UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION
JANUARY 2016

SUBJECT CODE	:	LNB 40503
SUBJECT TITLE	:	INTRODUCTION TO MARINE MACHINERY
LEVEL	:	BACHELOR
TIME / DURATION	:	9.00 pm – 12.00 am (3 HOURS)
DATE	:	26 MAY 2016

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. Please write your answers on the answer booklet provided.
4. Answer should be written in blue or black ink except for sketching, graphic and illustration.
5. Answer FIVE (5) questions only.
6. Answer all questions in English.

THERE ARE 5 PAGES OF QUESTIONS, INCLUDING THIS PAGE.

SECTION A (Total: 40 marks)
INSTRUCTION: Answer ALL questions.

Question 1

a) Sketch a schematic diagram of a marine gas turbine open cycle and explain all the processes that take place at the inlets and outlets of each components or sections.

(8 marks)

b) An open cycle marine gas turbine can be modelled into close cycle called an ideal Brayton cycle. Draw the P-v and T-s diagrams and explain the four internally revesible processes.

(8 marks)

c) In a marine gas turbine operation, the air intake tempereture into the compressor is 35°C and the pressure ratio across the compressor r_p = 10 (i.e. P_2/P_1). Assuming that the compressor draws in air from the ambient at the standard athmospheric pressure and the specific heat ratio k=γ=1.4, calculate the compressed air temperature at the inlet of the combustion chamber and deduce the pressure into the turbine.

(4 marks)

Question 2

Answer the following questions:

a) Draw a schematic diagram of a typical hybrid nuclear reactor steam turbine and electrical propulsion system which also drives a turbo generator to provide electricity to the propulsion motor and other ship services.

(10 marks)

b) Sketch and describe briefly the working principle of any two (2) of the following marine auxiliary machinery systems:

i) A sewage treatment plant.
ii) An oily water separator.
iii) Fuel oil – water centrifuge.
iv) Marine steering gear.
v) Ship stabilizer.

(10 marks)

SECTION B (Total: 60 marks)
INSTRUCTION: Answer only THREE (3) questions

Question 3

a) Explain the usage of a coupling, a gearbox and a clutch in a marine transmission system.

(6 marks)

b) You are involved in preparing a concept design of a gearbox in your company for use in a super mega container ship operating across all oceans. The ship owner requested the ship to be a twin propeller ship installed with a marine gas turbine of 45000 revolution per minutes (rpm) and intended to turn a maximum propeller shaft of not more than 1200 rpm through an appropriate reduction gear box. The diameter of the first gear at the output shaft of the gas turbine is 0.6 m. You are required to carry out a task on designing a practical and a possible gear train of not more than 4-step reduction to give an output of inward direction of rotation of the propellers. Due to the constraint of space availability on board the ship the maximum width or height of the gear box of each unit must not exceed 2.5 m and show the diameters of the gears at each step and the direction of rotation in your design proposal.

(10 marks)

c) Sketch a typical cross-sectional view showing the internal part of a propeller shaft, hydraulic oil distribution and the related mechanism or linkages of a pull-push rod type controllable pitch propeller system.

(4 marks)

Question 4

Answer the following questions:

a) Explain the usage of the following ship equipment:
   i) Pump.
   ii) Heat exchanger or cooler.
   iii) Fuel-water separator or centrifuge.
   iv) Steering gear.
   v) Stabilizer.

(10 marks)

b) Calculate the flowrate in m^3/hr the following types of piston pumps for the given data:

i) Single acting, diameter of piston D = 0.15 m, stroke S = 0.2 m, RPM = 500 and loss of flowrate due to leakage and internal friction is 15%.

(4 marks)

ii) The single acting piston pump in i) above is redesigned into a double acting piston pump with the addition of a piston rod of diameter 3 cm with the same data except that the volumetric efficiency has been improved to 90%.

(6 marks)

Question 5

a) Consider a point P on a propeller leading edge at radius r. As one is standing at the stern of a ship looking forward at the propeller, the movement of this point could be traced vertically and angularly as the propeller rotates. As viewed on the x-y plane, the point could be seen moving in a helical path which on the y axis showing the vertical position of the point and on the x-axis showing the axial distance travel of the point called pitch. The path of the movement of the point or locus could be opened-up into a straight line of length $2\pi r$ i.e. the total length of the circumference of the circle as the propeller completes one rotation. Sketch to trace the helical path of the moving point P, the pitch and the opened-up straight line showing the incremental pitch, the maximum pitch and the pitch angle.

(10 marks)

b) A 4-bladed propeller of diameter 1 m is intended to be installed in a newly constructed fishing vessel operated in South China Sea. Other data related to the propeller are; ship Speed V_s = 25 knots, advance speed V_A = 12 m/s, torque Q = 65 kN, thrust T = 90 kN, total ship resistance R_T = 80 kN, propeller rate of rotation per minutes N = 600. Calculate the following performance characterisation related to B-series Wageningen propeller:

i) Advance coefficient J.

ii) Thrust coefficient K_t.

iii) Torque coefficient K_q.

iv) Propeller open water efficiency η_o.

v) Propulsive efficiency of the ship hull η_t.

(10 marks)

Question 6

a) Sketch and explain the cycles of a 4-stroke marine diesel engine.

(8 marks)

b) List 5 types of ancillary support systems associated with a marine diesel propulsion system.

(5 marks)

c) Draw and label a schematic diagram of a marine diesel engine water jacket fresh water cooling system of a ship.

(5 marks)

d) State 2 differences between 2-stroke and 4-stroke engines.

(2 marks)