L-4/T-2/NAME **Date: 29/04/2023**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2020-2021

Sub: **NAME 423** (Power and Propulsion of Ships)

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

Symbols have their usual meaning. Reasonable values can be assumed for any missing data.

1. (a) What are the pros and cons of medium speed diesels? **(10)**

   (b) Explain the main features of gas turbine. **(15)**

   (c) What benefits the pod drive offers over the Z drive? **(10)**

2. (a) What are the prospects of electric propulsion in Bangladesh? **(15)**

   (b) Explain the working principle of Voith-Schneider propeller. **(10)**

   (c) Why engine-propeller matching is necessary and how it is done? **(10)**

3. (a) Is hydraulic jet propulsion popular in inland waterways of Bangladesh? Justify your answer. **(10)**

   (b) A vessel to be propelled by twin waterjets has an effective power of 2450 kW at its design speed of 30 knots. Carry out a preliminary design of the waterjets assuming the following values: wake fraction 0.05, thrust deduction fraction 0.03, pump efficiency in uniform inflow 0.89, relative rotative efficiency 0.96, inlet efficiency 0.82, nozzle efficiency 0.99, shafting efficiency 0.95, and height of nozzles above water at 30k 0.75 m. Assume the nozzle area as 40% of the inlet area. Use waterjet performance characteristics as shown in Fig. for Q. No. 3(b) **(25)**

4. (a) Why shaft generator is called green source of power? Explain its important features. **(10)**

   (b) How skysail/kite ship can be used for propelling a ship? **(10)**

   (c) An oil tanker has following particular: **(15)**

   L_{WL}=75m, B_{MLD}=20m, D=5m, T=4m, C_B=0.74, C_D=0.68, SFC_{ME}=225 gm/kW.hr, SFC_{AE}=185 gm/kW.hr, Main Engine BHP: 1000 HP at 100% MCR and Engine output at 75% MCR=80% of BHP, Carbon content of the fuel = 0.8648, No shaft motor used, Speed at 75% MCR=12 knot. What will be the EEDI? If Required main engine power is defined by : $C_B x (D^{(2/3)} x V^3/(1.03xC)$ where, D=Displacement, V=Ship speed, C=Coefficient and B_{MLD} is increased by 4.25% considering DWT, C_D and speed be the same as before, what will be the change in EEDI?.

Contd P/2

NAME 423

SECTION – B

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

5. (a) State the advantages and disadvantages of ducted or Kort nozzle propeller. **(20)**

   (b) Write down the types of ducts and then discuss its physics of flow. **(15)**

6. (a) Write short notes on (i) variable pitch propeller (ii) Reversible propeller (iii) Controllable pitch propeller (iv) Fixed variable pitch propeller. **(20)**

   (b) A controllable pitch propeller of 4.0 m diameter has a constant pitch ratio of 0.80 at a particular setting. It the pitch is increased by turning the blades through an angle of 10 degree, determine the resulting radial distribution of pitch and the mean pirch. The root section is at 0.3 R. **(15)**

7. (a) Describe the applications of fuel cells and its specific benefits for each application. **(15)**

   (b) Discuss various types of common fuel cell and then draw a comparison of performance of its. **(10)**

   (c) State the principle of magnetohydrodynamics propulsion system and its advanteges. **(10)**

8. (a) What are the technical problem that remain exist for commercial viability of MHD propulsion system. **(10)**

   (b) Write short notes on:- **(10)**

   (i) Fixed paddles (ii) Feathering paddles.

   (c) State the basic idea for the design of contra-rotating propulsion system and its advantages and disadvantages. **(15)**

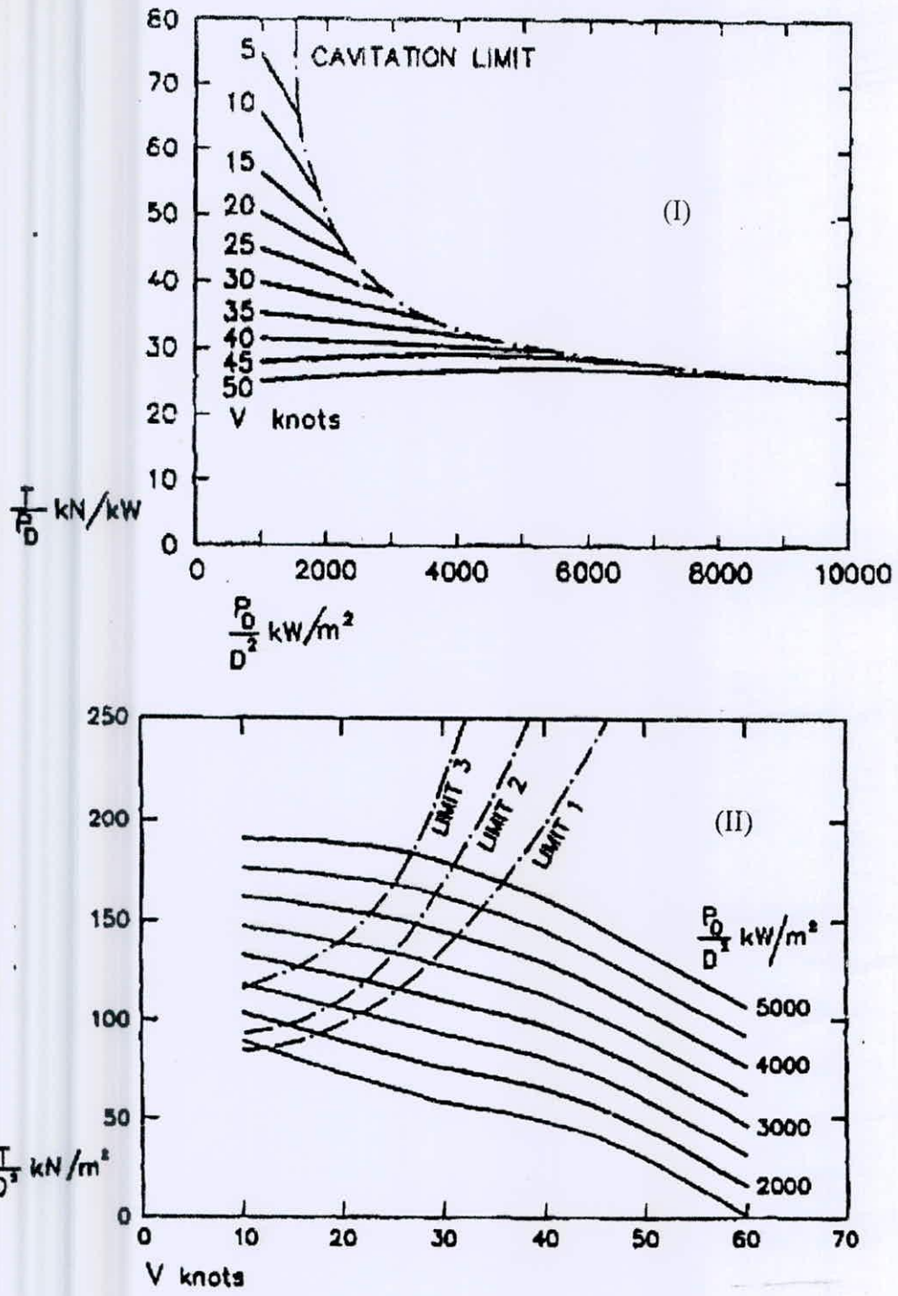

Fig. for Q. No. 3(b): Waterjet performance characteristics (I & II)

L-4/T-II/NAME **Date : 03/05/2023**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-II B. Sc Engineering Examinations 2020-2021

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

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

Symbols have their usual meaning. Assume reasonable value for any missing data. Necessary Table is attached.

1. A large anchor-handling vessel costing 6 M$ cash on delivery is to be built for charter. The owner anticipates a time charter higher rate averaging $ 5000 per day. Annual operating costs are expected to be $ 855,000. Annual off-hire days 25. Vessel life 15 years with zero residual value. Calculate NPV at 8% discount rate with corporation tax at 35% using the following method: **(35)**

   (i) No tax

   (ii) Straight line depreciation

   (iii) Free depreciation.

