

GENERAL CERTIFICATE OF EDUCATION BOARD
Technical and Vocational Education Examination

ELECTRICAL MACHINES 2
5235

JUNE 2022

INTERMEDIATE LEVEL

Specialty Name and Acronym	ELECTRICAL POWER SYSTEMS – EPS(F3)
Subject Title	ELECTRICAL MACHINES
Subject Code No.	5235
Paper No.	2

Duration: 3 HOURS

INSTRUCTIONS TO CANDIDATES

This Paper has Three Sections A, B and C and has a weighting of 35% of the whole subject.

Section A has **THREE** questions. Each question carries **10 Marks**. **ANSWER ANY TWO**

Section B has **THREE** questions. Each question carries **10 Marks**. **ANSWER ANY TWO**

Section C has **THREE** questions. Each question carries **30 Marks**. **ANSWER ANY TWO**

Show all steps in your calculations giving your answer at each stage and indicating the units and symbols used.

All sketches must be neat and clear.

You are allowed to use non-programmable calculators and mathematical sets

You are reminded of the necessity for good English and orderly presentation in your answers.

Turn Over

SECTION A – MAGNETISM AND ELECTROMAGNETISM

1. A conductor of length 10cm, carrying a current of 5A lies perpendicular to a magnetic field of flux density 20T.
 - (a) Calculate the force on the conductor. (5marks)
 - (b) Deduce the induced emf if the conductor is made to rotate at 5m/s. (5marks)

2. A conductor of length 0.8m cuts a magnetic field of 0.5T at a speed of 2m/s.
 - (a) Calculate the emf induced (5 marks)
 - (b) Deduce the magnetic flux cut, if the cross sectional area is 0.6m^2 (5 marks)

3.
 - (a) Explain the following terms as used in electromagnetism
 - (i) Self-inductance (1 mark)
 - (ii) Mutual inductance (1 mark)
 - (b) Describe the effect of a current carrying conductor placed in a magnetic field (2 mark)
 - (c) Explain what you understand by the following terms;
 - (i) Magnetomotive force (2 marks)
 - (ii) Magnetic field strength (2 marks)
 - (iii) Permeability (2 marks)

SECTION B – STATIC MACHINES

4. A transformer having a step down ratio of 2:1, has its primary supplied to a 240V, 50Hz mains. Consider the transformer to be ideal.
 - (a) What do you understand by an ideal transformer (2 marks)
 - (b) Calculate:
 - (i) The secondary voltage (2marks)
 - (ii) The secondary current for a load of 25Ω (3 marks)
 - (iii) The primary current (3 marks)

5. Considering a single phase 220/110V transformer
 - (a) Explain the two components that make up the no – load current of a transformer (2 marks)
 - (b) Explain the various losses that will occur on the transformer on;
 - (i) Load (2 marks)
 - (ii) No load (2 marks)
 - (c) How can the hysteresis and eddy current losses be obtained from a transformer (2 marks)
 - (d) Explain the main different methods that could be used to determine the efficiency of a transformer (2 marks)

6. A single phase 50KVA, 4400/220V transformer has $R_1=3.45\Omega$, $R_2=0.009\Omega$. The values of reactances are $X_1=5.2\Omega$ and $X_2=0.015\Omega$. Calculate for the transformer:
 - (a) Equivalent resistances as referred to the primary (2 marks)
 - (b) Equivalent resistances as referred to the secondary (2 marks)

- (c) Equivalent reactances as referred to the primary and secondary (3 marks)
- (d) Total copper losses (3 marks)

SECTION C – ROTATING MACHINES

7. The power input to a 500V, 50Hz, 6 pole, three phase induction motor running at 975 rpm is 40KW. The magnetic losses are 1KW and friction and windage losses total to 2KW. Calculate:
- (a) The slip (6 marks)
 - (b) The rotor copper loss (8 marks)
 - (c) Shaft power (8 marks)
 - (d) The efficiency (8 marks)
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8. In a two pole DC machine having the following parts: Yoke; Pole cores or pole shoes; Field coils; Armature windings (conductor); Commutator; Brushes.
- (a) Draw the diagram showing all the above mentioned parts. (12 marks)
 - (b) Give the role of each of the above mentioned parts (18 marks)
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9. A dc shunt generator has a full load output 10KW at a terminal voltage of 240V. The armature and the shunt field winding resistance are 0.6Ω and 160Ω respectively. The sum of the mechanical and core-losses is 500W.
- (a) Draw the circuit diagram of the generator (5 marks)
 - (b) Calculate:
 - (i) The armature current and field current (5 marks)
 - (ii) The field and armature copper losses (5 marks)
 - (iii) The total copper losses (5 marks)
 - (iv) The input power to the shaft (5 marks)
 - (v) The efficiency of the generator (5 marks)
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