

UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION
JANUARY 2016 SESSION

SUBJECT CODE : LEB 30303
SUBJECT TITLE : ELECTRO-TECHNIQUE 2
LEVEL : BACHELOR
TIME / DURATION : 2.00 PM – 5.00 PM / 3 HOURS
DATE : 24 May 2016

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
 2. This question paper is printed on both sides of the paper.
 3. Please write your answers on the answer booklet provided.
 4. Answer should be written in blue or black ink except for sketching, graphic and illustration.
 5. 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'.
 6. Answer all questions in English.
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THERE ARE 5 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

Section A (Total: 40 marks)**INSTRUCTION: Answer ALL Questions****Please use the answer booklet provided****Question 1 [CLO 1,2]**

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. [5 marks]

b) i) Explain and draw a basic principle of transformer and write an e.m.f Equation of a Transformer formulas. [3 marks]

ii) A single-phase 500V/100V, 50Hz transformer has a maximum core flux density of 1.5T and an effective core cross-sectional area of 50cm². Determine the number of primary and secondary turns. [4 marks]

iii) State two advantages in using a per unit system. A quantity is expressed in per unit if it has been divided by a chosen base quantity . Suppose that for a 10kVA, 2400V/ 240V transformer we choose

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

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 find the series equivalent resistance in per unit system.

[8 marks]

Question 2 [CLO 3,4]

a) Three-phase induction motors are the most common and frequently encountered machines in industry. Sketch and label the power flow of Induction Motor and state the tests are used to determine the values of the motor parameters as in Figure 1.

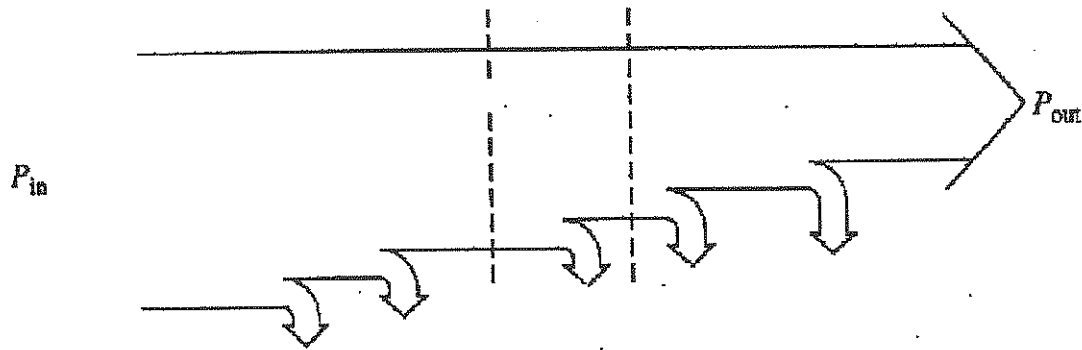


Figure 1

[6 marks]

b) Brief the three-phase induction motors which is the most common and frequently encountered machines in industry.

[4 marks]

c) A 500-V, 50 Hz, 50-hp, three phase induction motor is drawing 85A at 0.95 PF lagging. The stator copper losses are 1.5 kW, and the rotor copper losses are 400 W. The friction and windage losses are 380 W and 200W respectively, the core losses are 1500 W, and the stray losses are negligible. Find the following quantities:

- 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.

[10 marks]

Section B (Total: 60 marks)

INSTRUCTION : Answer THREE (3) questions only

Please use the answer booklet provided

Question 3 [CLO 1, 3]

- a) Synchronous motors are usually used in large sizes because in small sizes they are costlier as compared with induction machines. State the three principal advantages of using synchronous machine and three major advantages to operate generators in parallel. [6 marks]
- b) A 2300V 1000kVA 0.8PF lagging 60Hz two-pole Y connected synchronous generator has a synchronous reactance of 1.1ohm and armature resistance of 0.15ohm. At 60Hz, its friction and windage losses are 24kW, and its core losses are 18kW. The field circuit has a dc voltage of 200ohm. The OCC of this generator is shown in the Figure 2.
- How much field current is required to make V_T equal to 2300V when the generator is running at no load? [2 marks]
 - What is the internal generated voltage of this machine at rated conditions? [4 marks]
 - How much field current is required to make V_T equal to 2300V when the generator is running at rated conditions? [2 marks]
 - How much power and torque must the generator's prime mover be capable of supplying? [6 marks]

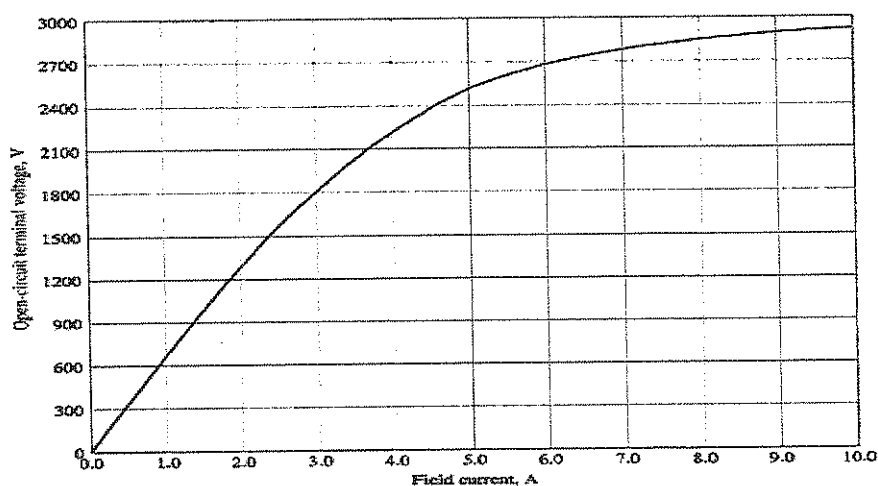


Figure 2

Question 4 [CLO 1, 2]

- a) 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:
- Primary and secondary currents on full load
 - Secondary e.m.f
 - The maximum core flux [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 10 V applied to two terminals, a current of 25 A was measured.
- Determine the speed of rotation in r/min. [6 marks]
 - Calculate the generated emf and saturated equivalent circuit parameters (armature resistance and synchronous reactance). [8 marks]

Question 5 [CLO 2,3]

- 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.
- What are the 3-phase voltages of the generator as a function of time?
 - Determine the rms phase voltage of the generator.
 - Calculate the rms terminal voltage of the generator. [7 marks]
- The flux in this machine is given by 0.03Wb and the rotor speed is $\omega = 377$ rad/s
- State the advantages of having a rotating magnetic field alternator. [4 marks]
 - State the device that produces an electric current by rotating a coil of wire in a magnetic field. [2 marks]
 - what is a coil of a wire that when carrying an electric current produces a magnetic field. [2 marks]
 - Explain clearly how to produce a rotating magnetic field in a 3 phase induction motor? [5 marks]

Question 6 [CLO 2, 3]

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 three test of the process. [9 marks]

b) Synchronous generator is also known as alternator. This machine consists of two main parts which are rotor winding and stator winding. State the different between two of them. A three phase Y- connected synchronous generator is rated 120KVA, 1.5kV, 50Hz, 0.75pf lagging. Its synchronous inductance is 2.0mH and effective resistance is 2.5 ohm.

i) Draw a circuit diagram to represent a supply voltage and load. [2 marks]

ii) Determine the voltage regulation at this frequency. [2 marks]

iii) Evaluate the rate voltage and apparent power if the supply frequency is going to be twice.

[4 marks]

iv) Calculate the voltage regulation if the frequency is increased to 100% of the original frequency.

[3 marks]

END OF QUESTIONS