2. (a) With a block diagram, show the decision chart for choice of economic criterion for marine problem. **(15)**

   (b) The building cost (P), annual operating cost (Y), annual cargo capacity (C) and annual revenues (R) for four cargo ship designs are prepared in the following Table. Assume a life of 25 years and interest rate 10%, calculate AAC and RFR. Which design should be selected? **(15)**

Item	Cargo ship-I	Cargo ship-II	Cargo ship-III	Cargo ship-IV
P($)	4000	4200	4500	4900
Y($)	600	610	620	630
C(Tonnes)	50	55.5	62	64.5
R($)	1000	1110	1240	1290

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

3. (a) With a block diagram show the integrated process for ship design. **(10)**

   (b) A ship owner purchases a tanker for $45 million and is offered two different deals by oil company A and oil Company B.

   Oil company A offers to charter the ship for $18,000 per day for 7 years, trading 355 days a year. At the end of the charter the oil company A guarantees to buy the ship for $35 million.

Contd P/2

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Contd...Q.No. 3(b)

Oil company B's proposal is a little complex. To fit its trading patterns the company wants to owner to have the cargo tanks epoxy coated. This will cost $3 million, bringing the total price upto $48 million. However, company B is willing to buy the ship at the end of the charter for $45 million. Also, they want to escalate the daily charter rate by $2000 each year from $12,000 per day in year 1 to $24,000 per day in year 7.

Consider 12% discount rate per annum; propose which deal the owner must choose? Which economic criteria would you select to determine the most profitable course of action? Write specific reasons for your selection. **(25)**

4 (a) The calculations of cashflow for building account and operating account are shown in Table for Q. No. 4(a) for a 100,000 m^3 liquefied gas carrier operating in a consortium with a 12 year time charter. The ship price is $100,000,000/with a 80% loan for eight years at 8% interest, the tax situation is U. K. new entry with decline balance. Show by calculation of the following: **(25)**

(i) whether the ship owner should charter the ship if he wishes to get IRR after tax of at least 12%

(ii) In case the answer to (i) above is negative, what conditions he should seek for getting his desired IRR.

(iii) point at the important irregular cash flow in this problem.

(b) A package of control equipment for an item of ships machinery comes in two models: a heavy duty model costing $40,000 which will last the 16 years life of the ship and the standard model costing $26,000 which lasts 8 years. Which model offers the lower cost over the ships life, if maintenance and operating costs, are the same for both models? Assume 12% opportunities cost of capital, i.e., the owner wants as good a rate of return as is available to him in other investment opportunities. **(10)**

SECTION – B

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

Assume reasonable values of missing data (if any). Symbols have their usual meaning.

5. Voyage information of a 75,000 tonnes dwt bulk carrier is given in Table for Q. No. 5. The port time of 3 days loading, and 2 days discharging (total 5 days) includes time waiting for a berth, documentation, loading and discharging cargo, bunkering and a day for transiting the Panama Canal. **(35)**

The speed is 15 knots on the loaded and ballast voyage and consider 5% sea margin to allow for weather conditions and other delays. The ship burns bunker oil 33 tons per day on the laden voyage and 31 tons per day on the ballast voyage. In additions, diesel oil consumption is 1 ton per day for both laden and ballast voyages. In addition, diesel oil consumption is 1 ton per day for both laden and ballast voyages.

Contd P/3

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Contd...Q. No. 5

The bunker price is $ 338 per ton for bunker oil and $531 per ton diesel oil for the auxiliaries.

Operating cost of the vessel is $5,620 per day. Total port costs (four port calls) = $418,000 and canal dues = $80,000.

Assume, operating time = 350 days per year, port congestion provision = 10 days, and broker's commission = 15%. Determine the time-charter equivalent per day for the round voyage.

6. (a) What is safety management system? Historically, how safety has been managed by the international maritime community? Explain using your own words. **(18)**

   (b) What is risk analysis? How risk analysis may improve maritime safety in Bangladesh? **(17)**

7. (a) Explain the ship operating economics indicating respective financial responsibilities. Use schematic diagrams. **(18)**

   (b) Define and classify chartered ships associated with the profit market. Provide appropriate examples. **(17)**

8. (a) Explain the differences and similarities between industrial carrier and common carrier. In your opinion which carrier may implement safety measures better than the other? **(17)**

   (b) Write short notes on the following contracts: **(18)**

   (i) LSFP

   (ii) CPIF

   (iii) CPFF

Table for Question No. 5

Route	Distance (miles)	Days at sea	Days in port	Cargo (tons)	Freight ($/ton)
Leg 1: US Gulf - Japan	9,123	26.7	5	54,000	56.0
Leg 2: Japan - Australia	4,740	13.9	0	Ballast	
Leg 3: Australia - Europe	12,726	37.2	10	70,000	39.0
Leg 4: Europe – East Coast North America	4,500	13.2	0	Ballast	

BUILDING ACCOUNT

Table for q. NO. 4(a) — V2

Thousands of Dollars

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Year	Building Instalments	Owner's 20%	Loan Drawdown	Owner's Expenses & Fees	Loan Repayments	Loan Outstanding	Loan Interest 8%	Owner's Cash Outflow
0	5000	5000		500				5500
0.5	10000		10000	500		10000	0	500
1	10000	5000	5000	500		15000	400	5900
1.5	15000		15000			30000	600	600
2	20000	5000	15000	500		45000	1200	6700
2.5	20000		20000			65000	1800	1800
3	20000	5000	15000	1000		80000	2600	8600
4					10000	70000	6400	16400
5					10000	60000	5600	15600
6					10000	50000	4800	14800
7					10000	40000	4000	14000
8					10000	30000	3200	13200
9					10000	20000	2400	12400
10					10000	10000	1600	11600
11					10000	0	800	10800
Total	100000	20000	80000	3000	80000		35400	138400

OPERATING ACCOUNT

Table for Q. No. 4(a) — 2/2

Thousands of Dollars

(1) Year	(2) Annual Income	(3) Crew Costs	(4) Upkeep Costs	(5) Other Costs	(6) Annual Operating Costs	(7) Cash Flow Before Tax	(8) TAX Interest	(9) 25% Annual	(10) ALLOWANCES Max. Cum.	(11) Actual Annual	(12) Actual Cum.	(13) Total Tax Allowances	(14) Taxable Profit	(15) Tax at 35%	(16) Cash Flow After Tax
4	22667	1200	1496	1702	4398	18269	13000	25750	25750	5269	5269	18269	0	0	18269
5	22667	1200	1616	1838	4654	18013	5600	19313	45063	12413	17682	18013	0	0	18013
6	22667	1200	1745	1985	4930	17737	4800	14484	59547	12973	30619	17737	0	0	17737
7	22667	1200	1885	2144	5229	17438	4000	10863	70410	13438	44057	17438	0	0	17438
8	20667	1200	2036	2315	5551	15115	3200	8147	78557	11915	55972	15115	0	0	15115
9	22667	1200	2199	2500	5899	16768	2400	6111	84668	14368	70340	16768	0	0	16768
10	22667	1200	2375	2700	6275	16392	1600	4583	89251	14792	85132	16392	0	0	16392
11	22667	1200	2565	2916	6681	15986	800	3437	92688	7556	92688	8356	7636	0	15986
12	22667	1200	2770	3150	7120	15547	--	2578	95266	2578	95266	2578	12969	2673	12874
13	18667	1200	2991	3402	7593	11073	--	1933	97199	1933	97199	1933	9140	4539	6534
14	22667	1200	3231	3674	8105	14562	--	1450	98649	1450	98649	1450	13112	3199	11363
15	22667	1200	3489	3968	8657	14010	--	1088	99737	1088	99737	1088	12922	4589	9421
16	30000					30000				+3263	103000	3263	26737	4523	25477
17														9358	-9358
Total	296002	14400	28398	32294	75092	220910	35400			103000		138400	82516	28881	192029

L-4/T-II/NAME **Date : 10/04/2023**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-II B. Sc. Engineering Examinations 2020-2021

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

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

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

1. (a) "We can increase the cold body temperature without any limit for improving the coefficient of performance of a refrigeration system working based on a reversed Carnot cycle"-Verify the statement.

