NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING

DEPARTMENT OF ELECTRONIC ENGINEERING

EEE 2212 ELECTRONIC DRIVES

This examination paper consists of 4 pages

Time Allowed: 3 Hours

Total Marks: 100

Examiner's Name: Eng. JT. Mawanza

INSTRUCTION AND INFORMATION TO THE CANDIDATE

1. **Answer ALL parts of Section A and any THREE questions from Section B.**
2. **Section A carries 40 marks and Section B carries 60 marks.**
3. **Start each question on a new page**
4. **Use of calculators is permissible**

MARK ALLOCATION

QUESTION	MARKS
1	40
2	20
3	20
4	20
5	20
Total marks attainable by candidate	100

SECTION A

Question 1

a) Define the following terms

i. Voltage commutation **[3 Marks]**

ii. Current commutation **[3 Marks]**

iii. Voltage ripple factor **[3 Marks]**

b) With the aid of the devices symbol and characteristic curve briefly explain the general characteristic features of the following

i. Triacs **[5 Marks]**

ii. Integrated Gate-Commutated Thyristors (IGCTs) **[5 Marks]**

iii. MOSFET **[5 Marks]**

c) Use circuit diagrams and waveforms to analyze the control characteristics of a GTO and an MCT. **[6 Marks]**

d) Show that the power factor for the controlled full-wave rectifier with a resistive load is

$$pf = \sqrt{\frac{1}{2} - \frac{\alpha}{2\pi} + \frac{\sin(2\alpha)}{4\pi}}$$

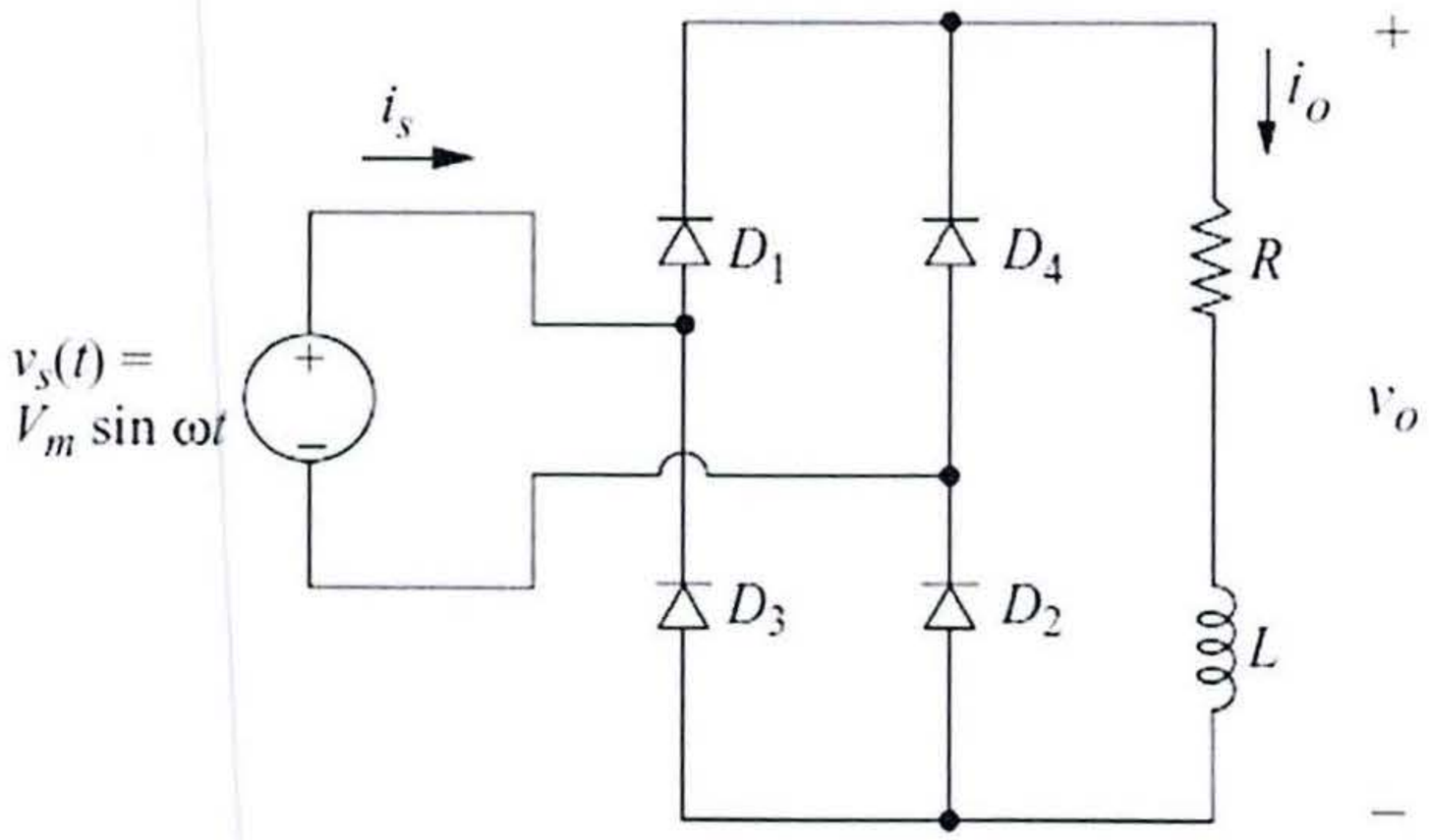
[10 Marks]

SECTION B

Question 2

a) The full-wave rectifier of Fig. 1 has $V_s(\omega t) = 200\sin(\omega t)\ V$, $R = 6\ \Omega$, $L = 40\ mH$, $V_{dc} = 96\ V$, and 2 (60) rad/s. Determine (a) the power absorbed by the dc source, (b) the power absorbed by the resistor, and (c) the power factor. (d) Estimate the peak-to-peak variation in the load current by considering only the first ac term in the Fourier series for current.

b) **[8 Marks]**



Question 3

a) With the aid of circuit and quadrantal diagrams explain the working principle of a class D chopper. **[20 Marks]**

Question 4

a) A single-phase full converter feeds power to the RLE load with $R = 6\ \Omega$, $L = 6mH$ and $E = 60\ V$. The AC source voltage is 230V, 50Hz. For continuous conduction, find the average value of load current for a firing delay of 50. In case one of the four SCRs gets an open circuit due to a fault, find the new value of the average load current taking the output current as continuous **[10 Marks]**

b. State and explain the effects of harmonics on the performance of a DC motor. **[10 Marks]**

Question 5

a) A three-phase half-wave rectifier is operated from a three-phase star-connected $300\ V$, 60Hz supply. Load resistance $= 20\ \Omega$. If it is required to obtain an average output voltage 50 % of max possible output voltage. Calculate i) delay angle, ii) rms value of output current, iii)

average value of output current, iv) thyristor avg and rms current, v) efficiency, vi) TUF vii) supply power factor. **[20 Marks]**