



TECHNICAL UNIVERSITY OF MOMBASA

School of Engineering and Technology

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING

EEE 4417: ELECTRICAL MACHINES IV

END OF SEMESTER EXAMINATION

SERIES: APRIL 2025

TIME: 2 HOURS

DATE: April 2025

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of FIVE questions. Attempt Question 1, Compulsory and any other Two Questions.

Do not write on the question paper.

Question One {30 marks} Compulsory

- a) Using a well labeled diagram explain the principle of operation of a stepper motor
[6 MARKS]
- b) Explain the relevance of step angle in operation of electric machines and deduce its expression
[6 MARKS]
- c) Name and explain three applications of stepper motor
[6 MARKS]
- d) Deduce and explain three advantages and three disadvantages of variable reluctance stepper motor
[6 MARKS]

- e) Using well labeled diagram explain the principle of operation of a permanent magnet stepper motor [3 MARKS]
- f) A 3 phase VR stepper motor has the following parameters: winding resistance is 1ohm, average phase winding inductance is 30 mH and rated winding current is 3 amps. Design a simple unipolar drive circuit such that the electrical time constant is 2 mS at phase turn on and 2 mS at turn off. The stepping rate is 300 steps per second [3 MARKS]

Question TWO

- a) Explain the following characteristics of a stepper motor [10 MARKS]
- Dynamic characteristic
 - Static characteristic
- b) Using well labeled diagrams explain the phasor representation of a synchronous reluctance motor [10 MARKS]

Question THREE

- a) Using appropriate tables explain the three modes of operation of a stepper motor [9 MARKS]
- b) Using appropriate diagrams explain the torque speed characteristics of a DC servomotor [6 MARKS]
- c) Define Switched Reluctance Motor [5 MARKS]

Question FOUR

- a) A stepper motor has a step angle of 2.5° , determine [6 MARKS]
- resolution
 - Number of steps per shaft to make 25 revolution
 - Shaft speed if starting stepping frequency is 3600 pulse/sec.
- b) Write two distinguished points between Switched Reluctance and stepper motor. [4 MARKS]
- c) Explain the Vector control of BLPM SNW motor [10 MARKS]

Question FIVE

- A Explain the construction and principle of operation of a dc servo motor [8 MARKS]
- Write the instantaneous torque equation of switched reluctance motor. [6 MARKS]
- Derive the EMF equation of BLPM SQW DC motors. [6 MARKS]