An air refrigeration used for food storage provides 25 TR. The temperature of the air entering the compressor is 7°C and the temperature at the exit of the cooler is 27°C. The quantity of air circulating in the system is 3000 kg/h. The compression and expansion both follow the law $pv^{1.3}$ = constant. Here, R = 0.287 kJ/kgk. Draw the p-v and T-s diagrams of the cycle and calculate – **(20)**

(i) C.O.P of the cycle (ii) Power per tonne of refrigeration required by the compressor.

(b) On a particular day, the atmospheric air was found to have a dry bulb temperature of 30°C and a wet bulb temperature of 18°C. The barometric pressure was observed to be 756 mm of Hg. Using the Saturate Stream-Temperature table given in the Table for question no. 1(b), determine the relative humidity, the moisture content, the dew point temperature, the enthalpy of air per kg of dry air and the volume of mixture per kg of dry air. **(15)**

2. (a) A vapour compression refrigerator uses R-12 as the refrigerant and the liquid evaporates in the evaporator at –15°C. The temperature of this refrigerant at the delivery from the compressor is 15°C when the vapour is condensed at 10°C. Take specific heat at constant pressure for the superheated vapour as 0.64 kJ/kgk and that for liquid as 0.94 kJ/kgk. The other properties of refrigerant are as follows: **(20)**

Temperature in °C	Enthalpy in kJ/kg		Specific entropy in kJ/kgK	
	Liquid	Vapor	Liquid	Vapor
–15	22.3	180.88	0.0904	0.7051
+10	45.4	191.76	0.1750	0.6921

(i) Calculate the theoretical coefficient of performance and net cooling produced per hour if there is no undercooling. For this case, take the actual coefficient of performance as 0.65 of the theoretical value and the mass flow rate of refrigerant as 5 kg/min. Also, draw the p-v and T-s diagrams of the cycle.

(ii) Calculate the theoretical coefficient of performance if the liquid is cooled by 5°C before expansion by throttling. Also, draw the p-v and T-s diagrams of the cycle.

Contd P/2

NAME 429

Contd...Q. No. 2

(b) Derive the formula of By-Pass Factor (BPF) from the perspective of the heating coil after expressing it by enthalpy balancing considering the situation where air is passing over a heating coil. Also, explain the relationship among dry bulb temperature, saturation pressure and partial pressure of water vapour using a T-s diagram. **(15)**

3. (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 the figure for question no. 3(a). If the quantity of air discharged 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)**

(b) If you find a pump working under cavitation, which parameter of the pump will you modify to minimize the cavitation and how?

A centrifugal pump running at 1000 rpm is connected to a 300 mm suction and delivery pipe the total length of which is 69 m. The discharge to the atmosphere is 15 m above the sump level. The entrance to the atmosphere is 15 m above the sump level. The entrance loss is equivalent to an additional 6 m of pipe and the friction factor is assumed as 0.024. The pump gives the following relation between head and discharge: **(15)**

Discharge (m^3/min)	0	4.5	9.0	13.5	18.0	22.5
Head Provided (m)	22.5	22.2	21.6	19.5	14.1	0

(i) Calculate the discharge in liter/s.

(ii) If it is required to adjust the flow by regulating the pump speed, estimate the speed to reduce the flow to one-half.

4. (a) The figure which is given in the figure for question no. 4(a) shows a typical duct (circular duct) layout. Take the velocity of air in the main duct (A) as 8 m/s. Assume a dynamic loss coefficient of 0.3 for upstream to downstream and 0.8 for upstream to branch and for the elbow. The dynamic loss coefficients for the outlets can be taken as 1. Using the velocity reduction method, calculate the fan total pressure required for the duct system. **(21)**

(b) Define the following terms: **(14)**

(i) 1TR

(ii) Percentage humidity

(iii) Relative humidity

(iv) Vapour density

(v) Dehumidification

(vi) Sensible heating

(vii) Net positive suction head.

Contd P/3

NAME 429

SECTION – B

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

All the symbols have their usual meaning.

5. (a) Briefly explain, the working principle of Two-stage vapor compression refrigeration cycle with water intercooler, liquid sub-cooler and Liquid Flash Chamber with necessary Schematic figures and P-H diagram. **(20)**

   (b) Using the designation system for refrigerant "Tetrafluoro-ethane: and "dichloro-tetrafluoro-ethene". Also discuss the environmental impact of these refrigerants. **(15)**

6. (a) Why it is important to chose accurate shafting system in a particular ship? Illustrate the popular methods of controlling shaft alignment in ships. **(20)**

   (b) What are the causes of pipe failure in ships? Discuss what measures you can take in case of pipe failure. **(15)**

7. (a) What are the physical and chemical properties of refrigerants and how do they influence the choice of refrigerant for a specific application? **(20)**

   (b) Write short notes on the following: **(15)**

   (i) Process air conditioning systems.
   (ii) Economizer
   (iii) Venturi Nozzle steam Trap.

8. (a) How do HVAC systems contribute to overall building sustainability and environmental impact? Explain elaborately. **(20)**

   (b) Why steam traps are used? Explain with necessary figures how thermodynamic steam traps are operated based on changes in fluid dynamics. **(15)**

NAME 429

SATURATED STEAM - TEMPERATURE TABLE

		Spec. vol. m^3=kg		Int. Ener. kJ/kg		Enthalpy kJ/kg		Entropy kJ=(kg°K)	
T °C	P bar	Sat. liq. v_f X1000	Sat. vap. v_g	Sat. liq. u_f	Sat. vap. u_g	Sat. liq. h_f	Sat. vap. h_g	Sat. liq. s_f	Sat. vap. s_g
0.01	0.0061	1.0002	206.1	0.01	2376	0.01	2501	0	9.156
4	0.0081	1.0001	157.2	16.79	2381	16.79	2509	0.061	9.051
5	0.0087	1.0001	147.1	21.00	2383	21	2511	0.0762	9.026
6	0.0093	1.0001	137.7	25.21	2384	25.21	2512	0.0912	9.000
8	0.0107	1.0001	120.9	33.61	2387	33.61	2516	0.1212	8.950
10	0.0123	1.0001	106.4	42.01	2389	42.01	2520	0.151	8.901
11	0.0131	1.0007	99.86	46.19	2391	46.19	2522	0.1658	8.876
12	0.0140	1.0007	93.79	50.40	2392	50.4	2523	0.1806	8.852
13	0.0150	1.0007	88.13	54.59	2393	54.59	2525	0.1953	8.828
14	0.0160	1.0007	82.85	58.80	2394	58.8	2527	0.2099	8.805
15	0.0170	1.0007	77.93	62.99	2396	62.99	2529	0.2245	8.781
16	0.0182	1.0013	73.34	67.17	2397	67.17	2531	0.239	8.758
17	0.0194	1.0013	69.05	71.36	2399	71.36	2533	0.2535	8.735
18	0.0206	1.0013	65.04	75.57	2400	75.57	2534	0.2679	8.712
19	0.0220	1.0013	61.30	79.76	2401	79.76	2536	0.2823	8.690
20	0.0234	1.002	57.79	83.94	2403	83.94	2538	0.2966	8.667
21	0.0249	1.002	54.52	88.13	2404	88.13	2540	0.3108	8.645
22	0.0264	1.002	51.45	92.32	2406	92.32	2542	0.3251	8.623
23	0.0281	1.0026	48.58	96.50	2407	96.5	2544	0.3392	8.601
24	0.0298	1.0026	45.89	100.7	2409	100.7	2545	0.3533	8.579
25	0.0317	1.0032	43.36	104.9	2410	104.9	2547	0.3673	8.558
26	0.0336	1.0032	41.00	109.0	2411	109.0	2549	0.3814	8.537
27	0.0357	1.0032	38.78	113.2	2412	113.2	2551	0.3953	8.515
28	0.0378	1.0038	36.69	117.4	2414	117.4	2553	0.4093	8.495
29	0.0401	1.0038	34.73	121.6	2415	121.6	2554	0.4231	8.474
30	0.0425	1.0045	32.90	125.8	2416	125.8	2556	0.4369	8.453
31	0.0450	1.0045	31.17	130.0	2418	130.0	2558	0.4507	8.433
32	0.0476	1.0051	29.54	134.1	2419	134.1	2560	0.4644	8.413
33	0.0503	1.0051	28.01	138.3	2421	138.3	2562	0.478	8.393
34	0.0532	1.0057	26.57	142.5	2422	142.5	2563	0.4917	8.373
35	0.0563	1.0057	25.22	146.7	2423	146.7	2565	0.5053	8.353
36	0.0595	1.0063	23.94	150.8	2425	150.8	2567	0.5188	8.333
38	0.0663	1.007	21.60	159.2	2427	159.2	2571	0.5457	8.295
40	0.0738	1.0076	19.52	167.5	2430	167.5	2574	0.5725	8.257
45	0.0959	1.010	15.26	188.4	2437	188.4	2583	0.6386	8.165
50	0.1235	1.012	12.03	209.3	2443	209.3	2592	0.7037	8.076
55	0.1576	1.015	9.569	230.2	2450	230.2	2601	0.7679	7.991
60	0.1994	1.017	7.671	251.1	2457	251.1	2610	0.8311	7.910
65	0.2503	1.020	6.197	272.0	2463	272.0	2618	0.8934	7.831
70	0.3119	1.023	5.042	293.0	2470	293.0	2627	0.9549	7.755
75	0.3858	1.026	4.131	313.9	2476	313.9	2635	1.016	7.682
80	0.4739	1.029	3.407	334.8	2482	334.9	2644	1.075	7.612

