



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

UNIVERSITY EXAMINATION FOR:
BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING
EEE 4415: POWER ELECTRONICS 2.
END OF SEMESTER EXAMINATION

SERIES: APRIL 2025

TIME: 2 HOURS

DATE: APRIL 2025

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.

Do not write on the question paper.

Question ONE.

(a)(i).Define a DC to DC voltage converter circuit and explain the meaning of the following terms.

(I).Switching Frequency. (II).Ripple Voltage.

(ii).State any two applications and any two advantages of DC to DC converters

(iii).A buck DC to DC converter has an input voltage of 10V and is required to deliver an output current of 0.25A across a resistive load. If the circuit operates at a frequency of 25 kHz and at a fixed duty cycle of 30% determine,

(I).The output voltage and the load resistor. (II).Circuit output power. (III).On state time.

(10 Marks).

(b)(i).State the operational difference between DC to DC and AC linked choppers.

(ii).With the aid of a power quadrant, draw and explain the operation of a class A chopper circuit.

(iii).A DC chopper circuit has an input voltage of 250V and an output voltage of 150V.If the circuit switching on time is 6 micro second and the load resistance is 30Ω , Find,

(I).Circuit duty cycle (II). Circuit switching frequency. **(10 Marks).**

(c) (i).Differentiate between HVAC and HVDC transmission systems.

(ii).Explain how power transmission efficiency is improved and cost reduced when using HVDC transmission systems.

(iii).Draw a mono polar HVDC system and explain its operation. **(10 Marks).**

Question TWO.

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

(ii).State the advantages of using burst firing instead of phase firing in thyristor operation.

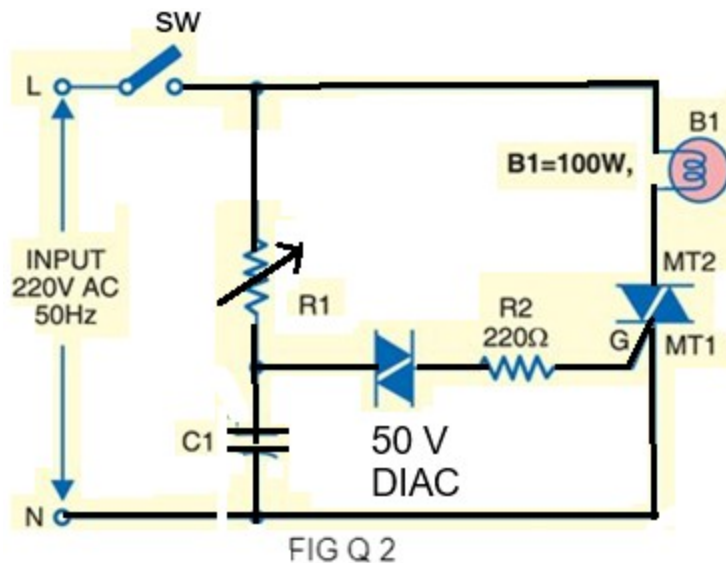
(9 Marks).

(b)(i).With the aid of appropriate characteristic, explain how a Thyristor can be operated on a forward biased mode under gate control.

(ii). Identify the circuit of Fig Q 2 and explain how it operates.

(iii).Calculate the circuit firing angle and the Rms current flowing through the bulb.

(11 Marks).



Question THREE

(a)(i). Define a DC chopper circuit and by using appropriate power quadrants, explain the difference between class A and B choppers.

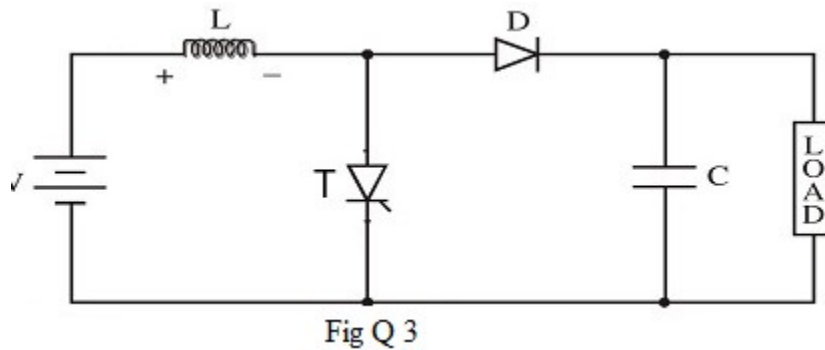
(ii). State the effect of a prolonged turn OFF time on chopper operation.

(7 Marks)

(b)(i). Identify the circuit of figure Q 3 and with the aid of appropriate waveforms, explain its operation.

(ii). Show how the circuit can step up the input voltage.

(10 Marks)



(c)(i). A chopper has a periodic time of $250\mu\text{s}$ and an off time of $150\mu\text{s}$. If the input voltage is 200V powers a resistance load of 15Ω , Calculate,

(i). The circuit duty cycle and average output voltage. (ii). Average output power.

(3 Marks)

Question FOUR

(a)(i). Explain the HVDC power transmission, hence explain why HVDC system is more popular than HVAC.

(ii). Explain the function of the inverters in the transmission system.

(iii). Explain the economic function of an HVDC system

(9 Marks).

(b)(i). Draw a basic bipolar HVDC link and explain the function of each component of the system.

(ii). State any two advantages of HVDC back to back system.

(8 Marks).

(c). A 3-phase full wave rectifier HVDC system is required to feed a transmission line of 100Ω . If a maximum supply of a 240V at 50Hz is connected to a Delta transformer with transformation ratio of 1:10, determine the following.

(i). Average rectifier output voltage. (ii). Sending line current.

(3 Marks).

Question FIVE

(a)(i). State the difference between a DC and an AC voltage converter.

(ii). Explain why computers employ switched mode power supplies rather than the conventional types. **(6 Marks).**

(b). Identify the circuit of figure Q 5 and explain how it operates. Derive the voltage expression relating the output voltage to the input voltage for the circuit. **(8 Marks).**

(c). The circuit of figure Q5 has an input voltage of 15V and delivers load current of 12mA to a load of 450Ω . The switching frequency of the circuit is 25Khz and the inductor ripple current is 0.8 amps. Calculate,

(I). Filter capacitance and inductance values. (II) Critical capacitance and inductance values.

(6 Marks).

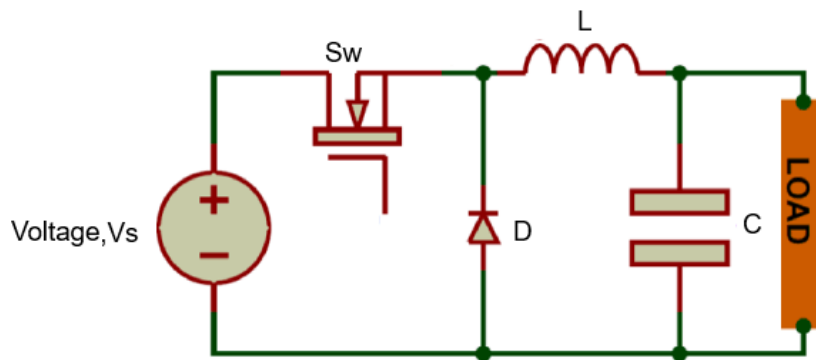


Fig Q 5