L-4/T-2/NAME **Date: 01/04/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T2 B. Sc. Engineering Examinations 2017-2018

Sub: **NAME 449** (Navigation and Maritime Regulations)

Full Marks: 210 Time: 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE** questions.

1. (a) Discuss the roles and functions performed by IMO as an organization as well as an international leader in the maritime sector. **(15)**

   (b) Name various committees and sub-committees of IMO. **(7)**

   (c) Distinguish among flag state control, port state control and coastal state control. **(8)**

   (d) Write a short note on "flag of convenience". **(5)**

2. (a) What is the difference between aid to navigation and navigational aids? **(5)**

   (b) What are the objectives of international hydrographic organization (IHO)? **(8)**

   (c) Name various types of fixed and floating aids to navigation? Briefly discuss the technical considerations for floating aids to navigation **(15)**

   (d) Define navigation. Differentiate between ocean navigation and coastal navigation. **(7)**

3. (a) What is ECDIS? What is the advantages of ECDIS over paper chart? Mention some limitations of ECDIS. **(7)**

   (b) With the aid of a suitable diagram explain LRIT system. **(8)**

   (c) Name and define various types of navigation lights. **(10)**

   (d) With suitable sketches mention various navigational lights and objects used in the following vessels: (any two) **(10)**

   (i) A 60 m tug with a towing length of 275 m.

   (ii) A vessel engaged in fishing, other than trawling and making way through the water.

   (iii) Dredger at work, restricted in her ability to maneuver with the obstruction on her port side.

4. (a) What is ILLC? Mention it's applications. **(5)**

   (b) Discuss how minimum freeboard is assigned for type A and type B ships. **(10)**

   (c) Discuss the requirements in context to ILLC for the followings: **(12)**

   (i) handrail and bulwarks

   (ii) windows and the scuttle

   (iii) air pipes and hatch coamings

   (d) Write a short note on 'Ballast water management" convention. **(8)**

Contd P/2

NAME 449

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE** questions.

5. (a) Make a list of design, drawings and documents to be submitted for approval of a cargo/passenger/tanker/special ships which is more than 24 meters in length. **(20)**

   (b) How do you estimate the passenger capacity of an inland passenger ship? **(15)**

6. (a) What are the causes of fire hazards in engine room, galley, accommodation and cargo spaces? **(18)**

   (b) Point out the guidelines/rules to be followed during the survey of an inland ship. **(17)**

7. (a) What are types of marine sewage treatment unit used in ships? **(10)**

   (b) What are the key requirements of energy efficiency regulations of ships? **(10)**

   (c) Write short notes on shipboard waste management. **(15)**

8. (a) Mention the general requirements of life boat. **(10)**

   (b) How the life boat of a ship shall be stowed? **(10)**

   (c) Write short notes on life buoys. **(15)**

L-4/T-2/NAME **Date: 07/04/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T2 B. Sc. Engineering Examinations 2017-2018

Sub: **NAME 467** (Control Engineering)

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks.

Symbols have their usual meaning.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE** questions.

1. (a) Explain the concept of sensitivity of control systems due to parameter variations. **(10)**

   (b) Mention at least five advantages of feedback control system over open-loop control system. **(5)**

   (c) For a typical feedback control system, deduce the expression of tracking error E(s) in terms of sensitivity function S(s) and complimentary sensitivity function C(s). Consider process, reference, output, disturbance and noise are marked respectively as G(s), R(s), Y(s), $T_d(s)$, and N(s). **(20)**

2. (a) How the performance of a control system is measured? What are the parameters? Draw necessary figures and explain. **(20)**

   (b) State Routh-Hurwitz criteria for system stability: **(5)**

   (c) Construct Routh array of the following systems and comment on stability: **(10)**

   (i) $q(s) = a_2s^2 + a_1s + a_0$

   (ii) $q(s) = a_3s^3 + a_2s^2 + a_1s + a_0$

3. (a) Explain the following with examples with regard to control systems: **(20)**

   (i) Stability

   (ii) Degree of stability

   (iii) Relative stability

   (iv) Marginal stability

   (b) What is the correlation between impulse input and response for various root locations in s-plane? Provide graphical explanation. **(15)**

4. (a) What is Bode plot? Describe its significance in control engineering. **(17)**

   (b) What is root-locus plot? Why it is important in control system design? Explain. **(18)**

Contd P/2

NAME 467

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE** questions.

5. (a) What do you mean by a control system and its linear model? **(5)**

   (b) State the features and the limitations of transfer function model. **(15)**

   (c) Define the transfer function and show that the transfer function of positive feedback control system shown in Fig. for Q. No. 5(c) can be expressed as: **(15)**

$$T(s) = \frac{C(s)}{R(s)} = \frac{G(s)}{1 - G(s)R(s)}$$

6. (a) Find the steady-state response of a control system govenerred by the different equation **(10)**

$$\frac{d^2y}{dy^2} + 4\frac{dy}{dt} + 3y = 2r(t)$$

With y(0) = 1, dy(0)/dt = 0 and r(t) = 1, $t \geq 0$.