~~Figure~~ for Question No. 1(b)

Table

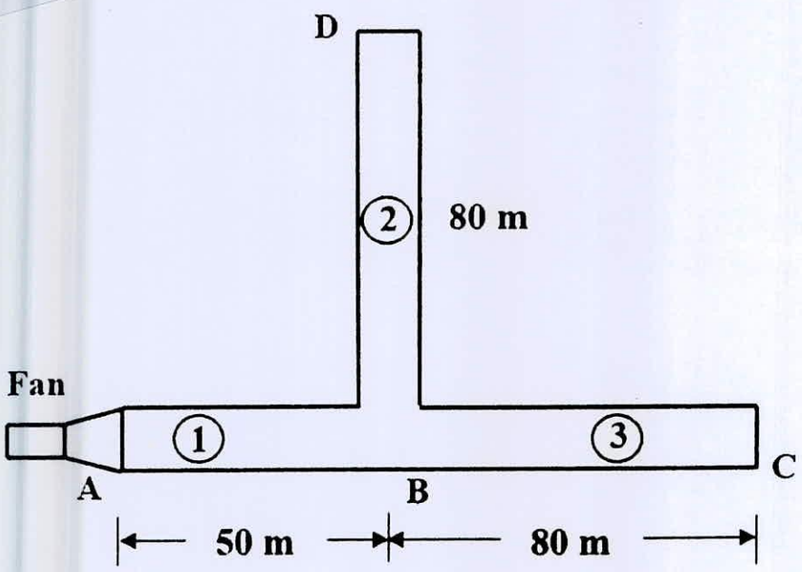

Figure for Question No. 3(a)

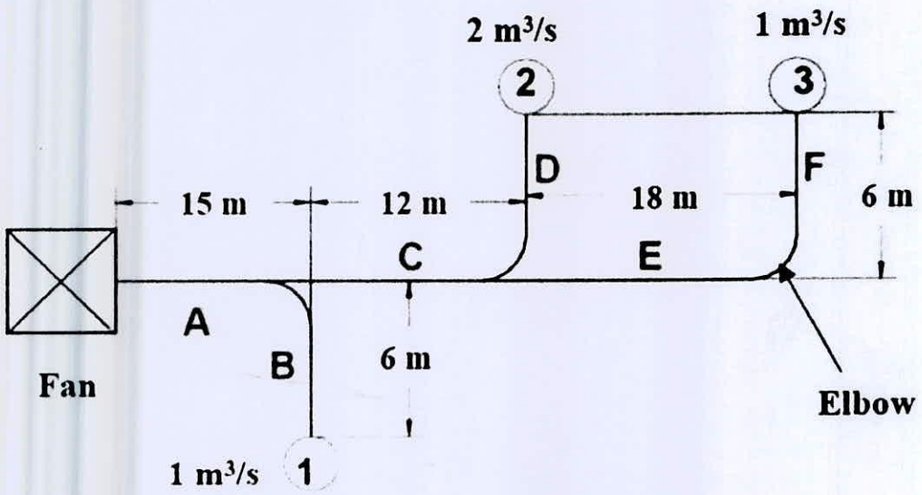

Figure for Question No. 4(a)

L-4/T-II/NAME **Date : 03/04/2023**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-II B. Sc. Engineering Examinations 2020-2021

Sub : **NAME 447** (Design of Inland Waterways Transportation System)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

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

1. (a) What is horizontal and Vertical Control in hydrographic Survey? Briefly explain the methods that will be most effective for estimating the vertical control in deep and Shallow water? **(20)**

   (b) In order to locate the position P of a Sounding boat, the angles APB and BPC subtended at P by three points A , B and C on the shore were measured with a Sextant and found to be 28°42′40″ and 30°28′20″, respectively, the points B and P being on opposite sides of AC. AB and BC were Scaled as 918 m and 1014 m. respectively, and angle ABC was 60°50′40″. Compute the distances PA, PB and PC. **(15)**

2. (a) Suppose you are provided with a station pointer and a plan for locating sounding by three point problem. Which method will you use for solving the three point problem in the shortest possible time? Describe how. Is it the best method for locating sounding? If it the best method for locating Sounding? If not, then state the best method and briefly explain the method. **(20)**

   (b) During a hydrographic survey at sea, the soundings were located by observing three shore stations A, B and C, having co-ordinates (meters) of 0-0, 500N-1000E, and 250N-1500E, respectively. When the boat was at p on the southern side of A, B and C, the angles APB and BPC were found to be 60°20′ and 40°30′, respectively. Calculate the distance AP, BP and CP. **(15)**

3. (a) Explain the method of gauging the flow of a stream by means of a current meter. How are the constants of such meters determined? Discuss briefly. **(10)**

   (b) A 45° V-notch is used to gauge a stream. Determine the flow corresponding to a head of 0.82 m. **(10)**

   (c) Calculate the discharge of a stream given the following current-meter data: **(15)**

Distance across from One bank (m)	0	10	20	30	40	50	60	70
Depth of bed (m)	0	0.50	1.00	1.50	2.00	1.50	1.00	0
Velocity of flow at 0.6 depth (m/s)	0	0.20	0.25	0.30	0.33	0.30	0.20	0

4. (a) What is Priming and lagging? How do these affect mean and vulgar establishment? **(15)**

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(b) "The high water at a place may not occur exactly at the moon's upper or lower transit" – explain the above statement with necessary figures. **(5)**

SECTION – B

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

5. (a) Draw the schematic diagram for the following. **(16)**
   (i) Surface-piercing (SP) and Fully Submerged(FS) hydrofoils;
   (ii) Self-stabilizing system for fully submerged (FS) hydrofoils.
   (b) Describe NACA 2412, NACA 12018 and NACA 712A315. **(9)**
   (c) Explain the different types of salvage. **(10)**

6. (a) Describe the categories of Inland and Oceangoing Tugboats. **(15)**
   (b) Lists the advantages of Articulated Tug and Barge (ATB) over Towed Barges (TB) **(10)**
   (c) Describe the pros and cons of Tug Barge System (TBS). **(10)**

7. (a) Describe the advantages of Inland Water Transport (IWT). **(10)**
   (b) Describe the inherent challenges facing the Inland Water Transport (IWI) sector of Bangladesh. **(12)**
   (c) Why re-classification of the inland waterway routes of Bangladesh is needed. Explain. **(13)**

8. (a) What is Intermodal Transport and Multimodal Transport? With neat sketch describe the difference between them. **(12)**
   (b) Draw the schematic diagram for a framework of the factors that influence the performance of intermodal barge transport. **(10)**
   (c) What are the functions that define an intermodal transport chain? Describe with schematic diagram. **(13)**

L-4/T-II/NAME **Date : 27/03/2023**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2020-2021

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

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

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

1. (a) Discuss the pollution problem from oil cleaning operations. Describe the "Load on Top" and "Crude Oil Washing" process of cleaning oil tanks. **(15)**

