CONFIDENTIAL

UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION

JULY 2025 SEMESTER SESSION (7-WEEK)

SUBJECT CODE	:	**LEB31403**
SUBJECT TITLE	:	**NAVIGATION EQUIPMENT AND SYTEM**
PROGRAMME NAME (FOR MPU: PROGRAMME LEVEL)	:	**BACHELOR OF ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY (MARINE) WITH HONOURS**
TIME / DURATION	:	**09.00 AM - 12.00 PM (3 HOURS)**
DATE	:	**18 SEPTEMBER 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 **ONE (1) section**.
4. Answer **FOUR (4) questions Only**.
5. Please write your answers on the answer booklet provided.
6. Answer **ALL** questions in English language **ONLY**.

THERE ARE 5 PAGES OF QUESTIONS, EXCLUDING THIS COVER PAGE

(Total: 100 marks)

INSTRUCTION: Answer FOUR (4) questions.
Please use the answer booklet provided.

Question 1

With reference to **Navigation Radar System**:

You are serving as the Navigation Officer onboard the MV Atlantic Pioneer, a bulk carrier en route from Busan to Vancouver. While navigating in the North Pacific during the early hours of the morning, the vessel encounters dense fog and moderate swell. The Officer of the Watch reports that the S-band radar is experiencing delayed target updates for fast-moving small vessels beyond 8 NM, while the X-band radar continues to display targets normally. The Master directs you to investigate the cause and recommend corrective actions, ensuring adherence to IMO performance standards and the ship's safety management system.

(a) Investigate the possible causes for the delayed target updates on the S-band radar in the given weather and operational conditions. Categorise your findings into:

i. Environmental factors
ii. Equipment performance issues
iii. Operational settings.

(6 marks)

(b) Examine the basic operation of marine radar under the scenario conditions described in part (a).

(6 marks)

(c) Determine **TWO (2)** functional checks you would carry out on the S-band radar.

(4 marks)

(d) Compare **THREE (3)** advantages and **THREE (3)** limitations of using only the X-band radar with the S-band radar in restricted visibility for these conditions.

(9 marks)

Question 2

With reference to **Gyro Compass System**:

During a passage through the South China Sea on board MV Pacific Horizon, a modern LNG carrier with a gyro compass system integrated into ECDIS, ARPA radar, and autopilot, the bridge team detects a gradual heading drift over an eight-hour period. The deviation now measures 5° from the steady magnetic compass reading. This discrepancy has triggered the autopilot to apply frequent, unnecessary helm corrections, resulting in excessive rudder activity, higher fuel consumption, and reduced steering efficiency. The Master instructs the Navigation Officer to investigate potential causes, assess the impact on connected navigation systems, and propose suitable corrective and preventive measures.

(a) Investigate **FOUR (4)** likely causes of the gyro compass heading drift, considering the principle of operation, common error sources, and environmental influences.

(8 marks)

(b) Analyse the operational impacts when a gyro compass with heading drift remains integrated with ECDIS, ARPA, and autopilot.

(5 marks)

(c) Appraise the corrective actions you would take for calibration, alignment, and preventive maintenance of the gyro compass.

(6 marks)

(d) Outline **THREE (3)** advancements in gyro compass technology that could help reduce heading errors in future designs.

(6 marks)

Question 3

With reference to **Global Positioning System**:

The bulk carrier MV Iron Voyager, carrying coal from Indonesia to China, is transiting the busy Singapore Strait. During the passage, the vessel's GPS receiver intermittently displays sudden and unrealistic position changes, triggering collision alarms on the ECDIS. The navigation system receives DGPS corrections from coastal reference stations and integrates GPS data with radar and AIS for improved situational awareness.

(a) Investigate the operational principles of GPS in this case, including how the satellite constellation and trilateration process determine the vessel's position.

(7 marks)

(b) Identify **THREE (3)** potential causes for the sudden GPS position jumps on MV Iron Voyager and relate each to specific factors affecting GPS accuracy.

(6 marks)

(c) Assess the suitability of Differential GPS (DGPS) for this voyage, including its correction mechanism.

(6 marks)

(d) Determine **THREE (3)** emerging GPS-related technologies that could be implemented on MV Iron Voyager within the next 5 years to minimise the risk of similar navigation errors.

(6 marks)

Question 4

With reference to **Speed Log**:

During a coastal voyage in the South China Sea, the bridge team notices that the ship's Doppler speed log is consistently showing 15.4 knots, while the GPS speed over ground indicates 14.7 knots. The difference becomes more noticeable when the vessel sails through tidal streams and encounters heavy swells. The Master assigns you to determine the cause of the discrepancy and propose measures to ensure accurate and dependable speed readings for safe navigation.

(a) Investigate **THREE (3)** possible reasons for the difference between the Doppler speed log reading and the GPS-based speed log reading in the given scenario.

(6 marks)

(b) Compare the working principles, advantages, and limitations of Electromagnetic Speed Logs and GPS-based Speed Logs, using diagrams to support your explanation.

(9 marks)

(c) Outline **TWO (2)** essential steps in calibrating a ship's speed log system, covering both dockside tests and sea trials, ensuring compliance with IMO performance standards.

(4 marks)

(d) Appraise **THREE (3)** standard maintenance and troubleshooting practices to follow when a ship's speed log produces incorrect or unreliable readings, including guidance from manufacturers and industry best practices.

(6 marks)

Question 5

With reference to **Echo Sounder**:

While conducting a coastal approach, the echo sounder on MV Horizon Voyager begins showing fluctuating depth readings — sometimes freezing mid-measurement or displaying depths much shallower than the actual charted depths. The vessel is fitted with a modern digital dual-frequency echo sounder, with its transducer located inside a sea chest.

(a) Break down the principle of operation of an echo sounder, including the depth calculation formula, and how ping rate and blanking distance can influence the accuracy of readings.

(7 marks)

(b) Identify **TWO (2)** possible causes of fluctuating echo sounder readings, categorising them into system-related and environmental factors.

(4 marks)

(c) Outline the vessel's echo sounder installation considerations and preventive maintenance measures by providing **TWO (2)** key points for each.

(8 marks)

(d) Compare **TWO (2)** types of echo sounding systems and their suitability for a vessel like MV Horizon Voyager.

(6 marks)

END OF EXAMINATION PAPER