FNU FIJI NATIONAL UNIVERSITY

School of Electrical and Electronics Engineering
Trade Diploma in Electrical Engineering

EEE533 Electrical Machines 2

FINAL EXAMINATION

Date: as per t/t   Time: as per t/t

Venue: as per t/t

Instructions

1. You are allowed 10 minutes extra reading time during which you are **NOT** to write.

2. Begin each answer on a fresh page and used both sides of the sheet.

3. Write your candidate number at the top of each attached sheet.

4. Insert all written fullscaps, graph paper, drawing paper etc in their correct sequence and secure with string.

5. For all sheets of paper on which rough/draft work has been done, cross it through and you must attach all of them to your answer scripts.

6. Write clearly the number(s) of the question(s) attempted on the top of each sheet.

7. **Answer All Questions**

Question 1 [25 marks]

1. A 415V, 25hp, 50Hz, 4 pole, Y-connected induction motor has the following impedances in ohms per phase referred to the stator circuit:

$R1 = 0.6\ \Omega$ $R2 = 0.2\Omega$

$X1 = 1.2\Omega$ $X2 = 0.4\ \Omega$ $Xm = 30\Omega$
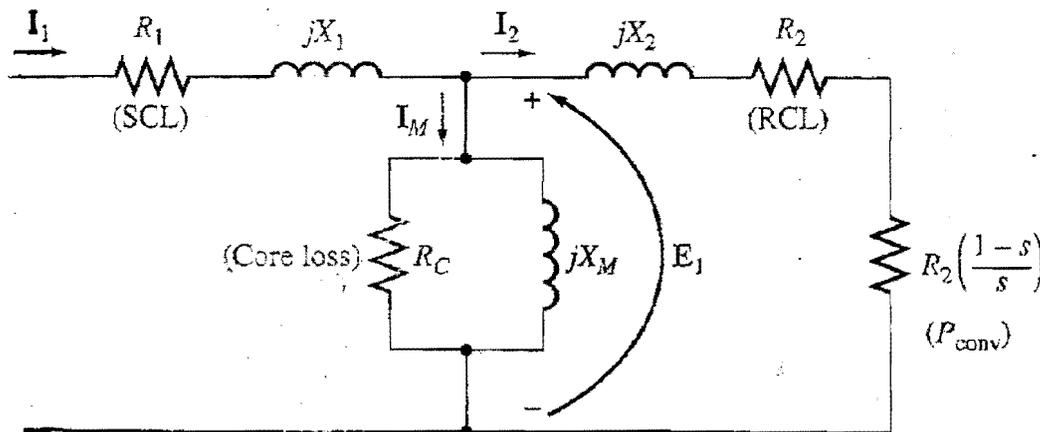
The total rotational losses are 900W and are assumed to be constant. The core loss is lumped in with the rotational losses. For a rotor slip of 3% at the rated voltage and rated frequency, find the motor's

a) speed (2 marks)
b) total impedance (9 marks)
c) stator current (2 marks)
d) power factor (1 marks)
e) excitation branch impedance (2 marks)
f) rotor branch impedance (2 marks)
g) rotor current (1 marks)
h) Pconv and Pout (2 marks)
i) τind and τload (2 marks)
j) efficiency (2 marks)

Question 2 [10 marks]

1. A series motor runs at 650 rpm when taking 120A from a 240v supply. The resistance of the armature circuit is 0.1 ohms and that of the series winding is 0.02 ohms. The useful flux per pole for 120A is 0.024 Wb and that for 45 A is 0.016 Wb. Calculate the speed when the current has fallen to 45A. (7 marks)

2. Draw schematic diagram for: dc shunt generator, series generator and compound generator. Label all the parts. (3 marks)

Question 3 [10 marks]

1. Calculate Ip and E (2 + 2 marks)
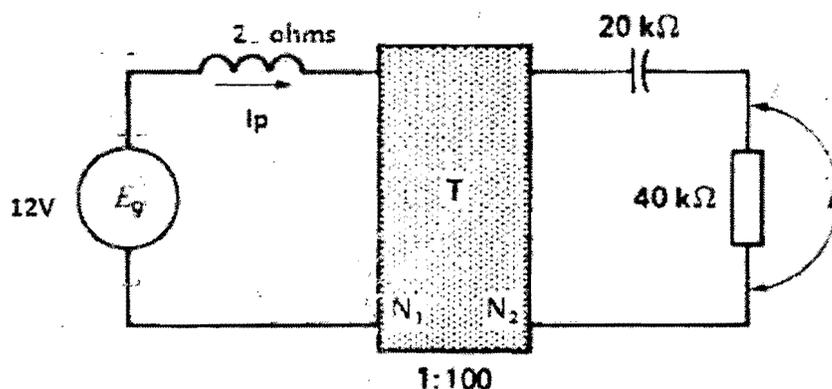
2. What is mutual flux as in transformers. (1 marks)

3. Why do transformers have laminations (1 mk)

4. Name three quantities a transformer can transform (3 marks)

5. What is the function of transformer oil? (1 mark)

Question 4 [30 marks]

1. Explain in six steps why induction motor can never run at synchronous speed (6 marks)

2. A 250V, 20kW, 4 pole, 50Hz, Y-connected induction motor has a full-load slip of 5%.

    a. What is the synchronous speed of this motor? (1 mark)
    b. What is the rotor speed of this motor at the rated load? (1 mark)
    c. What is the rotor frequency of this motor at the rated load? (1 mark)
    d. What is the shaft torque of this motor at the rated load? (1 mark)

3. A 480V, 60Hz, 50hp, 3 phase induction motor is drawing 60A at 0.85 PF lagging. The stator copper losses are 2kW, and the rotor copper losses are 700W. The friction and windage losses are 600W, the core losses are 1800W, and the stray losses are negligible. Find:

    a. The air gap power P_{AG} (2 marks)
    b. The power converted P_{conv} (2 marks)
    c. The output power P_{out} (2 marks)
    d. The efficiency of the motor (2 marks)

4. Name two types of rotors in induction motors (2 marks)

5. List 5 characteristics of NEMA class A motors (5 marks)

6. List 5 characteristics of NEMA class D motors (5 marks)

Question 5 [25 marks]

1. Draw the schematic diagram of a split phase – single phase motor (5 marks)

2. Draw the schematic diagram of a capacitor start – single phase motor (5 marks)

3. Give 5 characteristics of shaded pole motor (5 marks)

4. What are four reasons for paralleling AC generators (4 marks)

5. What four conditions must be satisfied before Synchronous generators are paralleled. (4 marks)

6. Name two types of stepper motors. (2 marks)

THE END