   (b) Describe two standards of ballast water management under BWM convention. **(8)**

   (c) Write short notes on the following- **(12)**

   (i) Hong Kong Convention

   (ii) Marine personnel

2. (a) Distinguish between "Flag state" and "Port state control". **(5)**

   (b) What are the certificates issued, their validity and types of risks managed under SOLAS conventions? **(10)**

   (c) Discuss about the MARPOL Annexes "Prevention of Pollution by Sewage from Ships" and Prevention of air Pollution from Ships. Also explain marine pollutant with its mark. **(14)**

   (d) Describe the reasons of Type-B ship having higher freeboards than Type-A ship. **(6)**

3. (a) A type-B ship has a freeboard length of 145 m measured on a waterline at 85% of the moulded depth of 12 m and a beam of 21 m. There is no bridge amidships and the forecastle and poop have mean covered lengths of 30 m and 15 m and sheer of the freeboard deck in mm is as follows: **(35)**

AP	L/6	L/3	L/2	2L/3	5L/6	FP
2730	320	0	0	0	1630	4060

   The displacement at a moulded draught of 85% of the moulded depth is 22700 m^3 and the displacement in seawater at the summer LWL is 19420 tonnes with a corresponding tonnes immersion per cm of 25. Determine the freeboards.

4. (a) What are the provisions introduced in UNCLOS? Describe the following according to UNCLOS- **(20)**

   (i) Archipelagic waters

   (ii) Exclusive economic zones

   (iii) Continental shelf

Contd P/2

NAME 449
Contd...Q.No. 4

(b) Distinguish between "Innocent passage" and "Transit passage". **(5)**

(c) Describe the activities those will be considered as prejudicial to innocent passage. **(10)**

SECTION – B

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

5. (a) Discuss the different methods of Navigation. **(10)**

(b) With schematic diagram, describe the Cardinal marks used in the marine buoyage system. **(15)**

(c) Write short notes on: **(10)**

(i) Electronic Chart Display and Information System

(ii) Safe Water Mark

(iii) Absolute bearing and True bearing

6. (a) Distinguish between the terms "vessel not under command" and "vessel restricted in her ability to manocurve" according to CoLREGs. **(5)**

(b) According to COLREGs, describe "Action to avoid collision". **(15)**

(c) What are the conduct of vessels during head-on situation, crossing situation and overtaking situation? **(15)**

7. (a) "Risk of collision may sometimes exist even when an appreciable bearing change is evident." Justify this statement with your own words. **(5)**

(b) Describe the requirements of Life buoy and Rocket Parachute Flare. **(15)**

(c) Classify fire on the basis of new definition of IMO, May 2007 and discuss about the appropriate fire extinguishers according to the classification. **(15)**

8. (a) According to IMO, in which situation(s) a state may sign a treaty subject to ratification, acceptance or approval? **(5)**

(b) Name the committees of IMO and discuss about their functions. **(15)**

(c) Describe the procedure of the approval of design and plan of inland ships. **(10)**

(d) Discuss the powers of surveyors and registrars. **(5)**

Regulation 30 *Correction for Block Coefficient*
Where the block coefficient (C_b) exceeds 0.68, the tabular shall be multiplied by the factor

$$\frac{C_b + 0.68}{1.36}$$

Regulation 31 *Correction for Depth*

(1) Where D exceeds $\frac{L}{15}$ the freeboard shall be increased by $\left(D - \frac{L}{15}\right)R$ millimetres, where R is $\frac{L}{0.48}$ at length less than 120 m and 250 at 120 m length and above.

(2) Where D is less than $\frac{L}{15}$, no reduction shall be made except in a ship with an enclosed superstructure covering at least 0.6 L amidships, with a complete trunk, or combination of detached enclosed superstructures and trunks which extend all fore and aft, where the freeboard shall be reduced at the rate prescribed in paragraph (1) of this Regulation.

(3) Where the height of superstructure or trunk is less than the standard height, the reduction shall be in the ratio of the actual to the standard height as defined in Regulation 33.

TABLE B. Freeboard Table for Type 'B' Ships

L [m]	f [mm]	L [m]	f [mm]	L [m]	f [mm]	L [m]	f [mm]	L [m]	f [mm]	L [m]	f [mm]
24	200	81	905	138	2065	195	3185	252	4045	309	4726
25	208	82	923	139	2087	196	3202	253	4058	310	4736
26	217	83	942	140	2109	197	3219	254	4072	311	4748
27	225	84	960	141	2130	198	3235	255	4085	312	4757
28	233	85	978	142	2151	199	3249	256	4098	313	4768
29	242	86	996	143	2171	200	3264	257	4112	314	4779
30	250	87	1015	144	2190	201	3280	258	4125	315	4790
31	258	88	1034	145	2209	202	3296	259	4139	316	4801
32	267	89	1054	146	2229	203	3313	260	4152	317	4812
33	275	90	1075	147	2250	204	3330	261	4165	318	4823
34	283	91	1096	148	2271	205	3347	262	4177	319	4834
35	292	92	1116	149	2293	206	3363	263	4189	320	4844
36	300	93	1135	150	2315	207	3380	264	4201	321	4855
37	308	94	1154	151	2334	208	3397	265	4214	322	4866
38	316	95	1172	152	2354	209	3413	266	4227	323	4878
39	325	96	1190	153	2375	210	3430	267	4240	324	4890
40	334	97	1209	154	2396	211	3445	268	4252	325	4899
41	344	98	1229	155	2418	212	3460	269	4264	326	4909
42	354	99	1250	156	2440	213	3475	270	4276	327	4920
43	364	100	1271	157	2460	214	3490	271	4289	328	4931
44	374	101	1293	158	2480	215	3505	272	4302	329	4943
45	385	102	1315	159	2500	216	3520	273	4315	330	4955
46	396	103	1337	160	2520	217	3537	274	4327	331	4965
47	408	104	1359	161	2540	218	3554	275	4339	332	4975
48	420	105	1380	162	2560	219	3570	276	4350	333	4985
49	432	106	1401	163	2580	220	3586	277	4362	334	4995
50	443	107	1421	164	2600	221	3601	278	4373	335	5005
51	455	108	1440	165	2620	222	3615	279	4385	336	5015
52	467	109	1459	166	2640	223	3630	280	4397	337	5025
53	478	110	1479	167	2660	224	3645	281	4408	338	5035
54	490	111	1500	168	2680	225	3660	282	4420	339	5045
55	503	112	1521	169	2698	226	3675	283	4432	340	5055
56	516	113	1543	170	2716	227	3690	284	4443	341	5065
57	530	114	1565	171	2735	228	3705	285	4455	342	5075
58	544	115	1587	172	2754	229	3720	286	4467	343	5086
59	559	116	1609	173	2774	230	3735	287	4478	344	5097
60	573	117	1630	174	2795	231	3750	288	4490	345	5108
61	587	118	1651	175	2815	232	3765	289	4502	346	5119
62	601	119	1671	176	2835	233	3780	290	4513	347	5130
63	615	120	1690	177	2855	234	3795	291	4525	348	5140
64	629	121	1709	178	2875	235	3808	292	4537	349	5150
65	644	122	1729	179	2895	236	3821	293	4548	350	5160
66	659	123	1750	180	2915	237	3835	294	4560	351	5170
67	674	124	1771	181	2933	238	3849	295	4572	352	5180
68	689	125	1793	182	2952	239	3864	296	4583	353	5190
69	705	126	1815	183	2970	240	3880	297	4595	354	5200
70	721	127	1837	184	2988	241	3893	298	4607	355	5210
71	738	128	1859	185	3007	242	3906	299	4618	356	5220
72	754	129	1880	186	3025	243	3920	300	4630	357	5230
73	769	130	1901	187	3044	244	3934	301	4642	358	5240
74	784	131	1921	188	3062	245	3949	302	4654	359	5250
75	800	132	1940	189	3080	246	3965	303	4665	360	5260
76	816	133	1959	190	3098	247	3978	304	4676	361	5268
77	833	134	1979	191	3116	248	3992	305	4686	362	5276
78	850	135	2000	192	3134	249	4005	306	4695	363	5285
79	868	136	2021	193	3151	250	4018	307	4704	364	5294
80	887	137	2043	194	3167	251	4032	308	4714	365	5303

Regulation 33 *Standard Height of Superstructure*
The standard height of a superstructure shall be as given in the following table:

L (metres)	Standard Height (in metres)	
	Raised Quarter Deck	All other Superstructures
≤ 30	0.90	1.80
75	1.20	1.80
≥ 125	1.80	2.30

The standard heights at intermediate lengths of the ship shall be obtained by linear interpolation.