   (b) Determine the differential equation and the transfer function of the mechanical translational system shown in Fig. for Q. No. 6(b) **(25)**

7. (a) State the features and the advantages of state variables model. **(10)**

   (b) Derive the closed loop transfer function of the system shown in Fig. for Q. No. 7(b) using Block diagram reduction method. **(5)**

8. (a) What do you mean by the state of a system and the state variables? **(5)**

   (b) A hovering vehicle control system is represented by two state variables and its system matrix is given by $A = \begin{bmatrix} 0 & 6 \\ -1 & -5 \end{bmatrix}$ **(15)**

   Find: (i) the roots of the characteristic equation and

   (ii) the state transition matrix $\phi(t)$ using Laplace transformation method

   (c) A system is represented by a block diagram shown in Fig. for Q. No. 8(c). Determine the state equation of the system. **(15)**

Cont ... P/3

NAME 467 Control Engineering

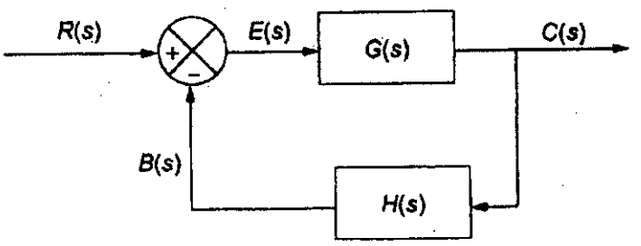


Fig. for Q. No. 5(c)

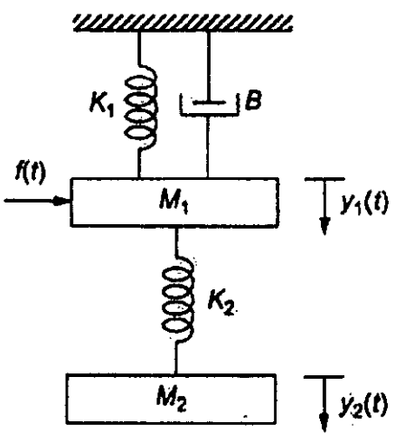


Fig. for Q. No. 6(b)

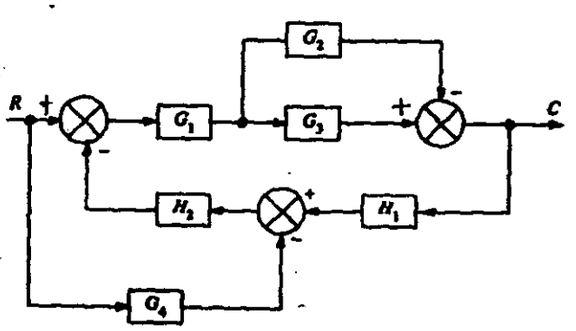


Fig. for Q. No. 7(b)

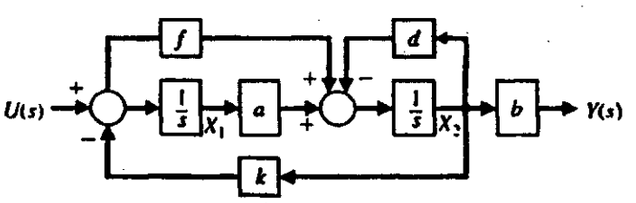


Fig. for Q. No. 8(c)

L-4/T-2/NAME **Date : 07/04/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2017-2018

Sub : **NAME 469** (Ship Performance)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

The symbols have their usual meaning. Assume any reasonable value for any missing data.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Discuss the importance of Hull roughness in terms of resistance of ship. **(10)**

   (b) Define Average Hull roughness. Describe the procedure/steps for measuring the ship hull roughness in detail with sketches. **(15)**

   (c) What is fouling? Classify different types and categories of fouling and its effect on hull resistance. **(10)**

2. A ship has the following particulars LBP = 300 m, Displacement 290000 m^3 , speed 12 knots **(35)**

   (a) Calculate the frictional resistance coefficient due to hull roughness of 260 micron.

   (b) Find also the fractional power increase at constant speed of 12 knots from a smooth AHR 75 micron to 260 micron. Consider the ship is Tanker and $C_T = 2.49 \times 10^{-3}$.

3. A single screw medium speed cargo ship has the following particulars, Length on water line 136 m, length between perpendiculars 133 m, breadth 19.5 m, draft 6 m, speed 16 knots, kinematic viscosity 1.188 $\times 10^{-6}$ m^2/s Block co-efficient 0.553, Prismatic coefficient 0.576 and water plane area coefficient 0.823, midship area coefficient 0.957. Hull roughness 260 micron. Days out of the dock 185 days. **(35)**

   Added resistance due to wind 48.965 kN, Added Wave resistance 42.63 kN, Clean Hull resistance 314.7 kN.

   (a) Find the Total resistance of the ship including fouling and hull roughness.

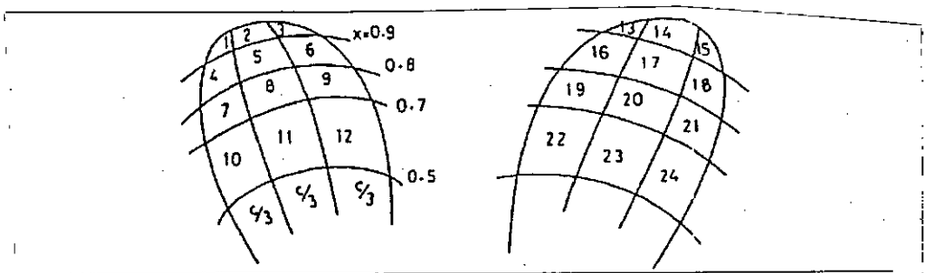
   (b) Calculate the frictional power increase at constant speed of 16 knots from smooth 70 micron to rough 260 micron.

