

**UNIVERSITY OF ESWATINI  
MAIN EXAMINATION, DECEMBER 2019**

**FACULTY OF SCIENCE AND ENGINEERING**

**DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING**

**TITLE OF PAPER:            ELECTRIC DRIVES**

**COURSE NUMBER:        EE553/ EEE554**

**TIME ALLOWED:         THREE HOURS**

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**INSTRUCTIONS:**

1. There are four questions in this paper. **Answer ALL questions.**
  2. Each question carries its own mark as shown in all questions.
  3. Marks for different sections are shown on the right-hand margin.
  4. Show the steps clearly in all your calculations including any assumptions made.
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**THIS PAPER HAS FOUR (5) PAGES INCLUDING THIS PAGE**

**QUESTION 1 (25 marks)**

(5-marks)

- a- A mechanical system shown in Fig.1 is described by:  $T_e - T_L = J \frac{d\omega}{dt} + B\omega$ , where  $J=0.01 \text{ Kg.m}^2$ ,  $B= 0.01 \text{ Nm/rad s}^{-1}$  and  $T_L=5 \text{ N.m}$ . Sketch the torque profile from the speed profile given below and show all your calculations for each time interval.

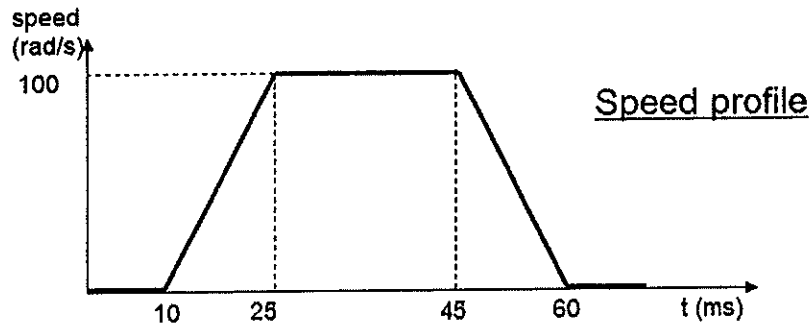


Fig. 1.

- b- In Fig. 2 the torque-speed characteristics of dc shunt motor with varying the armature voltage is given; explain with support of equations:

- 1- how the torque-speed characteristic is behaving as shown in Fig. 2? and (8-marks)
- 2- how the torque speed characteristic is affected by varying of the supply voltage? (2-marks)

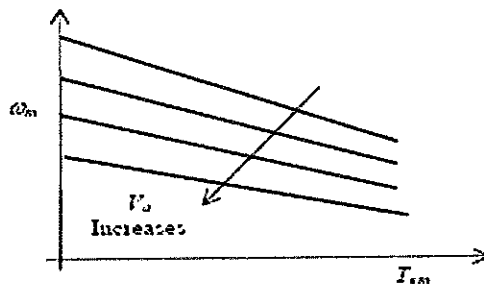


Fig. 2.

(10-marks)

- c- In the shunt dc motor shown in Fig. 3, is magnetically linear with negligible rotational losses and ohmic losses. The load torque ( $T_L$ ) has a constant value. If the motor is operating in steady-state when the switch (SW) is moved from position 1 to position 2.

- 1- predict the new motor current and
- 2- the new motor speed, both as a percentage of prior quantities.

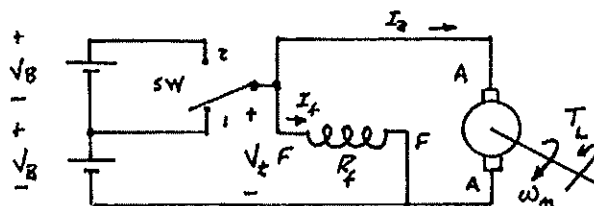


Fig. 3.

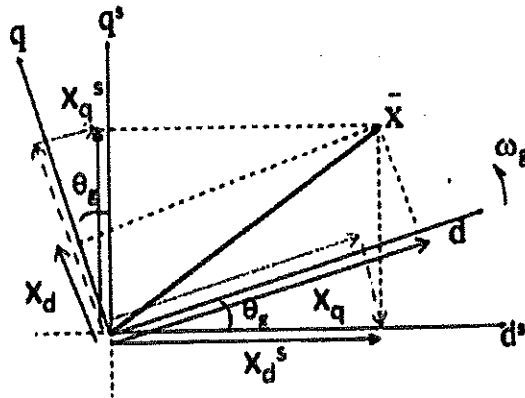
**QUESTION 4 (25 marks)**

(15-marks)

- a- Explain the indirect vector control method for induction motor drive system as follows: the idea, how it operates, and the positive and negative merits. Support your explanations by using block diagrams, equations and curves.

(10-marks)

- b- Use Fig. 8 to derive the equation to transform induction motor variables from  $d^s$ - $q^s$  stationary stator reference frame to the d-q rotating reference frame.



**Fig. 8 .  $d^s$ - $q^s$  and d-q axes .**

===== END OF QUESTION PAPER =====