FIJI NATIONAL UNIVERSITY

COLLEGE OF ENGINEERING, SCIENCE & TECHNOLOGY (CEST)

SCHOOL OF ELECTRICAL & ELECTRONICS ENGINEERING

TRADE DIPLOMA IN ELECTRICAL ENGINEERING - Stage 4

EEE545- ELECTRICAL MACHINES

FINAL EXAMINATION – TRIMESTER-1, 2017

Day/Date: As per timetable Time: As per timetable Room: As per timetable

INSTRUCTIONS TO STUDENTS

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 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 string

5. For all sheets of paper on which rough/draft work has been done, cross it though and you MUST ATTACH 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.

8. Show all workings where necessary.

9. Do not use programmable calculators, especially the ones that does the conversions of number systems.

SECTION A----------SHORT ANSWERS ----------50 MARKS

1. State Lenz's law (3 marks)

2. Outline the difference between a single phase motor and a 3 phase motor. (4 marks)

3. State the two groups armature windings can be divided into (2 marks)

4. Illustrate purpose of a start capacitor in a capacitor –start capacitor run motor? (2 marks)

5. State two applications of series motors. (2 marks)

6. Apply the uses of synchronous motor. Name and explain (3 marks)

7. Demonstrate through a circuit diagram, the load/speed and load/torque graphs of a shunt-field motor. (4 marks)

8. Relate by naming six parts of a motor. (2 marks)

9. Illustrate how is the direction of rotation reversed in a compound motor? You may use diagram to elaborate your answer (2 marks)

10. Outline the specific uses \ application of the following types of generators:

    a) separately excited permanent magnet (1 mark)
    b) wound field (1 mark)
    c) shunt excited (1 mark)

11. State two principal losses of machines (2 marks)

12. Illustrate three requirements that have to be met before synchronizing a Generator. (3 marks)

13. Outline the operation of an no-load transformer with the aid of diagrams. (3 marks)

14. State a practical application where matching would be used (2 marks)

15. State and briefly discuss the two different methods of cooling transformers (2 marks)

16. Specify the purpose of having tap changers on transformers? (2 marks)

17. State the three requirements for connecting a transformer in parallel and explain the effects of each.

(3 marks)

18. Draw the following transformer connections:
    a) Star – Delta b) Delta – Star (2 marks)

19. Draw the line diagram of a DOL starter and state its operation. (4 marks)

SECTION B----------CALCULATIONS----------50 MARKS

1. A 4-pole generator has a lap-wound armature with 50 slots with 16 conductors per slot. The useful flux per pole is 30mWb. Determine the speed at which the machine must be driven to generate an e.m.f. of 240V (4 marks)

2. A short-shunt compound generator supplies 80A at 200V. If the field resistance, Rf =40Ω, the series resistance, RSe =0.02Ω and the armature resistance, Ra =0.04Ω, determine the e.m.f. generated (3 marks)

3. A transformer has 200 primary turns and 700 secondary turns. If the primary voltage is 240V, determine the secondary voltage, assuming an ideal transformer. (3 marks)

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

5. A current transformer has a single turn on the primary winding and a secondary winding of 60 turns. The secondary winding is connected to an ammeter with a resistance of 0.15Ω. The resistance of the secondary winding is 0.25Ω. If the current in the primary winding is 300A, Determine

   (a) the reading on the ammeter, (3marks)

   (b) the potential difference across the ammeter (3marks)

   (c) the total load (in VA) on the secondary. (3marks)

6. A stator winding supplied from a three-phase 60 Hz system is required to produce a magnetic flux rotating at 900 rev/min. Determine the number of poles. (3marks)

7. The stator of a 3-phase, 4-pole induction motor is connected to a 50 Hz supply. The rotor runs at 1455 rev/min at full load.
Determine

   (a) the synchronous speed and (2marks)

   (b) the slip at full load. (2marks)

8. 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, (2marks)

   (b) the total mechanical power developed by the rotor, (3marks)

   (c) the output power of the motor if friction and windage losses are 750W,(3marks)

   (d) the efficiency of the motor, neglecting rotor iron loss. (3marks)

9. A separately-excited generator develops a no-load e.m.f. of 150V at an armature speed of 20 rev/s and a flux per pole of 0.10Wb. Determine the generated e.m.f. when

   (a) the speed increases to 25 rev/s and the pole flux remains unchanged (3 marks)

   (b) the speed remains at 20 rev/s and the pole flux is decreased to 0.08Wb, and (3 marks)

   (c) the speed increases to 24 rev/s and the pole flux is decreased to 0.07Wb. (3 marks)

.....THE END.....