UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF MARINE ENGINEERING TECHNOLOGY

FINAL EXAMINATION
SEPTEMBER 2016 SEMESTER

COURSE CODE	: LNB 31203
COURSE NAME	: SEAKEEPING & MANOUEVRING
PROGRAMME NAME	: BET OF NAVAL ARCHITECTURE & SHIPBUILDING
DATE	: 17 JANUARY 2017
TIME	: 09.00 AM – 12.00 PM
DURATION	: 3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please CAREFULLY read 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 questions in Section A. For Section B, answer THREE (3) questions only.
5. Please write your answers on the answer booklet provided.
6. Answer all questions in English language ONLY.

THERE ARE 7 PAGES OF QUESTIONS, INCLUDING THIS PAGE.

SECTION A (Total: 40 marks)

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

Question 1

a) Identify & briefly explain THREE (3) main boundary conditions (with the help of relevant formula or sketch) applied in the solutions of boundary value problems of ship motions.

(6 marks)

b) The evaluation of $A_{ij}(\omega)$ and $B_{ij}(\omega)$ for heave which due to the forced oscillation of the body with displacement $\zeta_3(t) = \Re\left(\xi_3 e^{i\omega t}\right)$, a fluid disturbance with the velocity potential is given as follow:

$$\phi_3 = \Re(\varphi_3 e^{i\omega t}) \qquad \text{with} \quad \varphi_3 = \xi_3 \psi_3$$

With respect to free surface condition, S_F and hull boundary condition, S_B below:

$$\frac{\partial^2 \psi_3}{\partial t^2} + g\frac{\partial \psi_{3z}}{\partial z} = 0 \text{, with } z = 0 \text{ ;} \qquad \frac{\partial \psi}{\partial n} = i\omega n_3, \quad on \qquad S_H$$

Derive or/and prove the following equations:

i) The hydrodynamic pressure from Bernoulli equation

ii) The force acting on the body in the heave direction, F_3 (in frequency domain)

iii) Express in complex form the Newton's law, $F_3(t)$ which defined in terms of the added mass and damping coefficient.

iv) Prove the following equations;

$$A_{33}(w) = \Re\left(-\frac{\rho}{w^2}\iint_{S_B} \psi_3 \frac{\partial \psi_3}{\partial n_3} ds\right)$$

$$B_{33}(w) = \Im\left(-\frac{\rho}{w}\iint_{S_B} \psi_{-3} \frac{\partial \psi_3}{\partial n} ds\right)$$

(14 marks)

Question 2

a) Give brief description (with the help of sketch) for each of the followings:

i) Wave energy spectrum

ii) Significant wave height/period

(4 marks)

b) Using ITTC formulation, plot a wave spectrum for a wind speed of 31 knot ($H_{1/3}$ = 5.6 m).

Where, $S(\omega) = \frac{A}{\omega^5} . \exp(-B/\omega^4)$ with A = 8.1 x $10^{-3}g^2$ & B = 3.11 / $(H_{1/3})^2$

(6 marks)

c) A sea spectrum is defined by the following table:

ω	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2
S(ω)	0.2	2.0	4.05	4.3	3.4	2.3	1.5	1.0	0.7	0.5
RAO	0.8	0.6	0.69	0.44	0.28	0.18	0.12	0.10	0.08	0.07

and $\frac{d\omega_E}{d\omega} = 1 + \frac{2\omega}{g} . V$; For 10 knots, $\omega_E = \omega(1 + 0.525\omega)$; $\frac{d\omega}{d\omega_E} = (1 + 1.05\ \omega)^{-1}$

Assuming the RAO of the vessel is picked-off at the encounter frequency, ω_E as in table above, calculate the mean wave height (H_1), significant wave height ($H_{1/3}$) and 1/10th highest wave, ($H_{1/10}$) and find the response spectrum and the statistical responses of the vessel.

(10 marks)

SECTION B (Total: 60 marks)

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

Question 3

a) Give brief description (with the help of relevant formula or sketch) for each of the followings:
   i) Shallow water
   ii) Deep water
   iii) Standing wave

(6 marks)

b) A group of waves is 300 m in length in deep water. The waves within the group are 30m in length. Calculate the time taken for a component wave to travel the length of the group.

(4 marks)

c) A deep water wave having a length of 30.5 m and of height of 1.5 m travels toward shore.
   i) What are the values of the length and celerity at the position where the water is 0.5m in depth?
   ii) What are the values of the total wave energy and the energy flux (per unit width) of the wave in deep water?

   (Assume ρsw = 1025 kg/m3)

(10 marks)

Question 4

a) Give brief description (with the help of sketch) for each of the followings:

i) Directional stability

ii) Course keeping ability

iii) Turning ability

(9 marks)

b) In a model experiment using a planar motion mechanism, the values of sway force (Y) and yaw moment (N) with respect to the drift angle (β) are found as follow:

Drift Angle (Deg)	-12	-8	-4	0	4	8	12
Sway Force (N)	-1.591	-1.06	-0.53	0	0.531	1.061	1.59
Yaw Moment (N.m)	-1.04	-0.739	-0.368	0	0.369	0.738	1.105

The model particulars are given as follow:

Length, L = 2.334 m, velocity, V = 0.509 m/s, density, ρ= 1000 kg/m^3, mass, m = 64 kg

i) By plotting, estimate the values for the linear derivatives Y_v and N_v and calculate their respective non-dimensional values.

ii) Given additional data of Y_r=0.922 N.s and N_r = -11.251 N.m.s comment on the directional stability of the model.

(11 marks)

Question 5

a) Give brief description (with the help of sketch) for each of the followings:

i) Straight line test

ii) Captive model test using Planar motion mechanism (PMM)

iii) Captive model test using rotating arm techniques

(9 marks)

b) Two designs possess the following values of derivatives

	Y'_v	N'_v	Y'_r	N'_r	m'
Design A	-0.36	-0.07	0.06	-0.07	0.12
Design B	-0.026	-0.10	0.01	-0.03	0.10

i) Comment on the directional stability of the two designs.

ii) Assuming both designs are 103 m long, how far are the neutral points forward of the center of gravity, CG.

iii) If putting a skeg in design B has caused

$Y'_v = -0.31$ and $N'_v = -0.048$

Assuming other derivatives remained unchanged, comment on the effect of the skeg on design B's directional stability

(11 marks)

Question 6

a) Give brief description (with the help of sketch) for each of the followings:

i) Rudder force

ii) Center of pressure position

(4 marks)

b) Select and briefly describe any THREE (3) types of rudder design in terms of its chord length, stock axis and position of water line (WL).

(9 marks)

c) Calculate the force and torque on the center line gnomon rudder shown, Fig. 1, for 38 degrees and a ship speed of 22 knots. The ship is fitted with single screw

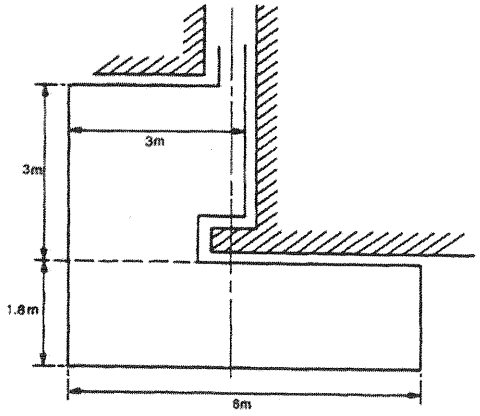

Figure 1

(7 marks)

END OF QUESTIONS