Regulation 37 *Deduction for Superstructures and Trunks*

(1) Where the effective length of superstructures and trunks is 1.0 L, the deduction from the freeboard shall be 350 mm at 24 m length of ship, 860 mm at 85 m length, and 1,070 mm at 122 m length and above; deductions at intermediate lengths shall be obtained by linear interpolation.

L [m]	f_e [mm]
24	350
85	860
≥ 122	1070

(2) Where the total effective length of superstructures and trunks is less than 1.0 L the deduction shall be a percentage obtained from one of the following tables:

Percentage of Deduction for Type 'B' ships

Total Effective Length of Superstructures and Trunks	0L	0.1L	0.2L	0.3L	0.4L	0.5L	0.6L	0.7L	0.8L	0.9L	1.0L
Ships with forecastle and without detached bridge	0	5	10	15	23.5	32	46	63	75.3	87.7	100
Ships with forecastle and with detached bridge	0	6.3	12.7	19	27.5	36	46	63	75.3	87.7	100

Percentages at intermediate lengths of superstructures and trunks shall be obtained by linear interpolation.

(3) For ships of Type 'B':

(a) where the effective length of a bridge is less than 0.2 L, the percentages shall be obtained by linear interpolation between lines I and II;
(b) where the effective length of a forecastle is more than 0.4 L, the percentages shall be obtained from line II; and
(c) where the effective length of a forecastle is less than 0.07 L, the above percentages shall be reduced by:

$$5 \times \frac{0.07L - f}{0.07L}$$

where f is the effective length of the forecastle.

Regulation 38 ***Sheer***

Standard Sheer Profile

(8) The ordinates of the standard sheer profile are given in the following table:

Standard Sheer Profile (Where L is in metres)

	Station	Ordinate (in millimetres)	Factor
After Half	After Perpendicular	$25\left(\frac{L}{3}+10\right)$	1
	1/6 L from A.P.	$11.1\left(\frac{L}{3}+10\right)$	3
	1/3 L from A.P.	$2.8\left(\frac{L}{3}+10\right)$	3
	Amidships	0	1
Forward Half	Amidships	0	1
	1/3 L from F.P.	$5.6\left(\frac{L}{3}+10\right)$	3
	1/6 L form F.P.	$22.2\left(\frac{L}{3}+10\right)$	3
	Forward Perpendicular	$50\left(\frac{L}{3}+10\right)$	1

Measurement of Variation from Standard Sheer Profile

(11)Where the forward half of the sheer profile exceeds the standard, and the after portion of the sheer profile is not less than 75 per cent of the standard, credit shall be allowed for the part in excess; where the after part is less than 50 per cent of the standard, no credit shall be given for the excess sheer forward. Where the after sheer is between 50 per cent and 75 per cent of the standard, intermediate allowances may be granted for excess sheer forward.

(12)Where sheer credit is given for a poop or forecastle the following formula shall be used:

$$s = \frac{y}{3}\frac{L'}{L}$$

where s = sheer credit, to be deducted from the deficiency or added to the excess of sheer,
y = difference between actual and standard height of superstructure at the end of sheer,
L' = mean enclosed length of poop or forecastle up to a maximum length of 0.5 L,
L = length of ship

Correction for Variations from Standard Sheer Profile

(13)The correction for sheer shall be the deficiency or excess of sheer (see subsections (9) to (11) inclusive of this Regulation), multiplied by

$$0.75 - \frac{S}{2L}$$

where S is the total length of enclosed superstructures.

Regulation 39. ***Minimum Bow Height***

(1) The bow height defined as the vertical distance at the forward perpendicular between the water line corresponding to the assigned summer freeboard and the designed trim and the top of the exposed deck at side shall be not less than:

for ships below 250 m in length,

$$56L\left(1-\frac{L}{500}\right)\frac{1.36}{C_b+0.68}\ \text{mm}$$

for ships of 250 m and above in length,

$$7000\frac{1.36}{C_b+0.68}\ \text{mm}$$

where L is the length of the ship in metres, Cb is the block coefficient which is to be taken as not less than 0.68.

L-4/T-2/NAME **Date: 29/04/2023**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2020-2001

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

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

Assume reasonable value for missing data (if any). Symbols have their usual meaning.

1. (a) For each of the following transfer functions, find the locations of the poles and zeros, plot them on the s-plane, and then write an expression for the general form of the step response without solving for the inverse Laplace transform. State the nature of each response. **(10)**

$$(i)\ T(s)=\frac{2}{s+2}$$

$$(ii)\ T(s)=\frac{5}{(s+3)(s+6)}$$

$$(iii)\ T(s)=\frac{10(s+7)}{(s+10)(s+20)}$$

$$(iv)\ T(s)=\frac{20}{s^2+6s+144}$$

$$(v)\ T(s)=\frac{s+2}{s^2+9}$$

(b) Deduce the time domain expression for a second order under-damped response for various damping ratio values. **(25)**

2. (a) For a second order under-damped system, deduce the expressions of the following performance specifications: **(25)**

(i) T_p, (ii) %OS, (iii) T_s.

(b) Explain the significance of pole locations for an underdamped second order system with respect to damping ratio, natural frequency, peak-time, settling time, and percent overshoot. **(10)**

3. (a) Consider the pitch control model of Unmanned Free-Swimming Submersible (UFSS) vehicle as shown in Figure for Q. No. 3(a). **(30)**

(i) Using only the second-order poles, shown in the transfer function, predict percent overshoot, rise time, peak time, and settling time.

(ii) Using laplace transforms, find the analytical expression for the response of the pitch angle to a negative step input in elevator surface deflection.

(iii) Evaluate the effect of additional pole and zero on the validity of the second-order approximation.

(iv) Plot the step response of the vehicle dynamics and verify your conclusions found in (iii).

(c) What is non-minimum phase system? **(5)**

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4. (a) Find the equivalent transfer function, T(s) for the system shown in Figure for Q. No. 4(a). **(20)**

   (b) Using Routh table, find the range of gain (k), for the system shown in Figure for Q. No. 4(b) that will cause it to be stable, unstable, and marginally stable. Assume K>0. **(15)**

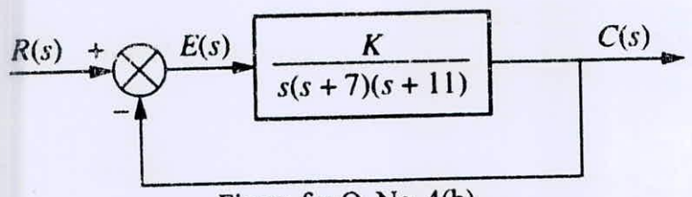


Figure for Q. No. 4(b)

