



TECHNICAL UNIVERSITY OF MOMBASA

SCHOOL OF ENGINEERING AND TECHNOLOGY

ELECTRICAL ENGINEERING DEPARTMENT

UNIVERSITY EXAMINATION FOR:

BACHELOR OF TECHNOLOGY IN ELECTRICAL AND ELECTRONIC ENGINEERING

TEE 4419: ELECTRICAL MACHINE DRIVES

END OF SEMESTER EXAMINATION

SERIES: AUGUST 2024

TIME: 2 HOURS

DATE: Pick Date Select Month Pick Year

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass, and student ID

This paper consists of **five** Questions; Each question carries 20 marks. Attempt any **THREE** Questions.

Do not write on the question paper.

Question ONE

- a)
- Sketch a block diagram an electric drive system.
 - State any **FOUR** applications of electric drives.

(8 Marks)

b) A lift system with no flywheel has the following parameters:

- The rated passenger load, $Q=300$ kg;
- The car mass, $C=300$ kg;
- The counterweight balance ratio $R = 50\%$
- Sheave diameter, $d=630$ mm;
- Gear box reduction ratio, $r=74:2$;
- Rated torque of the motor $T= 25.5$ Nm;
- Torque available for acceleration $T_a = 2T$;

- Moment of inertia of the motor rotor and the brake drum, $I = 0.1 \text{ kgm}^2$;
- Lift speed $v = 1.2 \text{ m/s}$;
- Motor speed is $N = 1350 \text{ rev/min}$.

Assume a total system efficiency of 55%, and calculate the initial linear acceleration in the two extreme cases:

- i. When the car is full of passengers, and travelling upwards.
- ii. When the car is empty and travelling upwards.

(12 Marks)

Question TWO

a)

- i. Sketch a DC Motor SCR drive system supplied from a 3-phase supply.
- ii. Draw the input output waveforms for the drive in a (i) above.

(8 Marks)

- b) A 500kW, 2000rpm separately excited DC Motor operating with a field weakening of 50% has use for propulsion. It has Armature resistance of $R_a = 0.04\Omega$, Back emf constant $K_b = 0.5$ and Torque Constant $K_m = 4.8$. The circuit for the system is as shown in **Fig Q2** below:

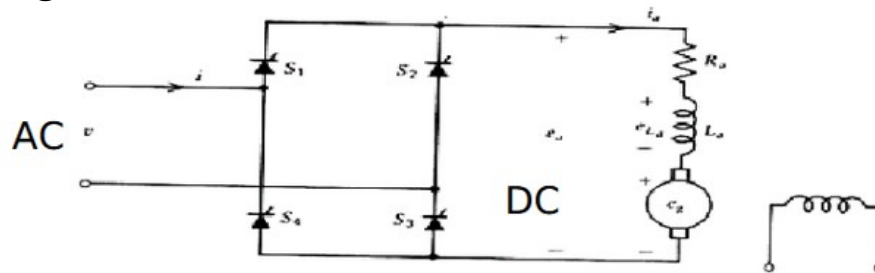


Fig Q2

Calculate the:

- i. Secondary Voltage
- ii. VA rating of transformer connected at supply end. Use the relationship:

$$\frac{VA}{P_{d0}} = 1.11, \text{ and } \frac{V_{ac}}{V_{d0}} = 1.11$$

- iii. Firing delay angle α when starting from stand still with a Torque of 6kN.

(12 Marks)

Question THREE

- a) State FOUR
- Advantages of Cyclo-converters
 - Disadvantages of Cyclo-converters
- (8 Marks)**
- b) A single-phase bridge-type Cyclo-converter has input voltage of 230V and 50Hz and load of $R = 10\Omega$. Output frequency is one-third of input frequency. For a firing angle delay of 30° , calculate:
- RMS value of output voltage
 - RMS current of each converter
 - RMS current of each Thyristor
 - Input power factor
- (12 Marks)**

Question FOUR

- a)
- Explain FOUR components of an electric Drive system in EV's.
 - State any TWO advantages of Electric Vehicles over mechanical.
- (6 Marks)**
- b) A 10 Pole, 1000rpm, 200W synchronous motor coupled to a Bicycle chain by a planetary gear makes the Bicycle electric. The bicycle and its driver weigh 100kg. The gear ratio 1:10 and the level ground speed of 25km/h. A three-phase converter feeds the motor from with batteries of 20V. Neglect the stator resistance and inductance. Determine the:
- magnetization expressed as flux vector at rated conditions
 - phase current at full torque
 - moment of inertia
 - time of acceleration
- (14 Marks)**

Question FIVE

- a)
- Sketch the block diagram of a Direct Torque Controller(DTC).
 - Explain the functions in the DTC diagram in a (i) above.
- (8 Marks)**

- b)
- i. Sketch circuit configuration for six-step-inverter switching topology.
 - ii. Draw a 7-state voltage vector table for b (i) above. Express all 3-phase voltages corresponding to ON switched devices as a factor of V_{dc} .

(12 Marks)