4. A propeller face and back is divided into 24 segments and the roughness of the each segments for two different bands are given below:

Contd P/2

NAME 469

Contd ... Q. No. 4



run loc'n.	1 Ra(b)	1 Ra	1 Pc	2 Ra(b)	2 Ra	2 Pc
face						
1	14.4	13.5	43	14.0	12.4	5:
2	17.4	15.6	22	16.5	15.1	2:
3	18.0	18.3	24	18.1	17.6	2:
4	19.9	19.1	19	19.6	19.1	1:
5	27.0	26.7	24	26.9	27.9	1:
6	22.8	24.5	10	23.6	20.8	1(
7	26.7	28.0	32	27.3	22.2	1:
8	10.1	10.9	15	10.5	10.0	2(
9	9.7	10.0	34	9.8	9.4	2:
10	8.2	6.7	17	7.5	6.6	3:
11	5.6	5.0	51	5.3	5.1	6:
12	10.8	10.2	39	10.5	10.6	1:
back						
13	21.7	20.3	29	20.7	20.6	2:
14	17.0	16.6	19	16.8	16.8	2(
15	21.5	20.0	27	20.7	19.8	2(
16	18.0	21.1	28	19.5	21.8	1:
17	46.4	46.8	17	46.6	47.0	1(
18	25.1	24.9	10	25.0	26.5	1:
19	23.1	21.0	15	22.0	20.2	2(
20	21.7	22.1	19	2:.9	24.6	2:
21	17.4	17.8	27	17.6	18.3	2:
22	22.6	22.5	36	22.5	20.6	3(
23	7.9	8.0	56	7.9	7.9	4(
24	8.0	8.2	46	8.1	8.4	3(

Weights for Calculating APR

i	Region	Weight
1	0.2 - 0.5	0.07
2	0.5 - 0.7	0.22
3	0.7 - 0.8	0.21
4	0.8 - 0.9	0.27
5	0.9 - TIP	0.23

Calculate the APR of this propeller. **(35)**

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) (i) Obtain the curves of wind coefficient for axial force, side force and yawing moment on a base of relative angle γ for a tanker of the following dimensions: **(20)**

   $L = 225$ m $C_B = 0.80$ $B = 35$ m

   $A_T = 412$ m^2 $T = 13$ m $A_L = 1460$ m^2

   (ii) Calculate the direct wind resistance for:

   Ship speed, $v = 15$ knots

   Ship's Heading = 50° NE

   True wind speed = 15 m/s

   True wind direction = –45° NW

   $\rho_{air} = 1.5$ kg/m^3

   (iii) Estimate the rudder resistance when rudder area is 52 m^2 and rudder angle of 1°.

   (iv) Estimate the yawing resistance if yawing amplitude is 2.5°

   (b) With a definition diagram, describe the equation of axial force, latent force and yawing moment of a ship experiences an oblique wind in a seaway. **(15)**

6. (a) Define 'Weather Margin'. Mention and explain various factors that are responsible for loss of speed in a seaway. **(15)**

Contd P/3

NAME 469

Contd ... Q. No. 6

(b) A 400 ft long cargo ship is encountering head waves of height 7 ft and 500 ft in wavelength. The following expressions are obtained for heaving, pitching, heaving exciting force and pitching exciting moment: **(10)**

$Z = 4 \sin(\omega_e t - 37°)$ (ft)

$Q = 3 \sin(\omega_e t - 41°)$ (degree)

$F = 300 \sin \omega_e t$ (ton)

$M = 80{,}000 \sin \omega_e t$ (ton –ft)

Calculate the resistance increase using Havelock's formula and determine the percentage increase of resistance associated with heaving and pitching individually.

(c) Briefly describe experimental methods for predicting added resistance of ships. **(10)**

7. (a) Following date are available from a model test: **(20)**

$L = 4.8$ ft $B = 0.684$ ft $V = 1.415$ knots $\Delta = 0.7106$ ft^3 $L_{WL} = L$

$\omega = 6.49$ rad/sec (deepwater)

Wave amp., $\xi_a = 0.05$ ft

Heave amp. $z_a = 0.0307$ ft

Pitch amp. $\theta_a = 0.0404$ rad

$\int b_m(\xi)\, d\xi = 3.171$ lb – sec/ft

$\int b_m(\xi)\, \xi\, d\xi = 0.045$ lb – sec

$\int b_m(\xi)\, \xi^2\, d\xi = 8.815$ lb – sec – ft

$\cos \epsilon = 0.0122$ $\rho = 1.9905$ lb – sec^2/ft (salt water)

Determine the added resistance of the model due to motion in a regular seaway.

(b) Write short note on: (i) wave induced resistance (ii) Far field and near field methods for predicting added resistance **(15)**

8. (a) Describe the effect of propeller roughness on ship. **(10)**

(b) How do you assess the propeller roughness? Discuss the causes of surface roughness of propeller with reference to the following: **(20)**

(i) Corrosion

(ii) Impingement attack

(iii) Cavitation erosion

(iv) Improper maintenance

(c) Classify the design parameters to be considered for good sea keeping performance of a ship. **(5)**

