UNIVERSITY COLLEGE TATI

UNIVERSITY COLLEGE TATI (UC TATI)

FINAL EXAMINATION QUESTION BOOKLET	
COURSE CODE	: BMT 3063
COURSE	: POWER ELECTRONIC AND DRIVE
SEMESTER/SESSION	: 2 - 2022/2023
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 9 PRINTED PAGES INCLUDING COVER PAGE

QUESTION 1

a) Rectifier is a converter circuit use in converting AC supply to DC supply. State two (2) type of rectifier circuit base on the switching device use. (2 marks)

b) Describe the main different between full wave and half wave rectifier. (2 marks)

c) Figure 1 shows the circuit of uncontrolled rectifier.

i. Name type of rectifier. (2 marks)

ii. Describe the operation of the circuit (7 marks)

iii. Explain the change in output waveform if the freewheeling diode add in parallel with the RL load. (2 marks)

iv. Give the reasons for your answer in (iii) (2 marks)

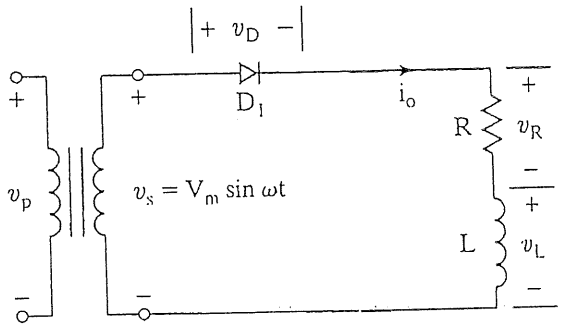

Figure 1

d) Figure 2 shows a type of controlled rectifier with value of α = 90°, f=50Hz, L=300mH and R=10Ω. Refer to the circuit :

i. Produce the waveforms of V_{out} and I_{out}. (4 marks)

ii. Explain the operation of the rectifier. (6 marks)

iii. Determine the condition of θ and α as α change to 45°. (2 marks)

iv. Produce the waveform of V_{out} and I_{out} as the α = 45°. (4 marks)

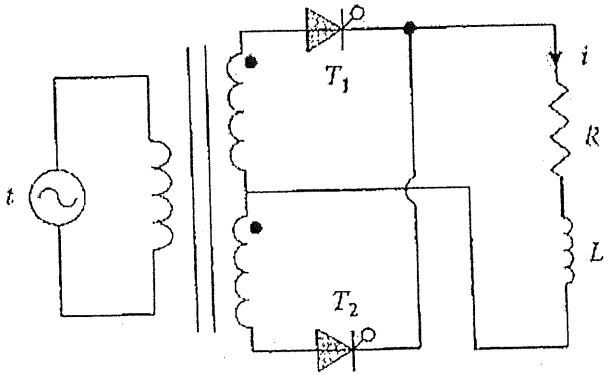

Figure 2

QUESTION 2

a) State the two (2) type of DC chopper with example. (4 marks)

b) Figure 3 shows a of the DC chopper circuit. Given V_{in} is 25V as the battery source C=100μF,L=400μH, R=20Ω,fs=20kHz and D=0.6.

i. Name the circuit of Figure 3 (2 marks)

ii. Explain the operation of the circuit during ON and OFF switching statecomplete with the circuit diagram. (10 marks)

iii. Calculate the voltage output,Vout (2 marks)

iv. Calculate the output voltage ripple, ΔV (2 marks)

v. Calculate the ripple factor,r (2 marks)

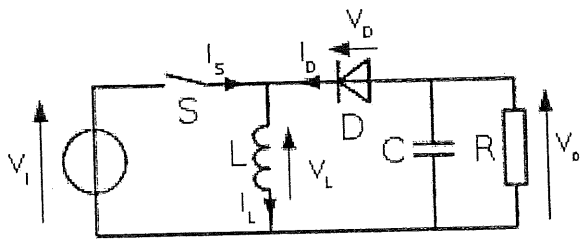

Figure 3

QUESTION 3

a) By referring to Figure 4 below :

i. Name the type of inverter (1 mark)

