UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF MARINE ENGINEERING TECHNOLOGY

FINAL EXAMINATION
JANUARY 2017 SEMESTER

COURSE CODE	: LGB21203
COURSE NAME	: SHIP MATERIALS
PROGRAMME NAME (FOR MPU: PROGRAMME LEVEL)	: BACHELOR OF ENGINEERING TECHNOLOGY (HONS) IN NAVAL ARCHITECTURE & SHIPBUILDING BACHELOR OF ENGINEERING TECHNOLOGY (HONS) IN NAVAL ARCHITECTURE & SHIPBUILDING
DATE	: 10/07/2017 MON
TIME	: 2.00 PM - 05.00 PM
DURATION	: 3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read CAREFULLY the instructions given in the question paper.
2. This question paper has information printed on both sides.
3. This question paper consists of TWO (2) sections; Section A and Section B. Answer ALL questions in Section A and THREE (3) questions from Section B.
4. Please write yours answers on the answer booklet provided.
5. Write your answers only in BLACK or BLUE ink.
6. Answer all questions in English.

THERE ARE 5 PAGES OF QUESTIONS, INCLUDING THIS PAGE.

SECTION A (Total: 40 marks)

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

Question 1

Define a crystal structure and elaborate the three (3) examples of common metal crystal structures.

(8 marks)

Question 2

Differentiate between creep and fatigue testing by referring to strain-time curve and S-N curve.

(8 marks)

Question 3

Sketch the microstructure development for hypereutectoid steel.

(8 marks)

Question 4

List **FOUR (4)** advantages of glass-fiber-reinforced plastic composites.

(8 marks)

Question 5

List five metals that are cathodic to hydrogen, and give their standard oxidation potentials. (Refer Table 1: Electrode potential in Appendix A)

(8 marks)

SECTION B (Total: 60 marks)

INSTRUCTION: Answer THREE (3) questions only.
Please use the answer booklet provided.

Question 6

(a) Discuss the "electron gas" model of metallic bonding that gives metals properties of high electrical and thermal conductivities.

(5 marks)

(b) Pure zinc has the HCP crystal structure with lattice constants a=0.2665nm and c/a = 1.633. By referring to Figure 1.

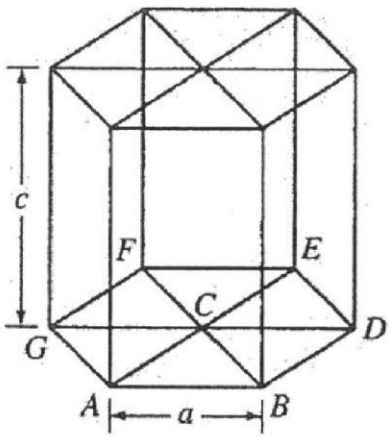

Figure 1: HCP unit cell

i. calculate volume of the zinc crystal structure unit cell

ii. prove that the atomic packing factor of HCP is 0.74.

(15 marks)

Question 7

(a) A 10mm diameter Brinell hardness indenter produced an indentation 2.50 mm in diameter in a steel alloy when a load of 1000 kg was used.

i. Compute the HB of this material.

ii. Determine the diameter of an indentation to yield a hardness of 300HB when a 500 kg load is applied.

(10 marks)

(b) A welding steel plate on a ship hull was conducted liquid dye penetrant testing to inspect defects. The welding inspector fails to detect the defect on the welding joint. Explain the procedure to perform liquid dye penetrant inspection. Discuss why the welding inspector fails to detect the defect.

(10 marks)

Question 8

(a) Explain the possibilities for an austenitic stainless steel to have austenitic structure at room temperature. Discuss the effect of chromium-carbides precipitate in the grain boundaries of austenitic stainless steel and then suggest the preventative method to reduce formation of the precipitate.

(10 marks)

(b) Hypereutectoid plain-carbon steel is slowly cooled from about 900 °C to a temperature just slightly above 723 °C as shown in Figure 2.

i. Calculate the weight percent cementite and austenite present in 0.90 wt% C plain-carbon steel.

ii. If hypereutectoid plain-carbon steel contains 4.7 wt% cementite, calculate the average carbon content.