NAME 469

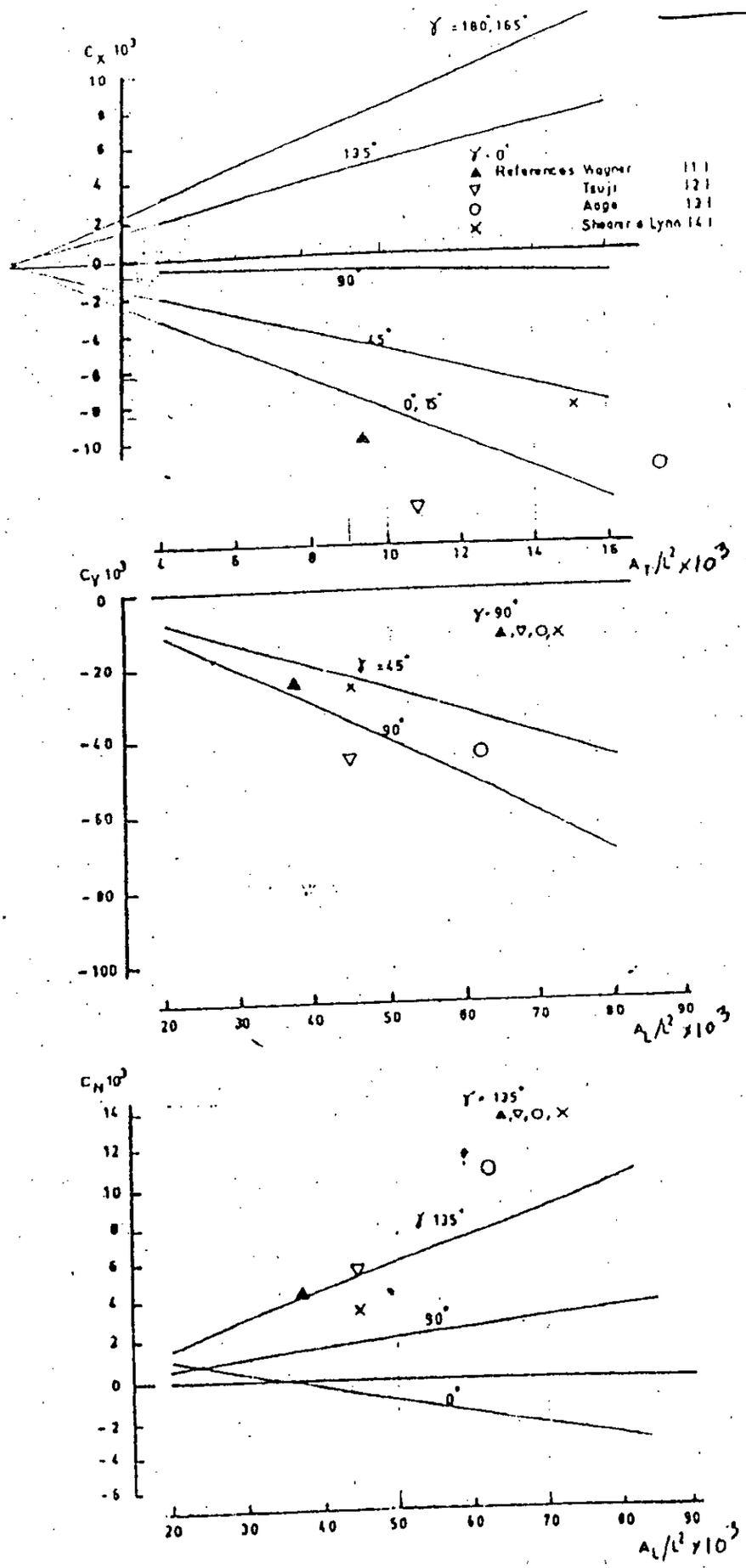


Fig. Level of wind coefficients for tankers for α = NO. 5 (a).

Cont... P/5.

NAME 469

$$\frac{R_{AW}}{\rho g \zeta_a^2 (B^2/L)} = \frac{L^2}{32B^2}\left[\left(\frac{z_a}{\zeta_a}\right)^2 P_1 + \frac{\pi^2 L^2}{L_w^2}\left(\frac{\theta_a L_w}{2\pi\zeta_a}\right)^2 P_3 - \frac{2\pi L}{L_w}\left(\frac{L_w\theta_a}{2\pi\zeta_a}\right)\left(\frac{z_a}{\zeta_a}\right) P_2 \cos\varepsilon\right] \quad (11.3)$$

where

$$P_1 = \frac{\omega_e^3}{\rho g^2}\frac{2}{L}\rho\nabla\sqrt{\frac{g}{L}}B_{33}$$

$$P_2 = \frac{\omega_e^3}{\rho g^2}\frac{2}{L}\rho\nabla\sqrt{\frac{g}{L}}(B_{35} + B_{53})$$

$$P_3 = \frac{\omega_e^3}{\rho g^2}\frac{2}{L}\rho\nabla\sqrt{\frac{g}{L}}4B_{55}$$

and

$$\varepsilon = |\varepsilon_z - \varepsilon_\theta|$$

Heave displacement, $z = z_a \cos\omega_e t$

and

Pitch displacement, $\theta = \theta_a \cos(\omega_e t + \varepsilon)$

The damping coefficients used in (11.3) are given as

$$B_{33} = \frac{1}{\omega_e \nabla}\sqrt{\frac{g}{L}}\int b_n d\xi$$

$$B_{35} + B_{53} = \frac{2}{\omega_e \nabla}\sqrt{\frac{g}{L}}\int \xi b_n d\xi$$

and

$$B_{55} = \frac{1}{\omega_e \nabla}\sqrt{\frac{g}{L}}\int \xi^2 b_n d\xi$$

where

ω_e = frequency of encounter [rad/sec]
∇ = volume of displacement [ft^3]
b_n = sectional damping coefficient
$\xi (= 2x/L)$ = nondimensional longitudinal coordinate [ft]

For q. no. 7(a)

— X —

L-4/T-2/NAME **Date : 27/03/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2017-2018

Sub : **NAME 427** (Maritime System and Management)

Full Marks : 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

The symbols have their usual meanings. Assume reasonable value for any missing data

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SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) List the name of different Contracts used in shipbuilding. Mention advantages and disadvantages of each of them. **(15)**