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

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

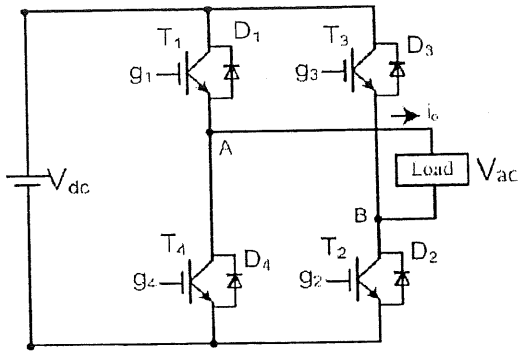

Figure 4

b) By referring to Figure 5 below :

i. Calculate the value of V_{out} from 90V battery source (2 marks)

ii. Produce the waveform of voltage and current output for Vs = 90V and R = 1Ω (4 marks)

iii. Explain the operation of the circuit (6 marks)

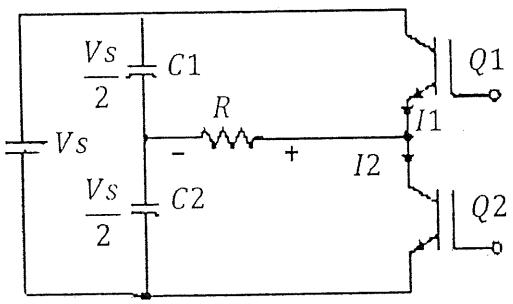

Figure 5

QUESTION 4

a) Complete the block diagram of electrical drives in Figure 6. (2 marks)

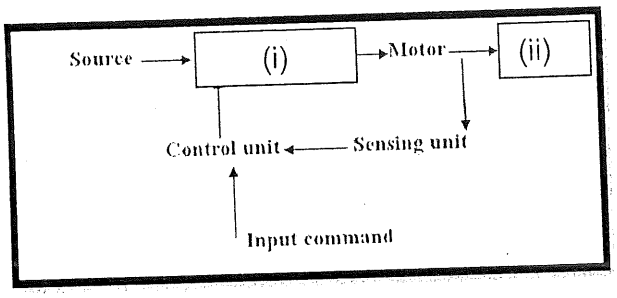

Figure 6

b) Describe the following term :

i. Source (3 marks)

ii. Motor (2 marks)

c) Describe two(2) methods to control the speed of series DC motor. (4 marks)

d) Figure 7 shows the dc motor fed by single phase controlled rectifier. Given the emf is 4V and the armature resistance is 10 ohm. Gate current supply to the single phase rectifier at the armature in delay of 45° and the V_{max} is 339.41V. For the field side, the single phase semi conductor have delay angle of 60°, field resistance of 5 ohm and V_{max} of 339.41V. Calculate :

i. Armature voltage, Va. (3 marks)

ii. Armature current, Ia. (2 marks)

iii. Armature voltage, Va if the firing angle increase to 60°. (3 marks)

iv. Field voltage, Vf of the single phase semi conductor. (4 marks)

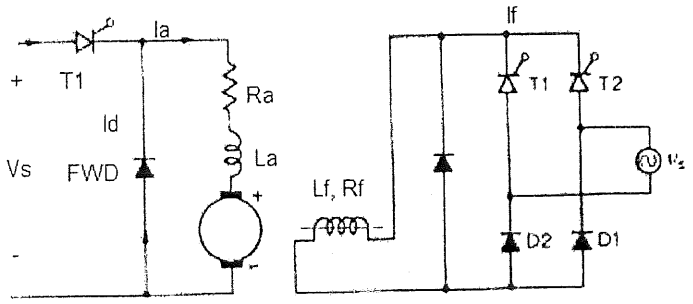

Figure 7

----------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	$P = IV$ $I_{Lmax} = V_O\left(\frac{1}{R} + \frac{(1-D)T}{2L}\right)$ $I_{Lmin} = V_O\left(\frac{1}{R} - \frac{(1-D)T}{2L}\right)$ $V_O = D(V_{in})$ $V_O = \left(\frac{V_{in}}{1-D}\right)$ $V_O = -Vi\left(\frac{D}{1-D}\right)$

	$\Delta V_O = \frac{V_O(1-D)T^2}{8CL}$ $\Delta V_O = \frac{V_O DT^2}{RC}$ $\Delta V_O = \frac{V_O DT}{RC}$ $r = \frac{(1-D)T^2}{8CL} x\ 100$ $r = \frac{DT}{RC} x100$ $r = \frac{DT^2}{RC} x\ 100$ $I_L = \frac{V_{in}}{(1-D^2)R}$ $I_L = \frac{V_O}{R}$
Inverter	$Vo = \frac{Vdc}{2}$ $V_O = Vdc$
Voltage divider	$V_x = \left(\frac{R_X}{R_T}\right) X\ V_S$
Current divider	$I_x = \left(\frac{R_T}{R_X}\right) X\ I_T$