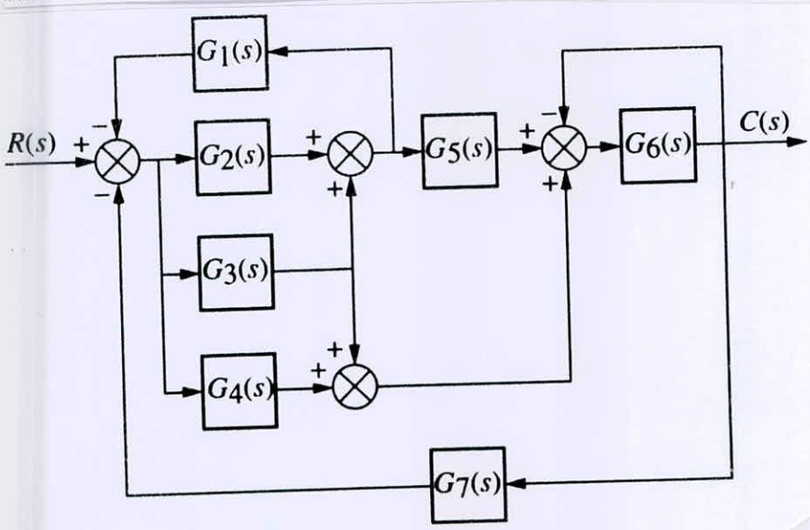
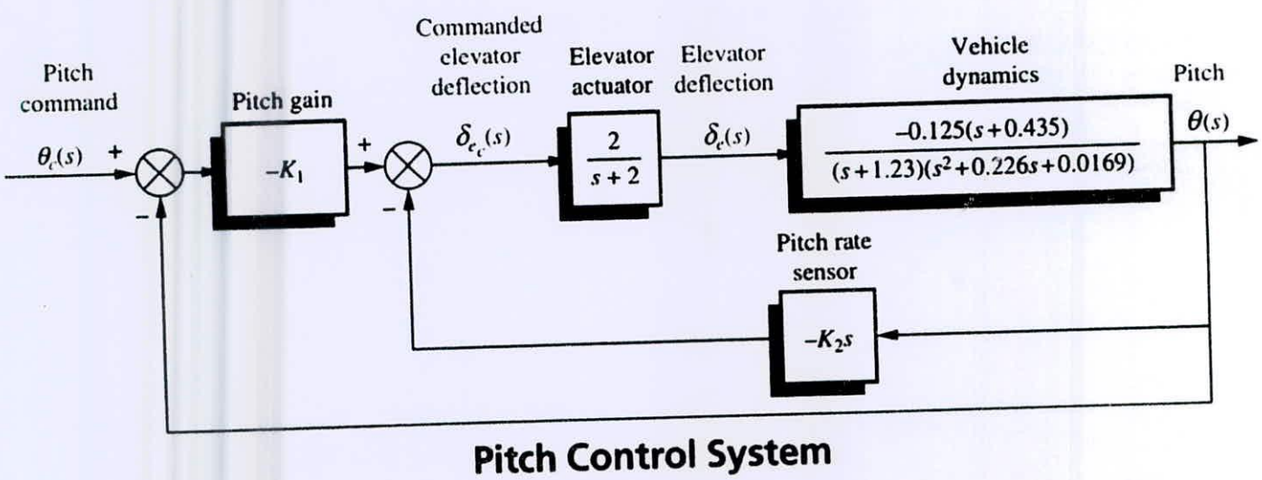


Figure for Q. No. 4(a)



Pitch Control System

Figure for Q. No. 3 (a)

NAME 467

SECTION – B

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

5. (a) Classify different types of control systems. Draw respective figures and explain each type of system. **(15)**

   (b) A tug boat needs to be precisely controlled for complicated operations. To develop a constant forward speed automatic heading control system a mathematical model needs to be constructed. Deduce a mathematical model for the ship's yaw motion and state necessary assumptions and/or conditions. For automatic heading control of the ship, deduce the transfer function from the motion equation. **(20)**

6. (a) Define the following test input signals using necessary figures and mathematical expressions: **(15)**

   (i) Impulse
   (ii) Step
   (iii) Ramp
   (iv) Parabola
   (v) Sinusoid

   (b) Discuss elaborately different types of controllers with mathematical relations. What are the differences between actuators and transducers? **(20)**

7. (a) Discuss and construct mathematical models of the following systems with necessary assumptions: **(25)**

   (i) Hydraulic system
   (ii) Pneumatic system

   (b) What are the differences between hydraulic systems and pneumatic systems? **(10)**

8. (a) Discuss the performance specifications of a first order system without zeroes for a step input. Deduce the mathematical relations of the performance specifications. **(25)**

   (b) A system has a transfer functions, $G(s) = 200/(s + 20)$. Find the time constant (Tc), rise time (Tr), settling time (Ts) and output response in time domain due to a unit step. Plot the results. **(10)**

L-4/T-II/NAME **Date : 03/04/2023**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-II B. Sc Engineering Examinations 2020-2021

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

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

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

Necessary figures are attached.

1. (a) Explain the procedure for predicting the added resistance of a ship in an irregular seaway. **(15)**

   (b) The following data is available from model experiments: **(15)**

ωe (rad/sec)	τ_a (ft)	S_τ (ωe) ft^2/sec)	R_{AW} (tons)
0.2	4	0	0
0.4	5	19	100
0.6	5	20	400
1.4	5	7.5	225
1.8	2	3.5	0

   Find the mean added resistance for the irregular seaway.

   (c) Mention pros and cons of the available methods for measuring roughness function. **(5)**

2. (a) The following data is given for a oil tanker: **(25)**

$$L = 254 \text{ m}, \nabla = 156{,}000 \text{ m}^3, T = 15 \text{ m}$$

Ship speed v = 15.6 knots

$$\frac{A_T}{L^2} = 0.01\,, \quad \frac{A_L}{L^2} = 0.035$$

   (i) Calculate wind resistance for relative wind speed V_R = 16 m/s relative wind direction

   $\gamma = 35°$ $\rho_{air} = 1.5$ kg/m^3

   (ii) Estimate the rudder resistance for steady condition given that rudder area $A_R = 76$ m^2 and rudder angle $\delta = 0.4$ degree

   (iii) Estimate the yawing resistance if the yawing amplitude is 1°.

   (iv) Estimate wave induced resistance for BN = 5.

   (b) Write short notes on voyage analysis and in service monitoring of commercial vessel. **(10)**

3. (a) Define roughness function. How this function is determined experimentally for a ship model? Explain briefly. **(10)**

   (b) Explain different experimental technique for predicting added resistance of a ship in waves. Write down also pros and cons of the experimental technique of added resistance. **(15)**

   (c) Mention and explain various factors that are responsible for loss of speed in a seaway. **(10)**

Contd P/2

NAME 469

4 (a) Mention the salient features of Havelock's theory for predicting added resistance of ship in waves. **(10)**

(b) What conclusions can be drawn from above mention theory in Q. No. 4(a)? **(5)**

(c) Briefly discuss the radiated energy approach for predicting added resistance of ship in waves. Also mention advantages and disadvantages of this method. **(15)**

(d) Briefly discuss application of added resistance for weather routing of ship in a seaway. **(5)**

SECTION – B

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

All symbols have their usual meaning. Assume reasonable value in case of any missing data.

5. (a) Suppose, you are given the task of measuring the hull roughness of a particular ship. Explian, with the necessary figures and formulation, how you can measure the roughness of that ship, keeping in mind that the measured roughness function for a set of surface shows a good correlation. **(20)**

(b) A ship has the following principal particulars Length overall: 163.150 m; length LBP: 155.00 m; Breadth: 22.860 m; Depth 13.420 m; Draft (summer): 9.727; DWT: ≥ 015 tonnes; Block coefficient: 0.710; Wetted Surface Area: 5079 m^2 Design speed = 16.75 Knot.

Consider the initial hull roughness 125 microns and when the vessel is on dock, it is found that the average hull roughness is 300 microns.

Calculate the fractional added resistance using Townsin's formula. (Given, Dynamic viscosity of sea water, $\mu = 8.50 \times 10^{-4}$ pa.s, Weather allowance Co-efficient 1000 $C_{AA} = 0.150$, Residual resistance Coefficient, 1000 $C_R = 1.100$ **(15)**

6. (a) What is Mean Apparent Amplitude (MAA) in measuring Surface roughness? Illustrate with necessary figures. **(10)**

(b) What is fouling? Describe how you can mitigate fouling by using biocidal and non-biocidal coatings on the basis of performance. **(10)**

(c) Explain the design parameters to be considered for good sea keeping and maneuverability of ships in a seaway. **(15)**

7. (a) Why propeller roughness is important for ship's Propulsive performance? Derive the expressions in detail for calculating the effect of propeller roughness on ship speed and power. **(10)**

Contd P/3

NAME 469

Contd...Q. No. 7

(b) For a roughened propeller of diameter 5.0 m, the value of torque is 551.39 kNm, rps is 3.67. If the power absorbed by the propeller in its smooth condition is 12000 kW, determine the value of percentage increase of power due to propeller roughness. If the value of local speed exponent of resistance curve is 3, calculate the speed penalty. Also analyze the calculated results. **(15)**