   (b) With a diagram, show the financial responsibilities in chartering of ships for bareboat charter, voyage charter and time charter. **(10)**

   (c) Calculate the freight rate between the Arabian Gulf and N. W. Europe for a 60,000 dwt tanker at W80 via the Cape or via a Suez Canal, given the W100 = $28.0 via Cape and W100 = $17.0 via Suez, Canal dues $3.0 per ton Cargo, brokerage 2.5% on actual income. Cargo capacity is 95% of dwt via Suez and for Cape 1000 ton less than that of Suez. **(10)**

2. (a) Show the integrated process of ship design by using block diagram. Why uncertainty and sensitivity analysis are required in ship design process? Briefly explain. **(20)**

   (b) Define the following terms: F. I. O., F. O. B., Lay days, Trip charter, Demisc charter. **(10)**

   (c) What is FOC? What are the motivation factor for taking FOC? **(5)**

3. (a) Write short notes on: **(15)**

   (i) Second hand market

   (ii) Contract of Affreightment

   (iii) Demolition market

   (b) Find the AAC of a passenger ship that has an investment cost of $28.0 M, a life expectancy of 30 years and a disposal value of $4.0 M. The operating costs are $3.0 M p. a. for the first 15 years and $3.5 M p. a. for the final 15 years. There are also rehabilitation expenses of $ 5.0 M in the 5^{th}, 10^{th} , 15^{th} , 20^{th} and 25^{th} year, interest rate is 22%. **(13)**

   (c) What are the factors that affect the demand and supply of maritime economy? **(4)**

   (d) Why little overhead is required to run ship and organize the cargo for bulk shipping? **(3)**

4. (a) Bulk carrier to carry full cargo of grain from New Orleans to Rotterdam after balfast voyage from U. K. **(20)**

Contd P/2

NAME 427

Contd ... Q. No. 4(a)

SHIP	30,000 tonnes d.w., Summer draft 10.4 m 37,500 m^3 grain, speed 14.5/15.5 knots at loaded/ballast 32 tonnes HVF per day plus 1.5 tones DO at sea or in port. Daily running cost £2900 excluding capital charges
CARGO	28,000 tonnes grain. Loading rate 7000 tonnes/day Discharging rate 4,000 tonnes/day Loading charge $1.00 per tone Free discharging. Freight $16.00 per tone, Brokerage 5% assume £1 = $1.30
TIME	Outward in ballast 4,800 miles at 15.5 knots. Distance between New Orleans to Rotterdam 5000 miles, Bunkering time and waiting for berth at new Orleans are 0.5 days and 1.5 days respectively. Harbour ducs on others $26,000 at New Orleans U. K. Port charges 7,000; Harbour dues and miscellaneous at Rotterdam $32000
FUEL	HVF cost $100/tonne. DO cost $ 170/tone.

Calculate: (i) total voyage time

(ii) Total port disbursements cost

(iii) Surplus per day.

(b) Mention differences between deep sea linear and bulk shipping. **(8)**

(c) Why general Cargo transport cost at sea is higher than bulk transport? How does the unit cost fall with the increase of ship size? **(7)**

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) Show that the Sinking Fund Factor (SF) can be expressed as: $SF = \frac{i}{(1+i)^n - 1}$ and hence also show that SF = CR – i, where CR is the capital Recovery Factor. **(20)**

(b) Define RFR and Permissible Price as an economic criteria for marine problems. Also draw a decision chart for the choice of economic criteria. **(15)**

6. (a) List the most important irregular cash flows that are found in practical cases of ship investment. **(9)**

(b) Which is the better freight contract for the owner of an existing ship: one with an NPV of $1.0 M with a duration of 8 years or one with $1.1 M over 10 years? Owner's opportunity cost of capital is 10%. **(6)**

(c) A flag-of-convenience ship-owner buys a 2,00,000 tonne DWT bulk carrier for $30.0 M cash (i. e. no loans or taxes). He is offered a 15 year time charter by a steel company and time charter rate is $2.50 per tonne DWT per month. Assume 11.5 months trading per annum and annual running costs $2.0 M. Draw cash flow diagram and calculate: **(20)**

(i) Net annual cash flow (ii) Maximum price payable for the ship to obtain the required rate of return 10%.

Contd P/3

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7. (a) For the following ship operating information, find whether the specific rate of interest is suitable or not. Straight line depreciation is applied. **(30)**

   Pay load = 30,000 ton

   Number of trips = 20 trips/year

   Freight rate = $14/ton escalating 5% p.a.

   Operating cost = $ 2.0 M escalating 10% p. a.

   Ship cost = $40.0 M

   Tax rate = 50%

   Ship life = 20 years

   i = 10%

   b) Define NPVI. Why is it important? **(5)**

8. (a) Consider the purchase of two ship navigation systems. Calculate the annual cost and present net value of these systems if the annual interest rate, i = 12% is considered and the initial cost, the maintenance and operating cost and the salvage value of the systems are shown below: **(20)**

System	1	2
Initial cost	$1,00,000	$65,000
Maintenance and operating cost	$4,000	$8,000
Salvage value after 5 years	$18,000	$5,000

   (b) In a new diesel propelled bulk carrier, fitting of an exhaust gas waste heat generating plant to provide electrical power at sea is estimated to cost $3,00,000 more than the equivalent system using only diesel alternators. The equipment reduces auxiliary fuel consumption by 1 ton per day at sea, with fuel assumed to cost $200 per tonne. If the ship operator expects the ship to spend 230 days at sea a year, and is looking for a rate of return over the 16-year life of the ship of at least 11% on the extra capital, does the equipment look a good investment? Draw cash flow diagram and support your answer by calculation. As a first approximation, it may be assumed that differences in maintenance costs, weights and space are negligible. **(15)**

