



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY
ELECTRICAL AND ELECTRONICS ENGINEERING DEPARTMENT

UNIVERSITY EXAMINATION FOR:

HIGHER DIPLOMA IN ELECTRICAL POWER ENGINEERING

EEP 3203: SPECIAL MACHINES & DRIVES

END OF SEMESTER EXAMINATION

SERIES: OCTOBER 2016

TIME: 2HOURS

DATE: OCTOBER 2016

Instructions to Candidates

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1. You should have the following for this examination

Answer Booklet

Examination pass

Student ID

Electronic calculator

2. This paper consists of FIVE Questions.

3. Attempt ANY THREE questions.

4. All questions carry equal marks.

5. This paper consists of THREE printed pages.

Do not write on the question paper.

Question ONE

(a) Describe the Swinburne's test and state its two advantages. **(5 marks)**

(b) State the applications of Ward Leonard system. **(2 marks)**

(c) With the aid of a diagram describe the dynamic braking of DC motors. **(4 marks)**

(d) A 50 Hz, 6 pole, 3 phase induction motor has a rotor current of frequency 2Hz. Determine:

(i) Slip.

(ii) Speed of motor. **(4 marks)**

(e) A 6 pole, 240W, 120V, 60Hz capacitor start induction motor takes a full load line current of 2.5A while running at 1840 r.p.m. If the full load efficiency of the motor is 64%, find:

(i) Motor slip.

- (ii) Power factor.
- (iii) Full load torque.

(5 marks)

Question TWO

- (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 TWO limitations of this method. **(5 marks)**
- (iii) A dc motor takes an armature current of 220A at 240V. The armature circuit resistance is 0.2Ω . The machine has 4 poles and the armature is lap connected with 468 conductors. The flux per pole is 0.4wb. Calculate:
 - a. The speed.
 - b. The gross torque developed by the armature. **(4 marks)**
 - c. A 250v, 50kW, 1200rpm dc shunt motor is on full load and efficiency of 75%. The armature circuit resistance is 0.34Ω and there is total voltage drop of 3v at the brushes. The field current is 1.8A. Determine:
 - i. Full load current.
 - ii. Full load shaft torque.
 - iii. Total resistance in motor starter to limit the starting current to 1.5 times the full load. **(6 marks)**

Question THREE

- a. Explain the principle on which electric motor works. **(4 marks)**
- b. Explain how the speed of a dc motor can be regulated using the rheostatic control method **(4 marks)**
- c. A 85 kw three phase Y connected, 60Hz, 330V cylindrical rotor synchronous motor operates at rated condition with 0.7pf leading. The motor efficiency excluding field and stator losses is 85% and $X_s = 3.5\Omega$. Calculate:
 - (i) Mechanical power developed.
 - (ii) Armature current.
 - (iii) Back emf.
 - (iv) Power angle.
 - (v) Maximum torque of motor. **(9marks)**
- d. Explain the disadvantages of star-delta starting of induction motor. **(3 marks)**

Question FOUR

- (a) Draw the equivalent circuit diagram of the following:
 - (i) Three phase induction motor.

- (ii) Single phase induction motor. **(5 marks)**
- (b) Draw the following:
- (i) Torque speed characteristics of a three phase squirrel cage induction motor.
- (ii) Torque speed characteristics of wound rotor induction motor with additional rotor resistances.
- (iii) Torque speed characteristics of a single phase induction motor. **(9 marks)**
- (c) With the aid of well labeled diagram explain how a synchronous motor can be synchronized using lamps in sequence method. **(6 marks)**

Question FIVE

- (a) Explain the following 3 phase connections and account for their applications.
- i. Delta star.
- ii. Star delta.
- iii. Delta delta. **(6 marks)**
- (b) (i) Explain the term synchronous condenser. **(1 mark)**
- (iii) Explain why consumers of electrical energy are encouraged to improve their load power factors. **(4 marks)**
- (c) State THREE conditions to be met before a synchronous machine can be synchronized with infinite bus bars. **(3 marks)**
- (d) Explain the function of damper winding in a three phase synchronous motor. **(2 marks)**
- (e) Compare any TWO operational characteristics of synchronous motors and induction motors. **(4 marks)**