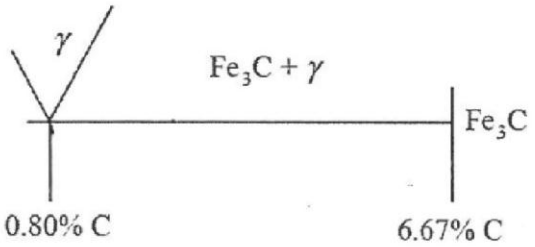

Figure 2

(10 marks)

Question 9

(a) Ceramic materials are important for many engineering designs and have a wide range of properties of applications in many technical areas or industries. Suggest the properties of ceramic applicable in marine related industries.

(5 marks)

(b) As a local fiberglass boat manufacturer, your company is well known in the small fiberglass boat manufacturing and maintenance. Elaborate about the manufacturing process of your fiberglass boat. Then, explain about the types of polymer, reinforcement material and the advantages of the mechanism you choose.

(15 marks)

Question 10

(a) A piece of corroded steel plate was found in a submerged ocean vessel. It was estimated that the original area of the plate was 10 in^2 and that approximately 2.6 kg had corroded away during the submersion. Assuming a corrosion penetrate rate of 200 mpy for this alloy in seawater, estimate the time of submersion in years. The density of steel is 7.9 g/cm^3.

(5 marks)

(b) In designing the hull of new fishing vessel to ensure corrosion protection, a few corrosion protection strategies can be applied. Suggest and discuss **THREE (3)** corrosion protection systems that can be implemented in the new fishing vessel.

(15 marks)

END OF EXAMINATION PAPER

APPENDIX B

THE FORMULAE

$$Atomic\ Packing\ Factor\ (APF) = \frac{Volume\ of\ atom\ unit\ cell}{Volume\ of\ unit\ cell}$$

$$density = \frac{n\,A}{V_c\,N_A}$$

$$BHN = \frac{P}{(\pi D/2)(D - \sqrt{D^2 - d^2})} = \frac{P}{\pi D t}$$

$$VHN = \frac{2P\sin(\theta/2)}{L^2} \approx \frac{1.854P}{L^2}$$

$$Stress(\sigma) = \frac{P}{A}$$

$$Strain(\varepsilon) = \frac{\delta L}{L}$$

$$Young's\ Modulus = \frac{\sigma}{\varepsilon}$$

$$Nernst\ equation = E^0 + \frac{0.0592}{n}\log C_{ion}$$

$$CPR = \frac{KW}{\rho A t}$$

APPENDIX A

Table 1: Standard Electrode Potentials at 25° C

Oxidation (corrosion) reaction	Electrode potential (E°) (volts versus standard hydrogen electrode)
$Au \rightarrow Au^{3+} + 3e^-$	+1.498
$2H_2O \rightarrow O_2 + 4H^+ + 4e^-$	+1.229
$Pt \rightarrow Pt^{2+} + 2e^-$	+1.200
$Ag \rightarrow Ag^+ + e^-$	+0.799
$2Hg \rightarrow Hg_2^{2+} + 2e^-$	+0.788
$Fe^{2+} \rightarrow Fe^{3+} + e^-$	+0.771
$4(OH)^- \rightarrow O_2 + 2H_2O + 4e^-$	+0.401
$Cu \rightarrow Cu^{2+} + 2e^-$	+0.337
$Sn^{2+} \rightarrow Sn^{4+} + 2e^-$	+0.150
$H_2 \rightarrow 2H^+ + 2e^-$	0.000
$Pb \rightarrow Pb^{2+} + 2e^-$	−0.126
$Sn \rightarrow Sn^{2+} + 2e^-$	−0.136
$Ni \rightarrow Ni^{2+} + 2e^-$	−0.250
$Co \rightarrow Co^{2+} + 2e^-$	−0.277
$Cd \rightarrow Cd^{2+} + 2e^-$	−0.403
$Fe \rightarrow Fe^{2+} + 2e^-$	−0.440
$Cr \rightarrow Cr^{3+} + 3e^-$	−0.744
$Zn \rightarrow Zn^{2+} + 2e^-$	−0.763
$Al \rightarrow Al^{3+} + 3e^-$	−1.662
$Mg \rightarrow Mg^{2+} + 2e^-$	−2.363
$Na \rightarrow Na^+ + e^-$	−2.714