L-4/T-2/NAME **Date : 16/03/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2017-2018

Sub : **NAME 429** (Marine Engineering)

Full Marks : 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

Symbols have their usual meaning. Assume reasonable values for any missing data.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Explain with figure the methods for obtaining humidification and dehumidification of refrigerant. **(10)**

   (b) What is by-pass factor? Find the BPF for heating and cooling coil in refrigeration and prove that $BPF = e^{\left(-\frac{UA_C}{1.022 m_a}\right)}$ **(25)**

2. (a) Write down the factors considered for the selection of refrigerant for a system. Give the chemical formula and names of the refrigerants R-22 and R-114. **(15)**

   (b) A simple refrigerant 134a heat pump for space heating, operates between temperature limits of 15°and 50°. The heat required to be pumped is 100 MJ/h. Determine: (i) The dryness fraction of refrigerant entering the evaporator, (ii) The discharge temperature assuming the specific heat of vapor as 0.996 kJ/kgK; (iii) The theoretical piston displacement of the compressor, (iv) The theoretical power of the compressor; and (v) The C.O.P.

   The specific volume of refrigerant 134a saturated vapor at 15°C is 0.04185 m^3/kg. The other relevant properties of R-134a are given below: **(20)**

Saturation temperature (°C)	Pressure (bar)	Specific enthalpy (kJ/kg)		Specific entropy (kJ/kg K)	
		Liquid	Vapour	Liquid	Vapour
15	4.887	220.26	413.60	1.0729	1.7439
50	13.18	271.97	430.40	1.2410	1.7312

3. (a) Explain the major differences between a refrigerator and a heat pump. How can you derive the EPR of a heat pump from the C.O.P. of a refrigerator? **(15)**

   (b) A cold storage plant is required to store 20 tonnes of fish. The fish is supplied at a temperature of 30°C. The specific heat of fish above freezing point is 2.93 kJ/kg K and below freezing point is 1.26 kJ/kg K. The fish is stored in cold storage which is maintained at –8°C. The freezing point of fish is -4°C. The latent heat of fish is 235 kJ/kg. If the plant requires 75 kW to drive it, find: **(20)**

   (i) The capacity of the plant, and (ii) Time taken to achieve cooling.

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4. Derive the expression for enthalpy (total heat) of moist air. A room 7m × 4m × 4m is occupied by an air-water vapor mixture at 38°C. The atmospheric pressure is 1 bar and the relative humidity is 70%. Calculate the humidity ratio, dew point, mass of dry air and mass of water vapor. If the mixture of air-water vapor is further cooled at constant pressure until the temperature is 10°C, find the amount of water vapor condensed. **(35)**

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) Briefly explain different types of winches used in ships. **(15)**

   (b) You are supposed to use HVAC&R system, what are the goals can you achieve using this system? **(5)**

   (c) A duct of 15 m length passes air at a rate of 90 m^3/min. Assume the friction factor is 0.005. Calculate the pressure drop in the duct in mm of water when (i) the duct is circular of diameter 0.3 m (ii) the duct is of 0.3 m square cross section. **(15)**

6. (a) A duct 2 m by 1 m in size carrying conditioned air runs in a straight line for 50 m from the supply fan. It divides into two parts each of 80 m long and 2 m by 1 m cross section as shown in figure. If the quantity of air discharge at 'C' is 1600 m^3/min, calculate the quantity discharged at 'D' and the static pressure at the fan outlet 'A'. Calculate the duct friction loss in N/m^2 taking the value of friction factor as 0.005. **(20)**

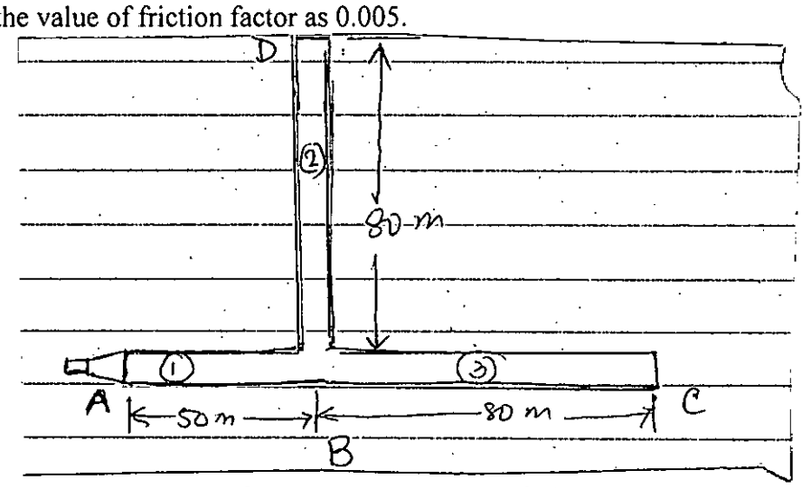

Fig. for Q. No. 6 (a)

   (b) Describe, whether figure, the basic principal of a centrifugal pump. **(10)**

   (c) You are suppose to design a duct, what are the general rules that you have to keep in mind? Explain. **(5)**

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7. (a) Explain the working principle of a steering gear with a schematic diagram. **(25)**

   (b) A single pump is used to take 500 litre water at a height of 20 m with a flow rate 65 litre/minute in about 8 m. If another pump is introduced to pump the water at the same height in 5 minutes, which configuration should we choose? Explain. **(10)**

