UNIVERSITY COLLEGE TATI

UNIVERSITY COLLEGE TATI (UC TATI)

FINAL EXAMINATION QUESTION BOOKLET	
COURSE CODE	: DEE 3133
COURSE	: POWER ELECTRONICS & DRIVES
SEMESTER/SESSION	: 1 - 2024/2025
DURATION	: 3 HOURS

Instructions:

1. This booklet contains 4 questions. Answer **all** questions.
2. All answers should be written in answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, raise your hands and ask the invigilator.

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO

THIS BOOKLET CONTAINS 8 PRINTED PAGES INCLUDING COVER PAGE

QUESTION 1

a) Figure 1 shows a block diagram of a converting system using circuit 'X'.

i. Identify circuit 'X' (1 mark)

ii. Explain the function of circuit 'X' (2 marks)

iii. Classify two (2) types of circuit 'X' (4 marks)

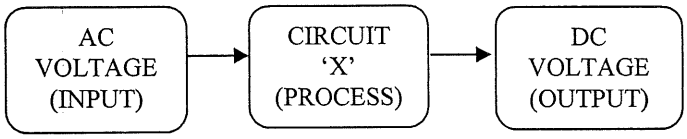

Figure 1

b) Base on table 1 below , draw the converter circuit for the criteria mentioned. (6 marks)

Table 1

Type	Controlled
Supply	Single Phase
Output	Full wave Bridge
Load	R

c) Figure 2 shows the circuit of half-wave with RL load and freewheeling diode. Given $V_{supply} = 300 \sin 314\, t$, $R = 15\Omega$ and the inductor value is too large.

i. Explain the circuit operation. (6 marks)

ii. Describe the function of freewheeling diode in this circuit (2 marks)

iii. Sketch the waveform of voltage input and output (8 marks)

iv. Calculate average load voltage, V_{avg} (3 marks)

v. Calculate Average load current, I_{avg} (2 marks)

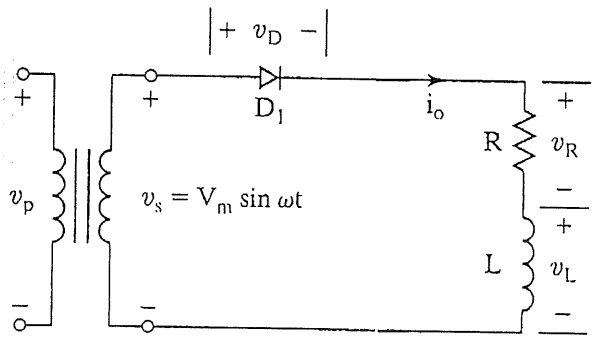

Figure 2

QUESTION 2

a) Define DC Chopper (3 marks)

b) Explain three (3) type of non isolated DC chopper topology. (6 marks)

c) Sketch the circuit of boost converter during turning on and off condition. (4 marks)

d) A buck converter is supplied from 25V battery source. Given L=400μH, C=100μF, R=20 ohm, fs=20kHz and D=0.6.

i. Explain operation of the circuit during ON and OFF switching state complete with the circuit diagram. (10 marks)

ii. Calculate voltage output produce by the circuit. (2 marks)

iii. Sketch the waveform of voltage input and output (8 marks)

QUESTION 3

a) By referring to Figure 3 below :

i. Name the inverter (2 marks)

ii. Explain operation of the inverter circuit with R load (6 marks)

iii. State three (3) basic type of switching scheme for this inverter (3 marks)

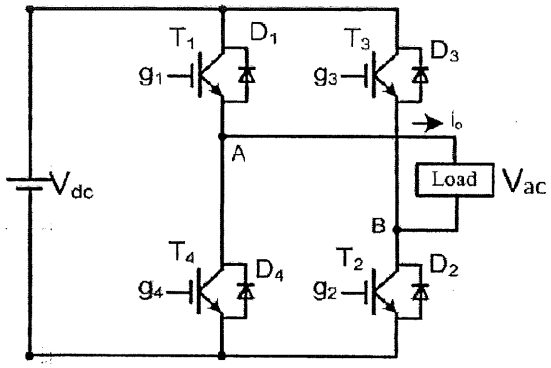

Figure 3

QUESTION 4

a) Figure 4 shows the block diagram of electrical drive system.

i. Give two (2) types of electrical drive (2 marks)

ii. State two (2) advantages of modern electric drive (2 marks)

iii. Explain any two (2) parts in the block diagram (6 marks)

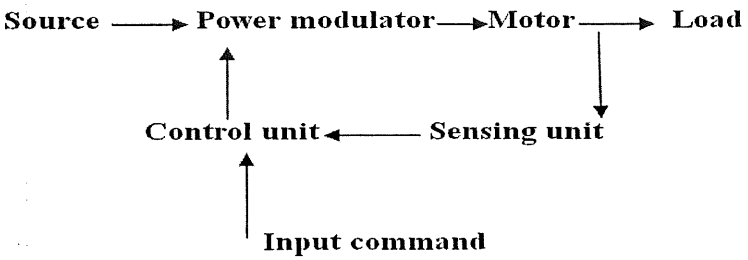

Figure 4

b) Explain operations of quadrant 1 and 3 in 4 quadrants mode of electrical motor including their application in real life. (6 marks)

c) Explain methods to control the speed of series and shunt dc motor. (6 marks)

----------End of question----------

LIST OF FORMULAS

Ohm's Law	$$V = IR$$
Uncontrolled rectifier	$$Vo_{avg} = \frac{V_m}{\pi}$$ $$P_L = I^2_{rms} R$$ $$Vo_{rms} = \frac{V_m}{2}$$ $$Vo_{avg} = \frac{V_m}{2\pi} * (1 - cos\,\beta)$$ $$Vo_{avg} = \frac{2V_m}{\pi}$$ $$Vo_{rms} = \frac{V_m}{\sqrt{2}}$$
Controlled rectifier	$$Vo_{avg} = \frac{V_m}{2\pi} * (1 + cos\alpha)$$ $$P_L = I^2_{rms} R$$ $$Vo_{rms} = \frac{V_m}{2}\sqrt{1 - \frac{\alpha}{\pi} + \frac{sin(2\alpha)}{2\pi}}$$ $$Vo_{avg} = \frac{2V_m}{\pi} * (cos\,\alpha)$$
DCchopper	$$P = IV$$ $$I_{Lmax} = V_O\left(\frac{1}{R} + \frac{(1-D)T}{2L}\right)$$ $$I_{Lmin} = V_O\left(\frac{1}{R} - \frac{(1-D)T}{2L}\right)$$ $$V_O = D(V_{in})$$ $$V_O = \left(\frac{V_{in}}{1-D}\right)$$

	$\Delta V_O = \frac{V_O(1-D)T^2}{8CL}$ $\Delta V_O = \frac{V_O DT^2}{RC}$ $r = \frac{(1-D)T^2}{8CL}$ $r = \frac{DT^2}{RC}$ $I_L = \frac{V_{in}}{(1-D^2)R}$ $I_L = \frac{V_O}{R}$
Voltage divider	$V_x = \left(\frac{R_X}{R_T}\right) X\, V_S$
Current divider	$I_x = \left(\frac{R_T}{R_X}\right) X\, I_T$