



**UNIVERSITI KUALA LUMPUR**  
**Malaysian Institute of Marine Engineering Technology**

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**FINAL EXAMINATION**  
**FEBRUARY 2025 SEMESTER SESSION**

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**SUBJECT CODE** : LED22603

**SUBJECT TITLE** : ELECTRICAL MACHINE

**PROGRAMME NAME** : DIPLOMA OF ENGINEERING TECHNOLOGY IN  
(FOR MPU: PROGRAMME LEVEL) ELECTRICAL AND ELECTRONICS (MARINE)

**TIME / DURATION** : 09.00AM - 12.00 PM  
(3 HOURS)

**DATE** : 30 JUNE 2025

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**INSTRUCTIONS TO CANDIDATES**

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1. Please read **CAREFULLY** the instructions given in the question paper.
2. This question paper has information printed on both sides of the paper.
3. This question paper consists of **TWO (2)** sections; Section A and Section B.
4. Answer **ALL** question in Section A, and **TWO (2)** questions **ONLY** in Section B.
5. Please write your answers on this answer booklet provided.
6. Answer **ALL** questions in English language **ONLY**.
7. Answer should be written in blue or black ink except sketches, graphic, and illustrations.

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**THERE ARE 7 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.**

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**SECTION A (Total:60 marks)**

**INSTRUCTION: Answer ALL questions**  
**Please use the answer booklet provided**

**Question 1**

With reference to fundamentals of electrical machine

- (a) Explain TWO (2) types of rotors for synchronous machines including their diagram.  
(10 marks)
- (b) Explain the principle of operation for synchronous generators including their step for parallel operation.  
(10 marks)

**Question 2**

With reference to direct current (DC) machine

- (a) Sketch FOUR (4) major types of DC generators aboard the ship and sketch their equivalent circuit for each type, including designations such as voltage source, field winding, armature winding, armature resistance, etc.

(12 marks)

- (b) A 12-pole dc generator has a simplex wave-wound armature containing 144 coils of 10 turns each. The resistance of each turn is 0.011  $\Omega$ . Its flux per pole is 0.05 Wb, and it is turning at a speed of 200 r/min. Calculate:

i. The current paths are there in this machine.

(3 marks)

ii. The induced armature voltage of this machine

(3 marks)

iii. The effective armature resistance of this machine.

(2 marks)

**Question 3**

With reference to transformers

- (a) Explain the basic parts of the transformer including their type and simple diagrams. (10 marks)

- (b) A step-down transformer with a turn ratio of  $N_1 : N_2$  of 50 000 : 500 has its primary connection to a 20 000 V transmission line. If the secondary is connected to a 25  $\Omega$  load, calculate the:  $V_1$   $r = 25$

i. Secondary voltage.

ii. Secondary current.

iii. Primary current.

iv. Power output.

$\frac{V}{IR} \rightarrow I = \frac{V}{R}$  (3 marks)

(3 marks)

$P = VI$  (2 marks)

(2 marks)

**SECTION B (Total:40 marks)****INSTRUCTION: Answer only TWO (2) questions.****Please use the answer booklet provided.****Question 4**

With reference to asynchronous machine

- (a) Explain TWO (2) types of rotors used in AC motors including their diagram and labels. (10 marks)
- (b) The A 220-V, three-phase, two-pole, 50-Hz induction motor is running at a slip of 5 %. Calculate:
- The speed of the magnetic fields in revolutions per minute. (3 marks)
  - The speed of the rotor in revolutions per minute. (3 marks)
  - The slip speed of the rotor. (2 marks)
  - The rotor frequency in hertz (2 marks)

 $N_s$ 

AS =

**Question 5**

With reference to synchronous machine

(a) Each phase coil of a wye-connected alternator generates an output of 120 V. The load connected to this three-phase alternator consists of three  $10 \Omega$  impedances connected in wye as shown in Figure 2. Each impedance has a power factor of 80 % lag. Determine the following:

- i. Terminal voltage output of the alternator. (3 marks)
- i. Line current to the load bank (3 marks)
- ii. Three-phase power output of the alternator (2 marks)
- iii. Total kVA load on the alternator (2 marks)

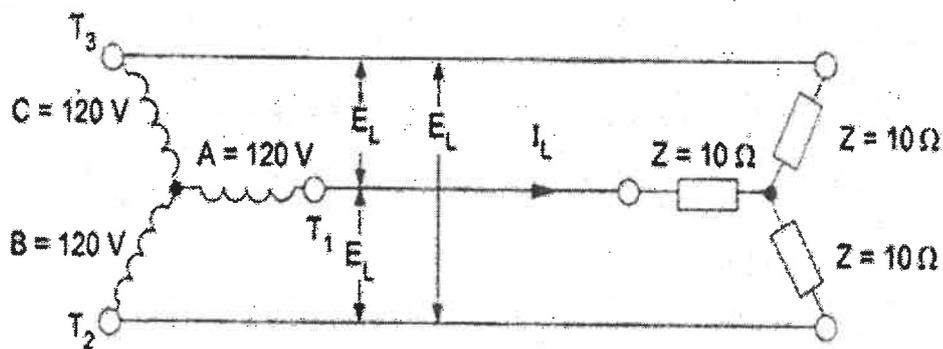


Figure 2

- (b) A 480-V, 50-H z, Y-connected, six-pole synchronous generator has a perphase synchronous reactance of 1.0  $\Omega$ . Its full-load armature current is 60 A at 0.8 PF lagging. This generator has friction and windage losses of 1.5 kW and core losses of 1.0 kW at 60 Hz at full load. Since the armature resistance is being ignored, assume that the  $I^2R$  losses are negligible. The field current has been adjusted so that the terminal voltage is 480 V at no load. Calculate:
- i. The speed of rotation of this generator.  
(3 marks)
  - ii. The terminal voltage of this generator is loaded with the rated current at 0.8 PF lagging.  
(3 marks)
  - iii. The efficiency of this generator (ignoring the unknown electrical losses) when it is operating at the rated current and 0.8 PF lagging.  
(2 marks)
  - iv. The shaft torque must be applied by the prime mover at full load.  
(2 marks)

**Question 6**

With reference to transformers

$N_1$

$N_2$

- (a) A not-quite-ideal transformer having 90 turns on the primary and 2250 turns on the secondary is connected to a 120 V, 60 Hz source. The coupling between the primary and the secondary is perfect but the magnetizing current is 4 A. Calculated:

$I$

- i. The effective voltage across the secondary terminals (4 marks)
- ii. The peak voltage across the secondary terminals. (4 marks)
- iii. The instantaneous voltage across the secondary when the instantaneous voltage across the primary is 37 V.

$$\frac{N_1}{N_2} = \frac{V_1}{V_2} = \frac{I_2}{I_1} \rightarrow \frac{90}{2250} = \frac{120}{V_2} \quad (2 \text{ marks})$$

$$270000 = 90 V$$

$$V = 3000 V$$

$N_1$

$N_2$

- (b) An ideal transformer having 90 turns on the primary and 2250 turns on the secondary is connected to a 200 V, 50 Hz source. The load across the secondary draws a current of 2 A at a power factor of 80 per cent lagging. Calculate:

- i. The effective value of the primary current. (4 marks)
- ii. The instantaneous current in the primary when the instantaneous current in the secondary is 100 mA. (4 marks)
- iii. The peak flux linked by the secondary winding. (2 marks)

$$I_1 = ?$$

**END OF EXAMINATION PAPER**