8. (a) For the following pump, determine the required pipe diameter to pump 60 litre/s and also calculate the needed power. **(20)**

   Minor losses : $10\frac{v^2}{2g}$
   Pipe length : 10 km
   Roughness : 0.15 m
   h_s : 20 m (static head)

Q(L/s)	70	60	50	40	30	20	10	0
H_t	31.0	35.0	38.0	40.6	42.5	43.7	44.7	45
η_p	40	53	60	60	57	50	35	-

   (b) Compute the discharge pressure head in meters, total power required kw and overall pumping efficiency for model 1040A with a 25.4 cm impeller and model 1230 A with a 30.48 cm impeller given in Figure for Question No. 8(b). When the pumps are placed in series. The pumps are to be operated at a rotational speed of 1750 rpm at a designed discharged discharge of 0.03155 m^3/s. **(15)**

Table C.1aSI Saturation Temperature Table for Steam in SI Units

T C	P_{sat} kPa	v_f m3/kg	v_g m3/kg	v_{fg} m3/kg	h_f kJ/kg	h_g kJ/kg	h_{fg} kJ/kg	u_f kJ/kg	u_g kJ/kg	u_{fg} kJ/kg	s_f kJ/kg K	s_g kJ/kg K	s_{fg} kJ/kg K
0	0.6119	0.000995	205.94	205.93	0.9007	2500.02	2499.12	0.9001	2374.02	2373.12	-0.0013	9.1582	9.1595
2	0.7066	0.000995	179.63	179.63	9.2488	2504.40	2495.15	9.2481	2377.48	2368.24	0.0297	9.1052	9.0755
4	0.8140	0.000996	157.04	157.04	17.5909	2508.60	2491.01	17.5901	2380.76	2363.17	0.0604	9.0531	8.9928
6	0.9357	0.000996	137.59	137.59	25.9279	2512.64	2486.72	25.9269	2383.90	2357.97	0.0908	9.0020	8.9113
8	1.0732	0.000997	120.82	120.82	34.2606	2516.58	2482.31	34.2595	2386.91	2352.66	0.1209	8.9519	8.8309
10	1.2282	0.000997	106.31	106.31	42.5897	2520.42	2477.83	42.5885	2389.84	2347.25	0.1508	8.9026	8.7518
12	1.4026	0.000998	93.74	93.74	50.9160	2524.19	2473.27	50.9146	2392.70	2341.79	0.1804	8.8542	8.6738
14	1.5985	0.000999	82.83	82.83	59.2401	2527.90	2468.66	59.2385	2395.51	2336.27	0.2098	8.8066	8.5969
16	1.8180	0.000999	73.33	73.33	67.5625	2531.58	2464.02	67.5607	2398.27	2330.71	0.2389	8.7599	8.5211
18	2.0635	0.001000	65.04	65.04	75.8837	2535.23	2459.34	75.8817	2401.01	2325.13	0.2678	8.7141	8.4463
20	2.3376	0.001000	57.80	57.80	84.2043	2538.85	2454.65	84.2020	2403.73	2319.53	0.2964	8.6690	8.3725
22	2.6431	0.001001	51.47	51.46	92.5247	2542.46	2449.94	92.5220	2406.43	2313.91	0.3249	8.6247	8.2998
24	2.9830	0.001002	45.90	45.90	100.845	2546.06	2445.21	100.842	2409.12	2308.28	0.3531	8.5811	8.2280
26	3.3604	0.001002	41.02	41.02	109.166	2549.65	2440.48	109.163	2411.81	2302.65	0.3811	8.5384	8.1572
28	3.7789	0.001003	36.72	36.71	117.488	2553.23	2435.74	117.484	2414.49	2297.01	0.4090	8.4963	8.0874
30	4.2420	0.001004	32.92	32.92	125.811	2556.81	2431.00	125.807	2417.17	2291.36	0.4366	8.4550	8.0184
32	4.7536	0.001005	29.57	29.56	134.136	2560.39	2426.25	134.131	2419.84	2285.71	0.4640	8.4143	7.9503
34	5.3181	0.001005	26.60	26.60	142.462	2563.96	2421.50	142.456	2422.52	2280.06	0.4913	8.3744	7.8831
36	5.9398	0.001006	23.96	23.96	150.790	2567.53	2416.74	150.784	2425.19	2274.40	0.5183	8.3351	7.8168
38	6.6235	0.001007	21.62	21.62	159.120	2571.09	2411.97	159.113	2427.86	2268.74	0.5452	8.2964	7.7512
40	7.3743	0.001008	19.54	19.54	167.452	2574.65	2407.20	167.444	2430.52	2263.08	0.5719	8.2584	7.6865
42	8.1975	0.001009	17.69	17.69	175.786	2578.20	2402.41	175.778	2433.18	2257.41	0.5985	8.2210	7.6226
44	9.0987	0.001009	16.04	16.03	184.123	2581.75	2397.63	184.114	2435.84	2251.73	0.6248	8.1843	7.5594
46	10.084	0.001010	14.56	14.56	192.463	2585.29	2392.83	192.452	2438.50	2246.04	0.6510	8.1481	7.4970
48	11.160	0.001011	13.23	13.23	200.805	2588.82	2388.02	200.794	2441.14	2240.35	0.6771	8.1125	7.4354
50	12.333	0.001012	12.05	12.04	209.150	2592.34	2383.19	209.137	2443.78	2234.65	0.7030	8.0775	7.3745
52	13.610	0.001013	10.98	10.98	217.498	2595.86	2378.36	217.484	2446.42	2228.93	0.7287	8.0430	7.3143

NAME 429 [Figure for Question No. 4]

