

Question TWO

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

- (ii). Explain the difference between Firing angle and integral firing as related to thyristors. **(7 Marks).**
- (b)(i). With the aid of appropriate diagrams, explain the operation of a forward biased thyristor.
- (ii). Identify the circuit of Fig Q 2 and explain how it operates. **(13 Marks).**

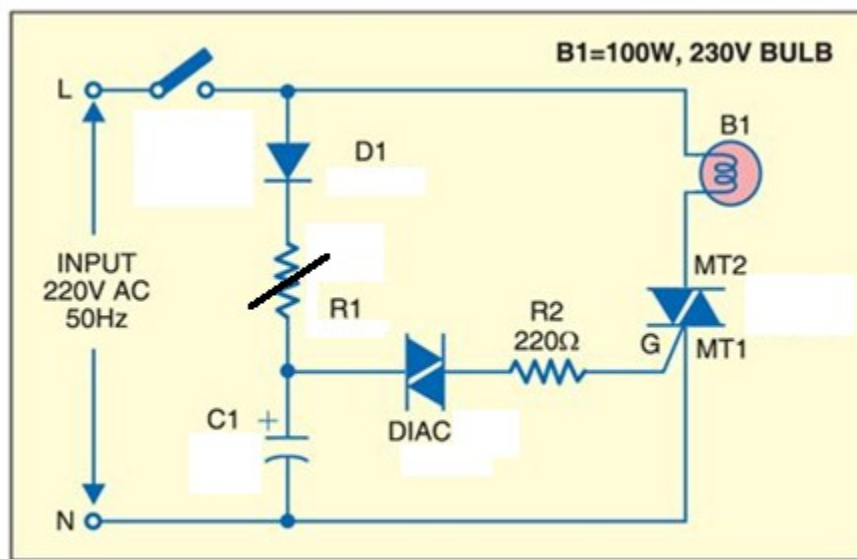


FIG Q 2

Question THREE

- (a). (i). Explain why power supplies employing un-controlled rectification is not suitable for commercial battery chargers.
- (ii). Explain the meaning of the following terms as used with the above converter.
- (I). Form Factor. (II). Ripple Factor.
- (iii). With the aid of a diagram, explain how a full wave controlled rectifier circuit can be used to vary the speed of a DC motor. **(13 Marks).**
- (b). (i). Explain the behavior of a Cyclo converter when one of its bridge rectifier controller fails to operate.
- (ii). A Cyclo converter with a frequency step down ratio of 3:1 is fed with a maximum input power of 300V at 60 Hz. If the load to the Cyclo converter is a 100Ω in series with an inductance of $1.2H$, determine the following when the converter is fired at angle $\beta = 45$ degrees.
- (I). RMS output voltage and current. (II). Input VA power. **(7 Marks).**

Question FOUR

- (a)(i). Differentiate between ON/OFF and phase firing in AC voltage regulators.
- (ii). Explain why ON/OFF AC voltage regulator is preferable to a half wave type in most industrial applications.
- (iii). State any two applications AC voltage regulator. **(6 MARKS)**

(b)(i). Draw and explain how a bidirectional AC voltage regulator can be used as a lamp light intensity controller.

(ii) Explain the operational effect if one of the Thyristors in the circuit of (bi) under goes an open circuit fault. **(11 MARKS).**

(c). A bidirectional AC voltage regulator is supplied with a stable 250V Rms supply at 50 Hz. If the load is pure resistor of $25\ \Omega$ and the forward Thyristors are fired at 60 degrees, determine,

(I). Rms output voltage (II). Peak and Rms input current. **(3 MARKS).**

Question FIVE

(a)(i). Define an inverter, hence differentiate between a half bridge and a full bridge inverter.

(ii). Explain the switch precautions to be taken when designing inverters. **(8 MARKS).**

(b)(i). Explain the meaning of the following terms as used with power inverter systems.

(I). Switching frequency. (II). Fundamental frequency.

(ii). Identify the circuit of Figure Q 5 and explain its operation. **(10 MARKS).**

(c). A single phase full bridge power inverter is supplied with a dc voltage of 150V and operates at a frequency of 50 Hz. If the load consists of a $100\ \Omega$ in series with an inductance of 480mH, determine the following.

(I). Fundamental RMS output voltage and circuit impedance. (II). RMS output power. **(2 MARKS).**

