CONFIDENTIAL

UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION

FEBRUARY 2025 SEMESTER SESSION

SUBJECT CODE	:	**LED31203**
SUBJECT TITLE	:	**NAVIGATION EQUIPMENT AND SYSTEM**
PROGRAMME NAME (FOR MPU: PROGRAMME LEVEL)	:	**DIPLOMA OF ENGINEERING TECHNOLOGY IN ELECTRICAL AND ELECTRONICS (MARINE)**
TIME / DURATION	:	**09.00 AM - 12.00 PM (3 HOURS)**
DATE	:	**30 JUNE 2025**

INSTRUCTIONS TO CANDIDATES

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 in Section B.
5. Please write your answers on this answer booklet provided.
6. Answer **ALL** questions in English language **ONLY**.

THERE ARE 6 PAGES OF QUESTIONS, INCLUDING THIS PAGE.

SECTION A (Total: 60 marks)

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

Question 1

With reference to **Ship Systems**:

Historical development in navigation has significantly improved the safety and efficiency of maritime voyages. Early navigators relied on natural celestial bodies, while modern ships use highly sophisticated electronic systems. Understanding this evolution helps maritime technicians appreciate the importance of accurate navigation techniques and equipment.

(a) Describe the methods of celestial navigation and dead reckoning used in early maritime history.

(8 marks)

(b) Explain the impact of the magnetic compass and marine chronometer on advancing navigation accuracy.

(8 marks)

(c) Identify **TWO (2)** benefits provided by the Global Positioning System (GPS) in modern navigation.

(4 marks)

Question 2

With reference to **Gyro Compass System**:

Understanding how a gyro compass works is essential to ensure proper navigation at sea. It utilizes physical principles rather than magnetic influences to maintain a reliable direction to true north.

(a) Explain the effect of gyroscopic inertia on compass stability.

(6 marks)

(b) Describe the mechanism by which Earth's rotation induces precession in a gyro compass.

(8 marks)

(c) Discuss the equilibrium condition in the operation of a gyro compass.

(6 marks)

Question 3

With reference to **Speed Log**:

The electromagnetic (EM) speed log operates based on Faraday's Law of Induction, providing continuous speed measurements through water without trailing devices.

(a) Explain the principle of operation of an EM speed log.

(8 marks)

(b) Identify **THREE (3)** key components involved in an EM speed log system.

(6 marks)

(c) Illustrate a simple system layout diagram showing the placement of major units.

(6 marks)

SECTION B (Total: 40 marks)

INSTRUCTION: Answer TWO (2) questions only.
Please use the answer booklet provided.

Question 4

With reference to **Navigation Radar System**:

A radar system is used to detect objects in a marine environment. The system transmits a pulse with a time delay of 3 microseconds before receiving the echo. The radar has a peak transmitted power of 60 kW, an antenna gain of 25 dB, a wavelength of 4 cm, and a target with a radar cross-section (RCS) of 3 m² located at 15 km.

(a) Calculate the distance to the target using the radar distance formula:

$$Distance = \frac{C \times t}{2}$$

(2 marks)

(b) Using the radar range equation below, determine the power received by the radar:

$$P_r = \frac{P_t \cdot G_t \cdot G_r \cdot \lambda^2 \cdot \sigma}{(4\pi)^2 \cdot R^4}$$

(8 marks)

(c) Determine the influence of antenna gain and RCS on received power.

(6 marks)

(d) Identify **TWO (2)** atmospheric factors that can significantly impact radar wave propagation and detection accuracy.

(4 marks)

Question 5

With reference to **Global Positioning System (GPS)**:

Trilateration is the core mathematical principle behind GPS positioning, using distances from satellites to determine a receiver's location.

(a) Calculate the distance from a GPS satellite to a receiver if the signal travel time is 0.075 seconds (Speed of Light = 3×10^8 m/s).

(2 marks)

(b) Determine the need for at least four satellites in 3D positioning and the role of the fourth satellite.

(8 marks)

(c) Use a 2D diagram with three satellites to illustrate the process of trilateration, highlighting the intersection points.

(6 marks)

(d) Determine the process by which a DGPS reference station calculates and transmits correction signals.

(4 marks)

Question 6

With reference to **Sonar System**:

Different sonar systems are designed for specific tasks, such as seabed mapping or object detection.

(a) Illustrate the block diagram of a basic sonar system, clearly labelling all key components and their interconnections.

(6 marks)

(b) Compare the operational principles of side-scan sonar and multibeam sonar, highlighting their key differences.

(6 marks)

(c) Calculate the time delay for an echo to return from a seabed 750 meters below, assuming the speed of sound in water is 1,500 m/s.

(4 marks)

(d) Identify **TWO (2)** factors that limit the range of high-frequency sonar compared to low-frequency sonar.

(4 marks)

END OF EXAMINATION PAPER