UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION
SEPTEMBER 2016

SUBJECT CODE	:	LGB 40503
SUBJECT TITLE	:	INTRODUCTION TO MARINE MACHINERY
LEVEL	:	BACHELOR
TIME / DURATION	:	9.00 am – 12.00 pm (3 HOURS)
DATE	:	16 JANUARY 2017

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 (40 MARKS)

INSTRUCTION: Answer ALL questions.

QUESTION 1

a. List 4 types of common marine propulsion system for seagoing ships.

(4 marks)

b. Illustrate or sketch the main internal parts of a 4-stroke marine diesel engine and to show the direction of rotation of the crankshaft and the movement of the piston for every stroke.

(8 marks)

c. Based on the illustration in 1b above, describe the four strokes of the diesel engine i.e. the intake, compression, power and exhaust strokes.

(8 marks)

QUESTION 2

a. List 5 main components found in a conventional marine steam propulsion system (i.e. non-nuclear reactor type).

(5 marks)

b. Sketch a block diagram of a typical hybrid nuclear reactor steam-electrical propulsion system used in naval vessels. In your sketch you are required to show the main components; heating water system from the nuclear reactor, overall piping routes of the water and steam system, the main turbines (HP and LP turbines), turbo generator driving the electrical power generating plant which produces the electricity for the services onboard the vessel and the electrical propulsion motor. Also, show the complete power transmission system main components from the turbines up to the propeller including the gearbox, coupling, plummer block, CPP hydraulic oil distribution box, stern tube and outboard shaft bracket.

(15 marks)

SECTION B (60 MARKS)

INSTRUCTION: Answe THREE (3) questions only)

QUESTION 3

a. Sketch a cross sectional view of a marine gas turbine engine showing the various sections such as the LP compressor, HP compressor, combustion chamber, HP turbine and the LP turbine.

(5 marks)

b. Sketch a block diagram of an open cycle model of a Brayton gas turbine engine, label the main components and describe briefly the processes across each section.

(5 marks)

c. A super passenger liner is installed with a marine gas turbine propulsion system. In the gas turbine engine operation, fresh air is taken in at an ambient temperature of 30° C, first through the LP compressor section and then further compressed at the HP side of the compressor. The pressure at the exit of the HP compressor leading to the combustion chamber is 20 bar. Calculate the temperature at the entry to the turbine and the thermal efficiency, given

that the specific heat ratio k = 1.1 and the temperature at the exit of the turbine to the surrounding is 400° C. Guiding formulae; $T_1/T_2 = (P_1/P_2)^{k-1/k}$, $\eta_t = 1 - T_1/T_2$

(10 marks)

QUESTION 4

a. Describe the purpose of the following ship auxiliary systems:

1) Sewage treatment plant

2) Fin stabilizer

3) Fuel/Oil - water centrifuge

4) Pump

5) Steering gear

(15 marks)

b. Sketch and label any one (1) of the ship auxiliary systems in Question 4a above.

(5 marks)

QUESTION 5

Consider a B-3.35 Wageningen propeller with the open water propeller test results conducted in fresh water tank are given in Figure 1. The diameter of the propeller D = 3 m and the revolution per minute (RPM) is 1200.

a. For an advance coeficcient J = 1.2 and P/D = 1.2, read off the readings for the thrust coefficients K_T, toque coefficient K_Q and the propeller open water efficiency η_o.

(6 marks)

b. With the coefficients K_T and KQ read off in 5a above, determine the thrust T, torque Q and the advance speed V_A.

(6 marks)

c. Sketch the B-3.35 Wageningen propeller and label the trailing edge, leading edge, pressure surface, suction surface, root and tip of the propeller blade.

(8 marks)

Guiding formulae; $K_T = T/(\rho N^2D^4)$, $K_Q = Q/(\rho N^2D^5)$, $\eta_o = TV_A/(2\pi NQ)$, $J = V_A/ND$

