MACHAKOS UNIVERSITY COLLEGE

(A Constituent College of Kenyatta University)
University Examinations for 2015/2016 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

SECOND SEMESTER EXAMINATION FOR DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING

EED 214: MACHINES II

DATE: 4/8/2016 **TIME: 8:30 – 10:30 AM**

INSTRUCTIONS TO CANDIDATES:

Answer Question One and Any Other Two Questions In Section B

SECTION A - COMPULSORY QUESTION

1. a) i) With the aid of a diagram describe the construction of a squirrel - cage rotor of a three-phase induction motor. (7 marks)

   ii) State any three advantages of slip –ring induction motors over squirrel cage induction motors. (3 marks)

   b) Explain the following terms with regard to squirrel cage induction motors

      i) Crawling

      ii) Cogging (6 marks)

   c) A 4- Pole, 3-phase induction motor operates from a supply whose frequency is 50Hz .Calculate

      i) The speed at which the magnetic field of the stator is rotating

      ii) The speed of the rotor when the slip is 0.04.

iii) The frequency of the rotor currents when the slip is 0.03

iv) The frequency of the rotor currents at standstill. (4 marks)

d) Explain with the aid of a diagram the method of self - synchronizing a synchronous motor coupled to an induction pony motor. (10 marks)

SECTION B. ATTEMPT ANY TWO QUESTIONS

2. a) Define the following terms with regard to synchronous motors

(i) Load angle

(ii) Pull-out torque. (4 marks)

b) (i) State three conditions to be satisfied before a synchronous machine can be connected with an incoming three phase power supply. (3 marks)

(ii) With the aid of a diagram explain the lamps in- sequence method of synchronizing a synchronous machine with a three-phase voltage supply.

(6 marks)

c) A factory with three-phase load of 840 KVA at a power factor of 0.65 lagging, has an additional load of 380 hp that is met by installation of a synchronous motor operating at an efficiency of 87% and also used to improve the power factor of the factory to 0.90 lagging.

Calculate the leading power factor that the synchronous motor must be operated at

(7 marks)

3. a) Define the following terms ;

(i) Synchronous speed

(ii) Slip (4 marks)

b) With the aid of wave form and phasor diagrams explain the production of a rotating magnetic field in a three-phase induction motor. (10 marks)

c) A three phase-, 415V, 50Hz ,6-pole star-connected induction motor has a full load slip of 4%. The motor resistance and stand still reactance are 0.12Ω and 0.85Ω per phase. The ratio of stator to rotor turns is 1.8.

Calculate the following ;

(i) The full load torque

(ii) The maximum torque

(iii) The speed at maximum torque (6 marks)

4. (a) Describe the principles of operation of a three phase synchronous motor.

(6 marks)

b) (i) State three advantages of a stationary armature in a three - phase synchronous motor. (3 marks)

(ii) Show with a power and control circuit diagram the direct-on line starter for a three-phase induction motor. (4 marks)

c) A three-phase 6.6KV synchronous motor runs at a constant voltage and constant excitation. Its synchronous reactance is 20Ω per phase and armature resistance is negligible when the input power is 1000KW with a power factor of 0.8 leading. When the input power in increased to 1500KW, calculate

(i) The load angle

(ii) The power factor (7 marks)

5. a) Describe with a diagram the principle of operation of a three- phase induction Motor. (6 marks)

b) Explain with the aid of a torque-speed characteristics and circuit diagram the rotor resistance starter method for starting a three-phase wound- rotor induction motor. (8 marks)

c) A three –phase 50 Hz, 8-pole induction motor runs at a speed of 710rpm with an input power of 35 KW. The stator losses are 1200 W while the rotational losses are 600W. Calculate the following ;

i) Rotor copper loss

ii) The gross torque developed

iii) The gross mechanical power developed

iv) The net torque. (6 marks)