FNU FIJI NATIONAL UNIVERSITY

COLLEGE OF ENGINEERING, SCIENCE & TECHNOLOGY (CEST)

SCHOOL OF ELECTRICAL & ELECTRONICS ENGINEERING

CERTIFICATE IV IN ELECTRICAL ENGINEERING-STAGE 4

EEE447 ELECTRICAL MACHINES

FINAL EXAMINATION PENSTER 2, 2016

DATE/DAY: TBA **TIME**: TBA

ROOM: AS PER TIMETABLE **DURATION:** 2HRS, 10MINS

INSTRUCTIONS TO STUDENTS

1. You are allowed **10 minutes** extra **reading time** during which you are **NOT** to write.
2. Begin each SECTION on a fresh page and use both sides of the sheet.
3. Write your candidate number at the top of each attached sheet.
4. Insert all written foolscaps, graph paper, drawing paper, etc. in their correct sequence and secure with a string.
5. For all sheets of paper on which rough/draft work has been done, cross it through and ATTACH these to your answer scripts.
6. Write clearly the number(s) of the question(s) attempted on the top of each sheet.
7. Use of programmable calculator(s) is prohibited.
8. **ANSWER ALL QUESTIONS**
9. Show all working where necessary.
10. **ALWAYS CHECK YOUR WORK BEFORE YOU LEAVE THE EXAM ROOM**

SECTION A DC MACHINES (35 MARKS)

1. Name the basic parts of any DC machine. (4 marks)

2. Draw and label the circuit diagram of:

   a. Shunt - wound machine (3 marks)

   b. Series - wound machine (3 marks)

3. D.C. generators are classified according to the method of their field excitation. Name and explain the two types of DC generators. (4 marks)

4. State four type of principal losses of machines. (4 marks)

5. Sketch typical characteristics of torque vs armature current for:

   a. Shunt motor

   b. Series motor

   c. Compound motor (3 marks)

6. A generator is connected to a 50Ω load and a current of 10A flows. If the armature resistance is 0.5Ω, determine:

   a. The terminal voltage, and

   b. The generated e.m.f. (4 marks)

7. The armature of a DC machine has a resistance of 0.25Ω and is connected to a 300V supply. Calculate the e.m.f. generated when it is running:

   a. As a generator giving 100A , and

   b. As a motor taking 80A. (4 marks)

8. A series motor runs at 800 rev/min when the voltage is 400V and the current is 25A. The armature resistance is 0.4Ω and the series field resistance is 0.2Ω. Determine the resistance to be connected in series to reduce the speed to 600 rev/min with the same amount of current. (3 marks)

9. Name four types of DC motor cooling. (3 marks)

SECTION B 3 PHASE MACHINES (35 MARKS)

1. Explain briefly, with the aid of sketches, the principle of operation of a 3-phase induction motor. (3 marks)

2. The slip speed of an induction motor depends upon (*choose the best answer*)

   (a) Armature current

   (b) Supply voltage

   (c) Mechanical load

   (d) Eddy currents (2 marks)

3. The starting torque of a simple squirrel-cage motor is:

   (a) Low

   (b) Increases as rotor current rises

   (c) Decreases as rotor current rises

   (d) High (2 marks)

4. A three-phase induction motor is supplied from a 50 Hz supply and runs at 1200rev/min when the slip is 4%. Determine the synchronous speed? (3 marks)

5. The frequency of the supply to the stator of an 8-pole induction motor is 50 Hz and the rotor frequency is 3 Hz. Determine

   (a) The slip, and

   (b) The rotor speed. (4 marks)

6. The power supplied to a three-phase induction motor is 32kW and the stator losses are 1200W. If the slip is 5 per cent, determine

   (a) The rotor copper loss,

   (b) The total mechanical power developed by the rotor,

   (c) The output power of the motor if friction and windage losses are 750W, and

   (d) The efficiency of the motor, neglecting rotor iron loss. (8 marks)

7. State the 3 starting methods for induction motors and draw the circuit diagram of one of the starting method. (5 marks)

8. State the three (3) advantages of squirrel-cage induction motors. (3 marks)

9. State the three (3) advantages of wound rotor induction motors (3 marks)

10. A three-phase 2-pole motor is to have a synchronous speed of 6000 rev/min. Calculate the frequency of the supply voltage. (2 marks)

SECTION C SINGLE PHASE MACHINES (30 MARKS)

Each Question is worth five (5) marks

1. Name five (5) characteristics of single phase motors.

2. Draw the circuit diagram of a Capacitor-Start Motor, explain how the direction of rotation can be reversed and state the level of starting torque required.

3. Draw the circuit diagram of a Capacitor-Start, Capacitor –Run Motor and explain its operation.

4. Draw the circuit diagram of a Split Phase Motor and explain its operation.

5. Draw the circuit diagram of a Shaded-Pole Motor, explain how the direction of rotation can be reversed and state the level of starting torque required.

6. Draw the circuit diagram of a Series Motor and explain its operation.

END OF PAPER