Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Department of Science and Technology
300 Level 2nd Semester Examination – December 2017/ January 2018
SCT 373-2 Electric Power and Machine

Uva Wellassa University

Instructions to candidates

Duration: Two (02) hours

Number of Questions : Four (04) Essay questions

Mark Allocation : 100 marks

Scientific calculators are allowed.

Answer **all** questions.

1.

a. What are salient pole and nonsalient pole construction of a synchronous machine rotor?

(3 marks)

b. What are the methods of supplying dc power to the rotor?

(5 marks)

c. Draw a schematic diagram of a brushless exciter circuit and briefly explain its operation.

(7 marks)

d. Draw phasor diagrams of a synchronous generator at lagging and leading power factor.

(5 marks)

e. Draw the power flow diagram of a synchronous generator and indicate losses.

(5 marks)

2.

a. List and describe the types of losses that occur in a transformer.

(5 marks)

b. Draw the equivalent circuit model of a transformer and explain how major power losses are modeled in the equivalent circuit.

(5 marks)

c. A 1000-VA 230/115-V transformer has been tested to determine its equivalent circuit. The results of the tests are shown below.

Open-circuit test	Short-circuit test
Voc = 230 V	Vsc = 19.1 V
Ioc = 0.45 A	Isc = 8.7 A
Poc = 30W	Psc = 42.3 W

All data given were taken from the primary side of the transformer.

i. Find the equivalent circuit of this transformer referred to the low-voltage side of the transformer.
ii. Find the transformer's voltage regulation at rated conditions and
(1) 0.8 PF lagging
(2) 1.0 PF
(3) 0.8 PF leading.
iii. Determine the transformer's efficiency at rated conditions and 0.8 PF lagging.

(15 marks)

3.

a. Explain slip and slip speed in an induction motor?

(3 marks)

b. Briefly, describe how does an induction motor develop torque?

(3 marks)

c. Briefly, describe why an Induction motor sometimes called rotating transformer?

(2 marks)

d. State the basic difference between a synchronous motor and an Induction Motor?

(5 marks)

e. A 208-V, IO-hp, four-pole, 60Hz, Y-connected induction motor has a full-load slip of 5 percent.

i. What is the synchronous speed of this motor?
ii. What is the rotor speed of this motor at the rated load?
iii. What is the rotor frequency of this motor at the rated load?
iv. What is the shaft torque of this motor at the rated load?

(12 marks)

4.

a. Explain how an Induction Motor is started? Why is the starter Used?

(7 marks)

b. Draw the power flow diagram, indicating how the power flows through an induction motor.

(2 marks)

c. A 120-V, 1/3-hp 60-Hz, four-pole, split-phase induction motor has the following impedances:

$R_1 = 1.80\ \Omega$ $X_1 = 2.40\ \Omega$ $X_M = 60\ \Omega$

$R_2 = 2.50\ \Omega$ $X_2 = 2.40\ \Omega$

At a slip of 0.05, the motor's rotational losses are 51 W. The rotational losses may be assumed constant over the normal operating range of the motor. If the slip is 0.05, find the following quantities for this motor:

i. Input power
ii. Air-gap power
iii. Pconv
iv. Pout
v. τ ind
vi. τload
vii. Overall motor efficiency
viii. Stator power factor

(16 marks)