

**COLLEGE OF ENGINEERING, SCIENCE & TECHNOLOGY (CEST)
SCHOOL OF ELECTRICAL & ELECTRONICS ENGINEERING
TRADE DIPLOMA IN ELECTRICAL ENGINEERING - Stage 3
EEE533- ELECTRICAL MACHINES
FINAL EXAMINATION – SEMESTER-1, 2016**

Day/Date: As per timetable Time(3 HRS): 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**MULTIPLE CHOICE****(20 MARKS)**

In each of the following statements one of the suggested answers is correct. Write the identifying letters beside the question numbering in your answer sheet.

1. A step-up transformer has a turns ratio of 10. If the output current is 5A, the input current is:
 - a. 50A
 - b. 5A
 - c. 2.5A
 - d. 0.5A

2. A 440V/110V transformer has 1000 turns on the primary winding. The number of turns on the secondary is:
 - a. 550
 - b. 250
 - c. 4000
 - d. 25

3. An advantage of an auto-transformer is that:
 - a. it gives a high step-up ratio
 - b. iron losses are reduced
 - c. copper loss is reduced
 - d. it reduces capacitance between turns

4. A 1 kV/250V transformer has 500 turns on the secondary winding. The number of turns on the primary is:
 - a. 2000
 - b. 125
 - c. 1000
 - d. 250

5. The core of a transformer is laminated to:
 - a. limit hysteresis loss
 - b. reduce the inductance of the windings
 - c. reduce the effects of eddy current loss
 - d. prevent eddy currents from occurring

6. Which of the following statements is false?
 - a. A d.c. motor converts electrical energy to mechanical energy
 - b. The efficiency of a d.c. motor is the ratio input power to output power
 - c. A d.c. generator converts mechanical power to electrical power
 - d. The efficiency of a d.c. generator is the ratio output power to input power

7. Which of the following statements is false?
- A series-wound motor has a large starting torque
 - A shunt-wound motor must be permanently connected to its load
 - The speed of a series-wound motor drops considerably when load is applied
 - A shunt-wound motor is essentially a constant-speed machine
8. The speed of a d.c. motor may be increased by
- increasing the armature current
 - decreasing the field current
 - decreasing the applied voltage
 - increasing the field current
9. The effect of inserting a resistance in series with the field winding of a shunt motor is to:
- increase the magnetic field
 - increase the speed of the motor
 - decrease the armature current
 - reduce the speed of the motor
10. The supply voltage to a d.c. motor is 240V. If the back e.m.f. is 230V and the armature resistance is 0.25ohms the armature current is:
- 10A
 - 40A
 - 960A
 - 920A
11. With a d.c. motor, the starter resistor:
- limits the armature current to a safe starting value
 - controls the speed of the machine
 - prevents the field current flowing through and damaging the armature
 - limits the field current to a safe starting Value
12. A 4-pole three-phase induction motor has a synchronous speed of 25 rev/s. The frequency of the supply to the stator is:
- 50 Hz
 - 100 Hz
 - 25 Hz
 - 12.5 Hz
13. The slip speed of an induction motor depends upon:
- armature current
 - supply voltage
 - mechanical load
 - eddy currents

14. The starting torque of a simple squirrel-cage motor is:
- low
 - increases as rotor current rises
 - decreases as rotor current rises
 - high
15. One of the advantages of single phase motors is that it:
- Requires less current
 - Runs faster
 - Can be used in three phase
 - Has only two windings
16. In a capacitor start capacitor run motor during starting a second capacitor is connected in:
- Series with the run winding
 - Parallel with run capacitor
 - Parallel with run winding
 - Series with capacitor
17. Which of the following motor has a cage rotor with salient poles in the stator?
- Split phase motor
 - Induction motor
 - Capacitor start motor
 - Shaded pole motor
18. The direction of rotation of single phase motors are achieved by:
- Reversing the polarity of both windings
 - Reversing the polarity of any one winding
 - Changing to three phase
 - All of the above
19. Capacitor start motors are used in general purpose heavy duty applications such as:
- molecule
 - solids
 - refrigerators and air conditioners
 - gas
20. Which of the following is the most common type of dc motor?
- Permanent magnet.
 - Shaded pole.
 - Capacitor start.
 - Capacitor- start capacitor run.

SECTION B-----SHORT ANSWERS-----50(MARKS)

1. Briefly explain the functions of the following parts including the material the part is made up of in reference to a motor :
 - (a) Brushes (1 marks)
 - (b) Yoke (1 marks)
 - (c) Armature (1 marks)

2. Draw a diagram showing the method of reversing the rotation of a shunt motor.
(2 marks)

3. Outline four (4) advantages of three phase induction motors. (2 marks)

4. Compare the characteristics of a single phase motor with a three phase motor.
(3 marks)

5. Draw the circuit connections and label your diagram of the following single phase motors:
 - a) capacitor motor (2 marks)
 - b) capacitor start, capacitor run motor (2 marks)
 - c) series motor (2 marks)

6. List down the functions of the run capacitor in a capacitor start- capacitor run motor.
(2 marks)

7. List four (4) applications for star – delta starters.
(2 marks)

8. Apply the uses of synchronous motor. Name and explain (2 marks)

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

10. State Lenz's law. (2 marks)

11. What are the major characteristics autotransformer starters? (2 marks)

12. Draw a single line diagram of a DOL starter and briefly explain its operation.
(4 marks)

13. Name two typical soft start applications. (2 marks)

14. 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)
15. State two principal losses of machines (2 marks)
16. Illustrate three requirements that have to be met before synchronizing a Generator. (3 marks)
17. Outline the operation of an on-load transformer with the aid of diagrams. (2 marks)
18. State two advantages of autotransformers (2 marks)
19. State and briefly discuss the two different methods of cooling transformers (2 marks)
20. Specify the purpose of having tap changers on transformers?(2 marks)

SECTION C-----CALCULATIONS-----30(MARKS)

1. An 8-pole, wave-connected armature has 600 conductors and is driven at 625 rev/min. If the flux per pole is 20 mWb, determine the generated e.m.f (3 marks)
2. An 8-pole, lap-wound armature has 1200 conductors and a flux per pole of 0.03Wb.
- a) Determine the e.m.f. generated when running at 500 rev/min.
 - b) Determine the generated e.m.f. for the above if the armature is wave-wound. (4 marks)
3. A 30 kW shunt-connected generator operates with a terminal voltage of 230 V. The armature has an effective resistance (R_a) of 0.17Ω and the shunt field (R_{sh}) has a resistance of 110Ω .
- Calculate:
- (a) The full load current. (2 marks)
 - (b) The field current. (2 marks)
 - (c) The total armature current (2 marks)
 - (d) The induced armature volt (2 marks)

4. A voltmeter, ammeter and wattmeter are connected to a single-phase circuit, by means of the appropriate instrument transformers, and the following results are obtained:

CT ratio	200:5
PT ratio	22 000:110
Voltmeter reading	20500 V
Ammeter reading	80 A
Wattmeter reading	1000 W

Calculate the actual voltage, current, volt-amperes and power in the secondary circuit.
(5 marks)

5. A three-phase two-pole induction motor is connected to a 60 Hz supply. Determine the synchronous speed of the motor in rev/min
(4 marks)

6. A 3-phase, 50 Hz induction motor has 2 poles. If the slip is 3 per cent at a certain load, determine

- (a) the synchronous speed, (2 marks)
- (b) the speed of the rotor, and (2 marks)
- (c) the frequency of the induced e.m.f. in the rotor. (2 marks)

-----THE END-----