UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION
SEPTEMBER 2016 SEMESTER

COURSE CODE	:	LEB 30303
COURSE NAME	:	ELECTRO-TECHNIQUE 2
PROGRAMME NAME	:	BACHELOR OF ELECTRICAL & ELECTRONICS
DATE	:	18 JANUARY 2017
TIME	:	09.00 AM – 12.00 PM
DURATION	:	3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please CAREFULLY read the instructions given in the question paper.
2. This question paper has information printed on both sides of the paper.
3. This question paper consists of TWO (2) sections; Section 'A' and Section 'B'. Answer ALL questions in Section 'A' and THREE (3) questions only from Section 'B'.
4. Please write your answers on the answer booklet provided.
5. Answer all questions in English language.

THERE ARE 5 PAGES OF QUESTIONS, INCLUDING THIS PAGE.

Section A (Total: 40 marks)

INSTRUCTION: Answer ALL Questions
Please use the answer booklet provided

Question 1 [CLO,1]

a) A transformer is a device that changes ac electric energy at one voltage level to ac electric energy at another voltage level through the action of a magnetic field. Brief describe the most important tasks performed by transformers in electric power systems. [3 marks]

b) One of the transformer windings is connected to a source of ac electric power which is called primary winding and the second transformer winding supplies electric power to loads – is called secondary winding. If a 400kVA transformer has a primary windings resistance of 0.5 Ω, and a secondary winding resistance of 0.001Ω while the iron loss is 2.5kW, power factor of the load is 0.85. and the primary and secondary voltages are 5kV and 320kV respectively, determine the efficiency of the transformer

i) on full load [8 marks]

ii) on half load [6 marks]

c) The open circuit voltage of a transformer is 240V. A tap changing device is set to operate when the percentage regulation drops below 25%. Determine the load voltage at which the mechanism operates.

[3 marks]

Question 2 [CLO 1,2]

a) In power system analysis, it is common practice to use per-unit quantities for analyzing and communicating voltage, current, power, and impedance values. These per-unit quantities are normalized or scaled on a selected base, allowing engineers to simplify power system calculations with multiple voltage transformations. Define per-unit system definition and state two (2) major advantages in using a per unit system.

[4 marks]

b) A quantity is expressed in per-unit if it has been divided by a chosen base quantity having the same physical dimension. Suppose that for 10KVA, 2400/240V transformer,

we choose:

$$P_{base} = 10KW,\ V_{1base} = 2400V,\ V_{2base} = 240V$$

This transformer has the following test data:

Open circuit test: 240V, 0.8A, 80W
Short circuit test: 80V, 5.1A, 220W

Convert all test data into per-unit values and fine the series equivalent resistance in perunit system.

[10 marks]

c) Briefly explain how does a transformer work. [6 marks]

Section B (Total: 60 marks)

INSTRUCTION : Answer THREE (3) questions only
Please use the answer booklet provided

Question 3 [CLO 3]

a) Three-phase induction motors are the most common and frequently encountered machines in industry. Sketch and label the power flow in Induction Motor and briefly explain the two (2) tests used to determine the values of the motor parameters.

[5 marks]

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

$R_1 = 0.641\Omega$ $R_2 = 0.332\Omega$

$X_1 = 1.106\ \Omega$ $X_2 = 0.464\ \Omega$ $X_M = 26.3\ \Omega$

i) Determine the maximum torque of this motor. At what speed and slip does it occur? [6 marks]

ii) Determine the starting torque of this motor. [4 marks]

iii) If the rotor resistance is doubled, find the speed at which the maximum torque now occur. [3 marks]

iv) Calculate the new starting torque of the motor. [2 marks]

Question 4 [CLO 1,2]

a) Due to the similarity between the induction motor equivalent circuit and the transformer equivalent circuit, same tests are used to determine the values of the motor parameters. Describe clearly the DC test, No load test and Locked rotor test. [9 marks]

b) Explain clearly step up and step down transformers and the different between transformer and induction motor (IM). [5 marks]

c) An ideal 25kVA transformer has 500 turns on the primary winding and 40 turns on the secondary winding. The primary is connected to 3000V, 50Hz supply. Calculate:

i) Primary and secondary currents on full load

ii) Secondary e.m.f [6 marks]

iii) The maximum core flux

Question 5 [CLO 1,4]

a) Synchronous motors are usually used in large sizes because in small sizes they are costlier as compared with induction machines. Discuss the three principal advantages of using synchronous machine and three (3) major advantages to operate generators in parallel.

[6 marks]

b) A 200 kVA, 480-V, 60-Hz, 4-pole, Y-Connected synchronous generator with a rated field current of 5 A was tested and the following data was taken.

from OC test – terminal voltage = 540 V at rated field current

from SC test – line current = 300A at rated field current

from DC test – DC voltage of 15 V applied to two terminals, a current of 25 A was measured.

i. Determine the speed of rotation in r/min. [4 marks]

ii. Calculate the generated emf and saturated equivalent circuit parameters (armature resistance and synchronous reactance Z_s, X_s). [10 marks]

Question 6 [CLO 2]

a) The peak flux density of the rotor magnetic field in a simple 2-pole 3-phase generator is 0.2 T; the mechanical speed of rotation is 3600 rpm; the stator diameter is 0.5 m; the length of its coil is 0.3 m and each coil consists of 15 turns of wire. The machine is Y-connected.

i. Evaluate the 3-phase voltages of the generator as a function of time.

ii. Determine the rms phase voltage of the generator.

iii. Calculate the rms terminal voltage of the generator.

The flux in this machine is given by **0.03Wb** and the rotor speed is ω = **277 rad/s**

[9 marks]

b) Give three (3) advantages of having a rotating magnetic field alternator. [3 marks]

c) State the device that produces an electric current by rotating a coil of wire in a magnetic field. [1 marks]

d) Explain clearly how to produce a rotating magnetic field in a 3 phase induction motor? [7 marks]

END OF QUESTIONS