MACHAKOS UNIVERSITY

University Examination 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

SECOND YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONICS ENGINEERING)

EMM 214: ELECTRICAL ENGINEERING II

DATE: 21/5/2019 **TIME: 8.30-10.30 AM**

INSTRUCTIONS

Answer Question ONE and any other TWO Questions.

QUESTION ONE (30 MARKS)

a) Explain the following rules stating when and where they apply (9 marks)

i. Fleming's right hand rule

ii. Fleming's left hand rule

iii. Right hand screw rule

b) Explain 3 advantages of AC motors over DC motors (6 marks)

c) A 20 kW compound generator works on full load with a terminal voltage of 250 V. The armature, series and shunt windings have resistances of 0.05Ω, 0.025Ω and 100 Ω respectively. Calculate the total EMF generated in the armature when the machine is connected as short shunt. (8 marks)

d) Using illustrations, explain the difference between lap winding and wave winding (5 marks)

e) Define the following terms as used in a machine (2 marks)

i. Stator

ii. Rotor

QUESTION TWO (20 MARKS)

a) A 220V DC shunt motor draws 10A at 1800rpm. The armature resistance is 0.2Ω and field winding resistance is 440Ω. Determine (16 marks)

i. the torque

ii. the speed and line current at a torque of 20 N-m (if field current is constant)

b) Explain the difference between motor action and generator action (4 marks)

QUESTION THREE (20 MARKS)

a) Derive the torque equation for a shunt DC motor (8 marks)

b) The primary winding of transformer is rated at 115 V and the secondary winding is rated at 300 V. The primary winding has 500 turns. If transformer has a full load secondary output of 300 VA at 300 V. Calculate; (12 marks)

i. The full-load secondary current

ii. The full-load primary current (neglect all losses)

iii. The relationship between the primary current and the secondary current

iv. The number of turns on the secondary winding.

QUESTION FOUR (20 MARKS)

a) A 480-V, 60 Hz, 50-hp, three phase induction motor is drawing 60A at 0.85 PF lagging. The stator copper losses are 2 kW, and the rotor copper losses are 700 W. The friction and windage losses are 600 W, the core losses are 1800 W, and the stray losses are negligible. Find the following quantities:
(12 marks)

i. The air-gap power $P_{AG.}$

ii. The power converted P_{conv}.

iii. The output power P_{out}.

iv. The efficiency of the motor.

b) Explain four losses in a transformer (8 marks)

QUESTION FIVE (20 MARKS)

A 460-V, 25-hp, 60 Hz, four-pole, Y-connected induction motor has the following impedances in ohms per phase referred to the stator circuit:

$R_1 = 0.641\Omega$, $R_2 = 0.332\Omega$, $X_1 = 1.106\ \Omega$ $X_2 = 0.464\ \Omega$ $X_M = 26.3\ \Omega$.

The total rotational losses are 1100 W and are assumed to be constant. The core loss is lumped in with the rotational losses. For a rotor slip of 2.2 percent at the rated voltage and rated frequency, find the motor's

a) Speed

b) Stator current

c) Power factor

d) P_{conv} and P_{out}

e) τ_{ind} and τ_{load}

f) Efficiency