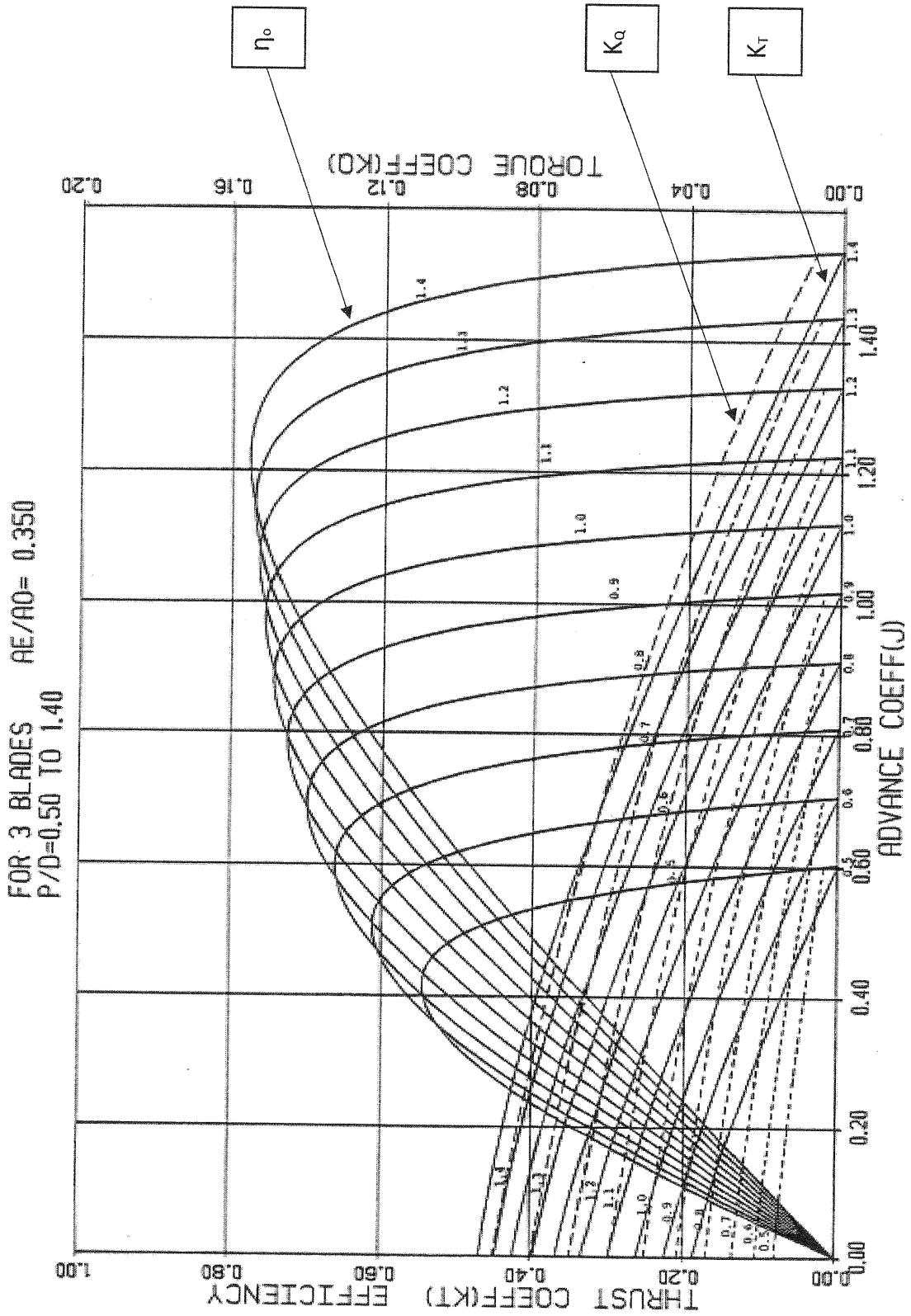

Figure 1 - 3-Bladed B-Series Wageningen Propeller

QUESTION 6

a. Calculate the fluid flowrate of a single acting piston pump in m^3/h; diameter of piston D = 0.12 m, stroke S = 0.3 m, cycle per minute n = 600 and loss of flowrate due to leakage and internal friction is 15%.

(5 marks)

Guiding formulae; $Q = FSn\eta_v$, $F = \pi D^2/4$

b. The single acting piston pump in 6a above is redesigned into a double acting piston pump with the addition of a piston rod of diameter d = 3 cm with the same data as in the single acting pump except that the volumetric efficiency η_v has been improved to 90%. Calculate the fluid flowrate of the pump in m^3/h.

(5 marks)

Guiding formulae; $Q = (2F-f)Sn\eta_v$, $F = \pi D^2/4$, $f = \pi d^2/4$

c. Perform a conceptual design of a gearbox for use in a medium size car-passenger ferry operating around Asian waters. The ship owner requested the ship to be installed with a marine gas turbine of 20000 RPM and intended to turn a single propeller of not more than 1000 RPM through an appropriate reduction gear box. The diameter of the first gear at the output shaft of the gas turbine is 0.5 m and rotating in anti-clockwise direction. The gear train is to be designed of not more than 4-step reduction to give an output of clock-wise propeller rotation. Space availability on board the ship is a constraint and therefore the maximum width and height of the gear box must not exceed 3.5 m. Show the diameter of each gear at every step of reduction and the direction of rotation in your design proposal. Note that you must allow an all-round clearance of at least 5 cm between the gears and the gearbox casing or housing in considering the maximum width and height of the gear box unit.

(10 marks)