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. State the three major classifications of dc motors.   **(3 marks)**
   b. Explain the significance of back emf in dc machines.   **(7 marks)**
   c. A dc motor takes an armature current of 110A at 480V. The armature circuit resistance is 0.2, the machine is a lap connected armature with 6 poles having 864 conductors and the flux per pole is 0.05wb. calculate
      i. The speed of the machine.
      ii. The gross torque developed by the armature.   **(4 marks)**
   d. With the aid of a labeled diagram explain star-delta starting method of a 3 phase induction motor.   **(6 marks)**

Question TWO

a. Explain any TWO advantages and TWO disadvantages of using induction motor in industrial applications. **(4 marks)**

b. Draw the exact equivalent circuit of an induction motor, label all the parts of this circuit. **(2 marks)**

c. A 415, 3 phase, 4 pole 50 Hz star connected induction motor was used in a mining site rated at 3.73kw. the exact equivalent circuit parameters were $R_1 = 0.45\Omega$, $X_1 = 0.8\Omega$ $R_2 = 0.4\Omega$ $X_2 = 0.8\Omega$ $X_0 = j30$. The stator core loss is 50w and rotational loss is 150w for a slip of 0.04 find:

    (i) Power factor of the machine.
    (ii) Air gap power developed by the motor.
    (iii) The mechanical power developed by the motor.
    (iv) The gross torque of the motor. **(8 marks)**

Question THREE

a. State any TWO types of repulsion type single phase motors. **(1 mark)**

b. With the aid of circuit diagrams differentiate between a resistor start and an inductor start single phase motors. **(3 marks)**

c. With the aid of a well labeled diagram, explain the Hopkinson's test for dc motors. **(2 marks)**

d. A 250v dc shunt machine has an armature resistance including inter-pole of 0.5 and shunt field resistance of 125Ω both values at working temperatures. When it is running light as a motor, the current taken from the supply is 5A. Calculate the efficiency of the machine:

    (i) When taking a current of 52A from the supply as a motor.
    (ii) When delivering a current of 35A as a generator. **(5 marks)**

e. State any TWO types of rotors used in induction motor. **(1 mark)**

f. A 240 kw three phase Y connected, 60Hz, 440V 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. **(8marks)**

Question FOUR

a. Explain why single phase motor is not self-starting. **(3 marks)**
b. Explain the operation of the shaded pole motor. **(5 marks)**
c. With the aid of a circuit diagram explain the operation of the shaded pole single phase induction motor. **(6 marks)**
d. A three phase induction motor is wound for 10 poles and is supplied from 50Hz system. Calculate:
   (i) The synchronous speed.
   (ii) The speed of the motor when slip is 6%.
   (iii) Rotor current frequency when motor runs at 600 r.p.m. **(6 marks)**

Question FIVE

a. 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)**
b. (i) State THREE types of starters for induction motors.
c. State the merit of each of the starters in (i) above. **(6 marks)**

d. Draw the equivalent circuit diagram of the following:
   (i)Three phase induction motor.
   (ii) Single phase induction motor. **(5 marks)**