



TECHNICAL UNIVERSITY OF MOMBASA

SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRICAL CAL ENGINEERING
BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING
EEE 4415: POWER ELECTRONICS II.
SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: July 2025. TIME: 2 HOURS. DATE: July 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 compulsory Question one and any two Questions.

Do not write on the question paper.

Question ONE.

(a) (i). Explain the phenomenon of HVDC transmission systems and state any two merits compared to HVAC.

(ii). State why HVAC power transmission cables are less expensive compared to AC power distribution cables.

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

(b) (i). Define a semiconductor boost converter and explain how it is cost effective as compared to AC linked type.

(ii). Draw a basic boost converter diagram and explain how it functions.

(iii). A boost converter has an input voltage of 20 V and is required to operate at a 80% duty cycle. If the load to the converter is a 15Ω resistance, determine,

(I). Average output voltage. (II). RMS output power and input VA power. **(11 Marks).**

(c) (i). Differentiate between industrial and domestic inverters.

(ii). Explain the contribution of inverters in renewable energy systems.

(iii). Name any two industrial inverter applications.

(iv). A full bridge single phase inverter is connected to 100 V DC power supply and serves a resistive load of 4.8Ω , determine,

(I).The RMS output load voltage at fundamental frequency. (II).RMS Output Power. **(9 Marks).**

Question TWO.

(a)(i).Differentiate between HVDC and HVAC mode of power transmission, hence explain why HVAC mode is less popular.

(ii).State the need for inverters for HVDC transmission system. **(8 Marks).**

(b)(i).Draw a basic block diagram of an HVDC back to back system and explain the function of each component of the system.

(ii).State any two advantages of HVDC back to back system. **(9 Marks).**

(c).A 3-phase full wave rectifier HVDC system is required to feed a transmission line of 150Ω .If the supply is a Delta connection with a 150V at 50 Hz, determine the following if the voltage transformation ratio is set at 1:10.

(i.). Rectifier output voltage. (ii).Sending line current. **(3 Marks).**

Question THREE.

(a)(i). Explain the operational difference between a Diac and a Thyristor.

(ii). State any two applications of power Thyristors. **(4 Marks).**

(b). (i). With the aid of waveforms, draw and explain the construction and operation of a Diac.

(ii). Identify the circuit of figure Q 3 and explain its operation. **(14 Marks).**

(c). Calculate

(i).The value of the current passing through the LED when it is on.

(ii).The capacitor value for circuit to flash at a frequency of 10Hz given both R_1 and R_v to be $10\text{ k}\Omega$. **(2 Marks).**

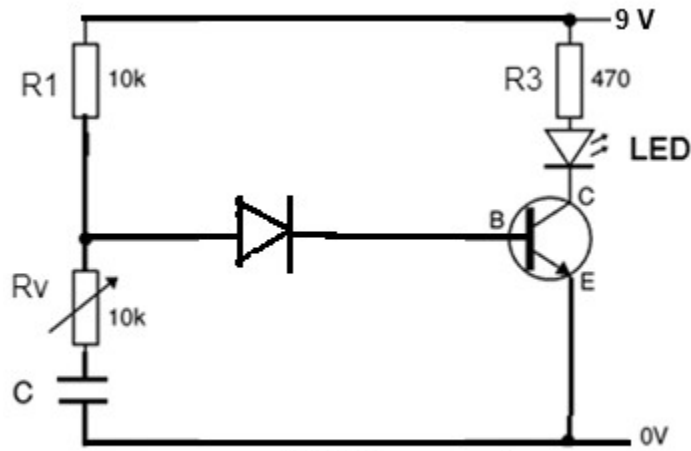


FIG Q 3

Question FOUR

(a)(i). State the need for DC choppers in electronics circuits.

(ii). Explain the meaning of the following chopper terms.

(I). Trigger signal. (II). Chopper efficiency.

(5 Marks).

(b) (i). State any two sources of power supplies for choppers.

(ii). Identify the circuit of Figure Q4 and explain its operation. Derive the expression relating the input and output voltages. **(11 Marks).**

(c). A step up chopper has an input voltage of 200V and an output voltage of 500V. If the ON state conducting time is $100\mu\text{s}$, and given the load resistance R as 10Ω , compute,

(I). Chopper Duty Cycle. (II). Non conducting time for the Thyristor. (III). Average output current to the chopper load. **(4 Marks).**

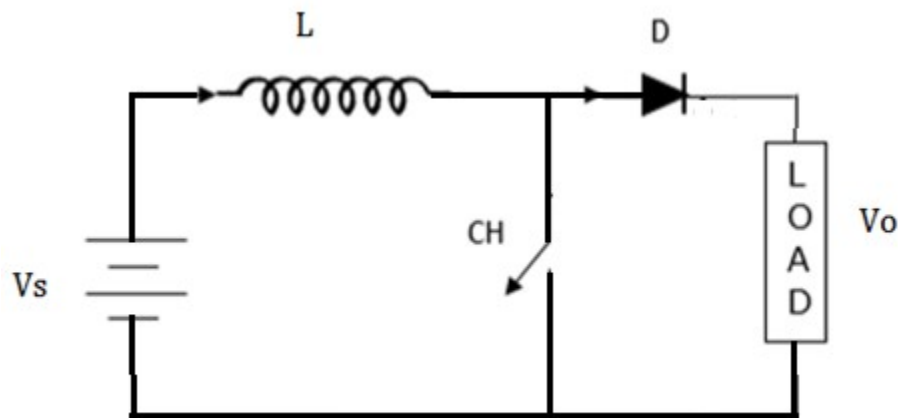


FIG Q 4

Question FIVE

- (a)(i). Define an inverter and hence distinguish between single and three phase inverter.
(ii). Explain the switch precautions to be taken when designing inverters.
(iii). Define the following terms as used with power inverter systems.

(I). Inverter Harmonics. (II). Inverter Efficiency. **(6 Marks).**

- (b)(i). Draw a three phase transistorized inverter circuit diagram.
(ii). Using the stated switching codes, explain the operation of the circuit using a 180 degrees mode.
(10 Marks).

(c). A 3ϕ bridge inverter delivers power to a resistive load from a 600V DC power source. If the load is star connected with a 20Ω /phase, find,

(I). Rms load current. (II). Rms Thyristor current. **(4 Marks).**