



MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS

UNIVERSITY ORDINARY EXAMINATION

2023/2024 ACADEMIC YEAR

..... YEAR **SECOND SEMESTER EXAMINATION**

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EET 307 – POWER ELECTRONICS

DURATION: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

1. Answer question one and any other two questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE (30 MARKS)

- a. List three applications of power electronics. (3marks)
- b. State two advantages and disadvantages of a TRIAC over SCR. (2marks)
- c. Define the following terms in relation to PN junction.
 - i. Forward voltage, V_F
 - ii. Breakdown voltage, V_B
 - iii. Reverse current, I_R (6marks)
- d. The manufacturer of a selected diode gives the rate of fall of the diode current And its reverse time $t_{rr} = 5 \dots$. What value of peak reverse current do you expect. (4marks)
- e. Outline four applications of power diodes. (4marks)
- f. State the advantages of power electronics converters have over the traditional methods of power conversions. (5marks)
- g. Discuss the I-V characteristics of a MOSFET (6marks)

SECTION B – ANSWER ANY TWO QUESTIONS IN THIS SECTION

QUESTION TWO (20 MARKS)

- a. Discuss the I-V characteristics of the Silicon controlled rectifier (SCR). (10marks)
- b. The DC battery is charged through a resistor R as shown below. Derive an expression for the average value of the charging current in terms of V_m , E, R on the assumption that SCR is fired continuously. For an AC source voltage of 230V, 50Hz.
 - i. Find the value of average charging current for $R = 8\Omega$ and $E = 150V$.
 - ii. Find the power supplied to the battery and that dissipated in the resistors.
 - iii. Calculate the supply pf. (10marks)

Insert diagram.....

QUESTION THREE (20 MARKS)

- a. Using a circuit, explain the working principle of a single phase, half bridge. Inverter and draw the output voltage curve. (10marks)
- b. A three-phase to single phase cycloconverter employs 3-pulse positive and negative group converters. Each converter is supplied from delta/star transformer with per phase turns ratio of 2:1. The supply voltage is 400V, 50Hz. The RC load had $R = 25\Omega$ and t low

output frequency $\omega_{01} = 1.5\Omega$. In order to account for commutation overlap and thyristor turn-of time, the firing angle in the inversion mode should not exceed 160 degrees. Compute:

- i. The value of the fundamental rms output voltage.
- ii. RMS output current.
- iii. Output power

(10marks)

QUESTION FOUR (20 MARKS)

A single phase full bridge inverter has RIC load of $R = 4\Omega$, $L = 35\text{mH}$ and $C = 155\mu\text{F}$. The DC input voltage is 230V and the output frequency is 50Hz. Calculate:

- i. Find an expression for load current, up to the fifth harmonic.
- ii. The rms value of the fundamental load current.
- iii. The power absorbed by load and the fundamental power.
- iv. The rms and peak currents of each thyristor,
- v. The conduction time of thyristors and diodes of only fundamental component were considered.

(20marks)