



TECHNICAL UNIVERSITY OF MOMBASA
FACULTY OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

**UNIVERSITY EXAMINATION FOR:
HIGHER DIPLOMA IN ELECTRICAL AND ELECTRONIC
ENGINEERING**

EEP 3204: ELECTRICAL MACHINES I

**END OF SEMESTER EXAMINATION
SERIES: MAY 2016**

TIME: 2 HOURS

DATE:

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 any **THREE Questions**

Do not write on the question paper.

QUESTION ONE

- a. Explain the disadvantages of Star-Delta Starting of Induction motor (3 marks)
- b. Explain why power factor of a single phase induction motor is low. (2 marks)
- c. Give two applications of capacitor-start motors. (2 marks)
- d. Give three methods employed in making single phase induction motors self-starting. (3 marks)
- e. Explain three factors that affect the speed of a dc motor. (6 marks)
- f. A 500V shunt motor runs at its normal speed of 250 r.p.m when the armature current is 200A. The resistance of armature is 0.12Ω . Calculate the speed when a resistance is inserted in the field reducing the shunt field to 80% of normal value and armature current is 100A. (4 marks)

QUESTION TWO

- a. A 3- phase induction motor is wound for 4 poles and is supplied from 50Hz system. Calculate :
- (i) The synchronous speed.
 - (ii) The speed of the motor when slip is 4%.
 - (iii) Rotor current frequency when motor runs at 600 r.p.m. (6 marks)
- b. A 4 pole, 3-phase, 50Hz induction motor has a star connected rotor. The rotor has a resistance of 0.1Ω per phase and stand still reactance of 2Ω /phase. The induced emf between the slip rings is 100V. if the full-load speed is 1460 r.p.m, calculate:
- (i) The slip.
 - (ii) The emf induced in the rotor in each phase.
 - (iii) The rotor reactance per phase.
 - (iv) The rotor current.
 - (v) Rotor power factor. (8 marks)
- c. Explain how Torque-Slip Characteristics vary when adding resistance to rotor circuit? (2 marks)
- d. What is the condition for maximum torque in induction motor? (1 mark)
- e. State two advantage and one disadvantage of induction motors. (3 marks)

QUESTION THREE

- (i) Describe the Swinburne's test and state its two advantages. (5 marks)
- (ii) State the applications of Ward Leonard system. (2 marks)
- (iii) With the aid of a diagram describe the dynamic braking of DC motors. (4 marks)
- (iv) A 50Hz, 4 pole, 3-phase induction motor has a rotor current of frequency 2Hz. Determine:
 - a. Slip.
 - b. Speed of motor. (4 marks)
- (v) A 4-pole, 250W, 115V, 60Hz capacitor start induction motor takes a full-load line current of 5.3 A while running at 1760 r.p.m. If the full-load efficiency of the motor is 64%, find:
 - a. Motor slip.
 - b. Power factor.
 - c. Full load torque. (5 marks)

QUESTION FOUR

- (i) Describe the torque- slip characteristics of a three phase induction motor. (5 marks)
- (ii) Describe how speed control of a three phase induction motor by changing the applied voltage can be achieved and state any TWO limitations of this method. (5 marks)
- (iii) A dc motor takes an armature current of 110A at 480V. The armature circuit resistance is 0.2Ω . The machine has 6 poles and the armature is lap connected with 864 conductors. The flux per pole is 0.05wb. calculate:
(a) The speed.
(b) The gross torque developed by the armature. (4 marks)
- (iv) A 500V, 37.3 kW, 1000 rpm dc shunt motor has on full load an efficiency of 90%. The armature circuit resistance is 0.24Ω and there is total voltage drop of 2v at the brushes. The field current is 1.8A. determine:
(a) Full load current.
(b) Full load shaft torque in N-m.
(c) Total resistance in motor starter to limit the starting current to 1.5 times the full load. (6 marks)

QUESTION FIVE

- (i) Explain the principle on which electric motor works. (4 marks)
- (ii) Explain how the speed of a dc motor can be regulated using the rheostatic control method. (4 marks)
- (iii) A 3-phase synchronous motor has 12 poles and operates from 440V, 50Hz supply. Calculate its speed. If it takes a line current of 100A at 0.8 power factor leading, what torque the motor will be developing? Neglect losses. (4 marks)
- (iv) A 75 Kw, 3-phase Y connected, 50Hz, 440V cylindrical rotor synchronous motor operates at rated condition with 0.8pf leading. The motor efficiency excluding field and stator losses is 95% and $X_s = 2.5\Omega$. calculate:
a. Mechanical power developed.
b. Armature current.
c. Back emf.
d. Power angle.
e. Maximum torque of motor. (8 marks)