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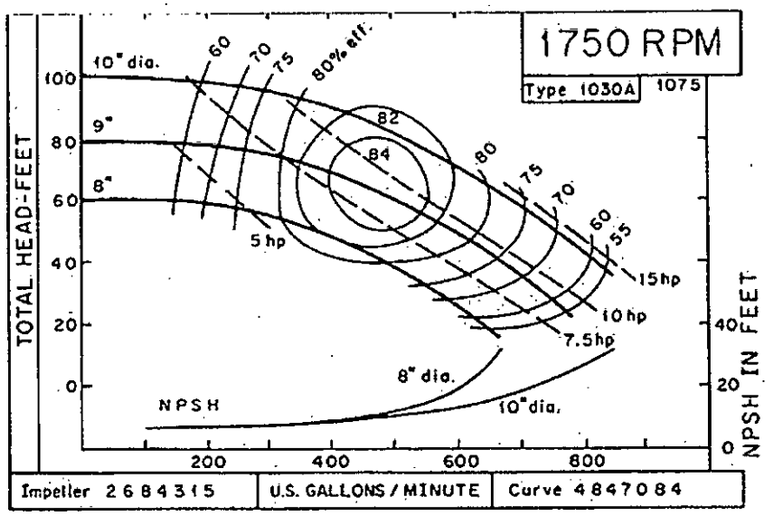

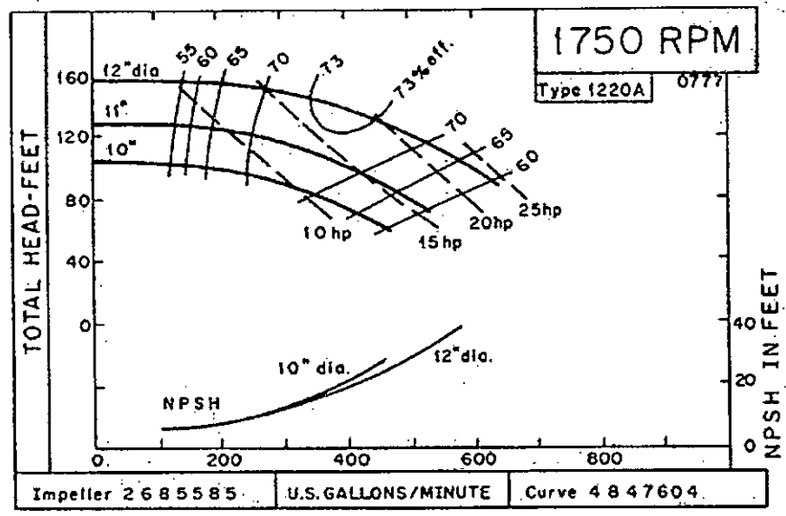

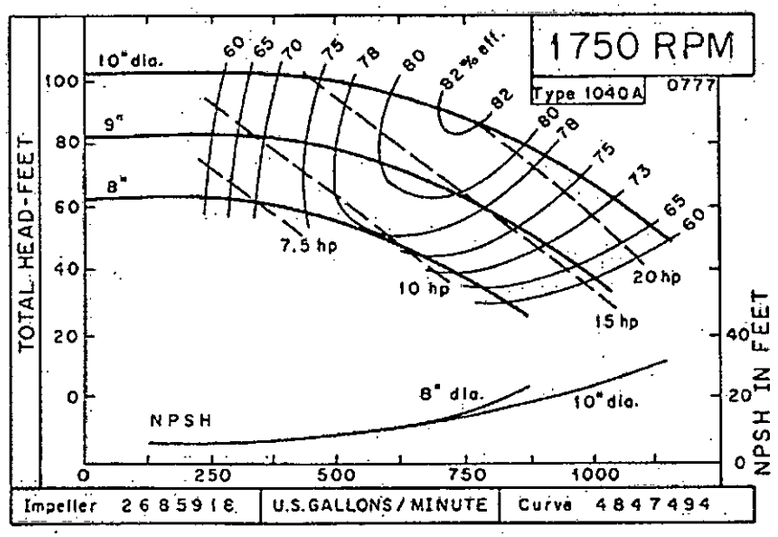

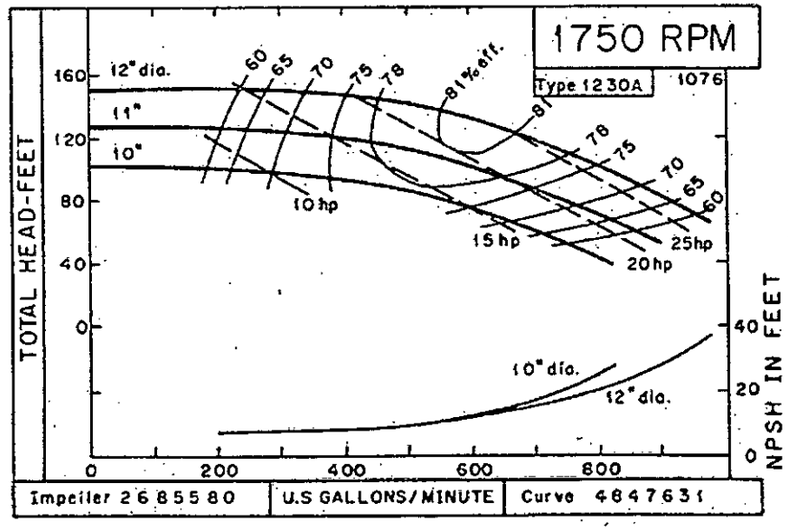

FIGURE FOR Q. NO - 8 (b)

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