



MACHAKOS UNIVERSITY

University Examination 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

FIFTH YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONICS ENGINEERING)

EEE 508: POWER ELECTRONICS AND VARIABLE SPEED DRIVES

DATE: 20/5/2019

TIME: 8.30-10.30 AM

INSTRUCTIONS

Answer Question ONE and any other TWO Questions.

QUESTION ONE (30 MARKS)

- a) State the three conventional methods of speed control in D.C motors. (3 marks)
- b) A separately excited D.C motor is driven by a three phase fully controlled converter with a contractor for speed reversal. The line voltage is 440 volts, 50HZ. The motor armature resistance is 0.12Ω and the armature voltage constant is 2v/rad/sec at the rated field current. Determine:
 - i. The firing angle necessary at the armature current of 40Amps and speed of 1500RPM.
 - ii. The required delay angle to get armature current to 40A for regenerative braking if contractor is operated after a delay angle control is used to bring the armature current to zero and the start of the sequence of speed reversal.
 - iii. Regenerative braking power
 - iv. Braking torque (12 marks)
- c) With the aid of fig Q 1(c) and output waveforms show that the steady state continues voltage applied to the armature terminal of a single phase fully controlled rectifier fed D.C drive is given by

$$V_a = \frac{2V_{max}}{\pi} \cos \alpha$$

(10 marks)

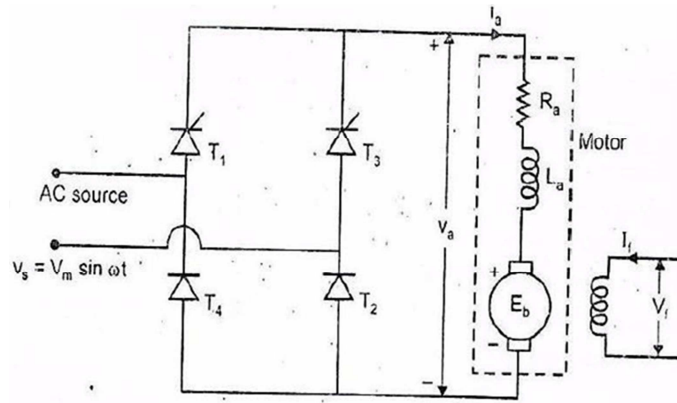


Fig Q 1.(c)

- d) State any five applications of D.C choppers (5 marks)

QUESTION TWO (20 MARKS)

- a) Draw a circuit diagram of anti-parallel SCR, hence describe its operation as applied in reversal of speed of D.C motor. (7 marks)
- b) A separately excited D.C motor is driven from a 240 volts, 50HZ supply using a fully controlled bridge rectifier. The motor has armature resistance of 1Ω and a motor constant of 0.8v/rad/sec . the field current is constant at its rated value. Assume its armature current is steady. If the motor speed is 1600RPM and firing angle is 30° , determine:
- Armature current
 - Torque
 - Limits of the armature delay angle. (13 marks)

QUESTION THREE (20 MARKS)

- a) With an aid of a diagram, describe the operation of a regenerative braking D.C chopper as applied in D.C motors. (8 marks)
- b) A D.C chopper is used to control the speed of a separately excited D.C motor. The D.C supply is 330 volts. The armature resistance is 0.26Ω and the motor constant is 0.98v/rad/sec . the motor drives a constant load torque of 115NM . If the field current is

held constant at 1.5A, assuming no load losses, determine the range of speed control for the motor (8 marks)

- c) Draw a circuit diagram of a four quadrant D.C chopper. (4 marks)

QUESTION FOUR (20 MARKS)

- a) Draw a closed loop control system of a D.C drive (5 marks)
- b) With an aid of a schematic block diagram, derive an open loop transfer function of a D.C motor which relates the output speed to input voltage. (15 marks)

QUESTION FIVE (20 MARKS)

- a) State the four advantages of A.C drives (4 marks)
- b) With an aid of a schematic block diagram, describe the frequency and voltage control of a three phase induction motor (8 marks)
- c) A three phase 11.2kw, 1750RPM, 460Volts, 60HZ, 4-pole star connected induction motor has the following parameters; $R_s = 0.66\Omega$, $R_r' = 0.38\Omega$, $X_r' = 1.71\Omega$, $X_m = 33.2\Omega$. the motor is controlled by varying both the voltage and the frequency. The volts/Hertz ratio which corresponds to the rated voltage and voltage is maintained constant. Determine the maximum torque and maximum speed for a frequency of 60 HZ. (8 marks)