8. A propeller face and back are divided into 24 segments and the roughness of each segment for two different bands are given in table for Q. No. 8. Calculate the APR of this propeller. **(35)**

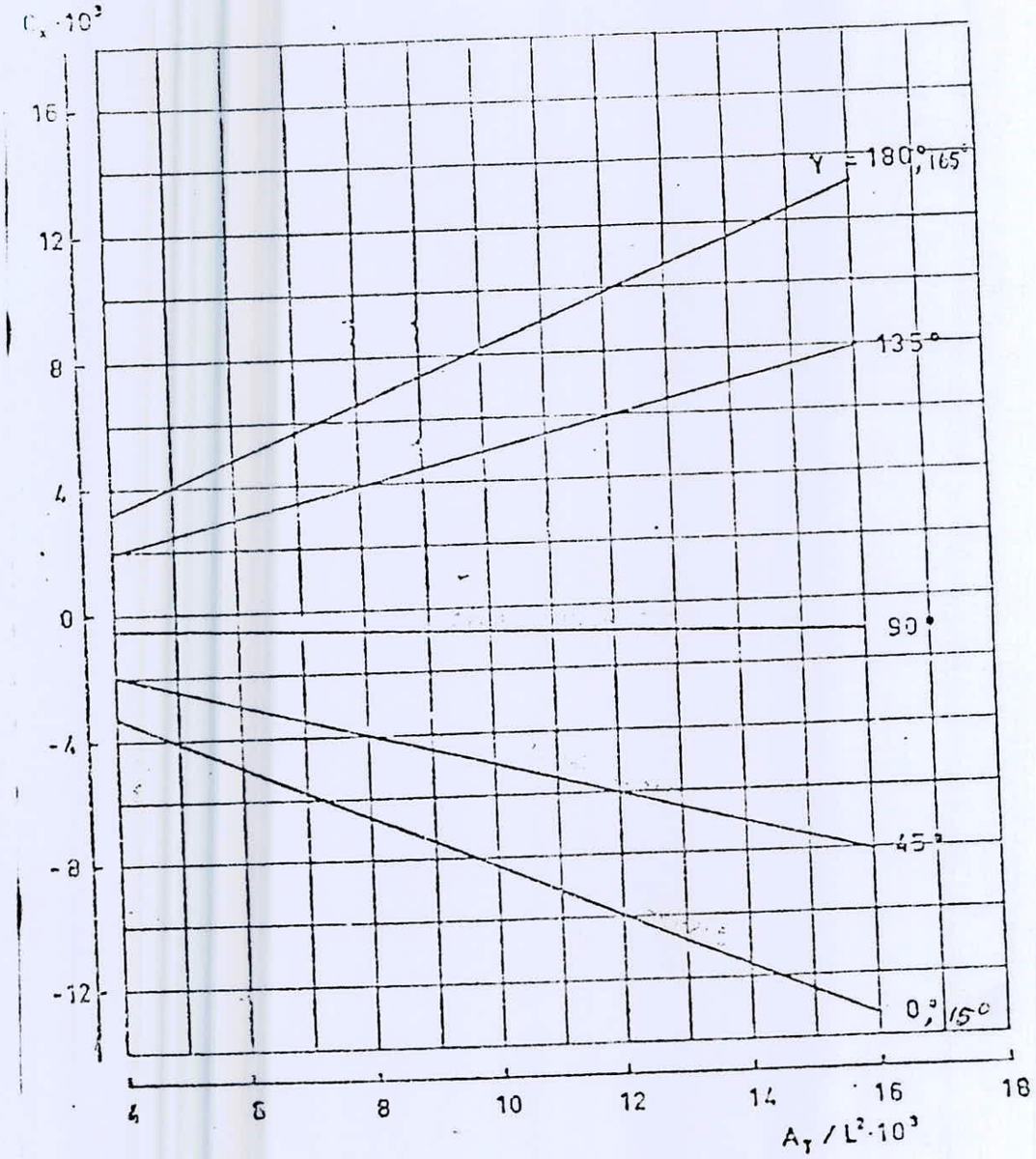


FIG 4 (1) LEVEL OF WIND COEFFICIENT C_X FOR TANKERS

For Q. No. 2(a) — 1/4

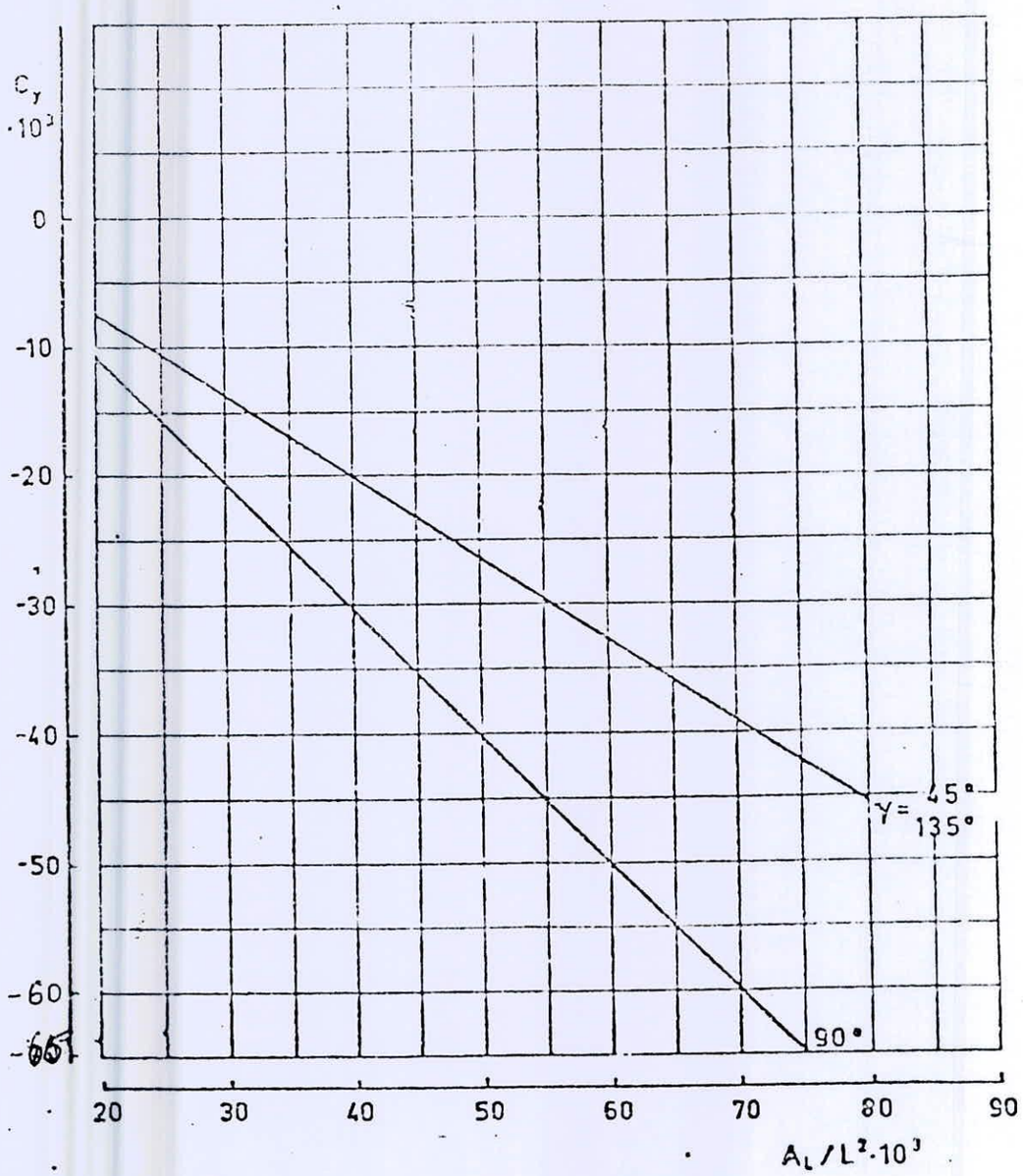


FIG 4 (2) LEVEL OF WIND COEFFICIENT C_y FOR TANKERS

For Q. No. 2(a) – 2/4

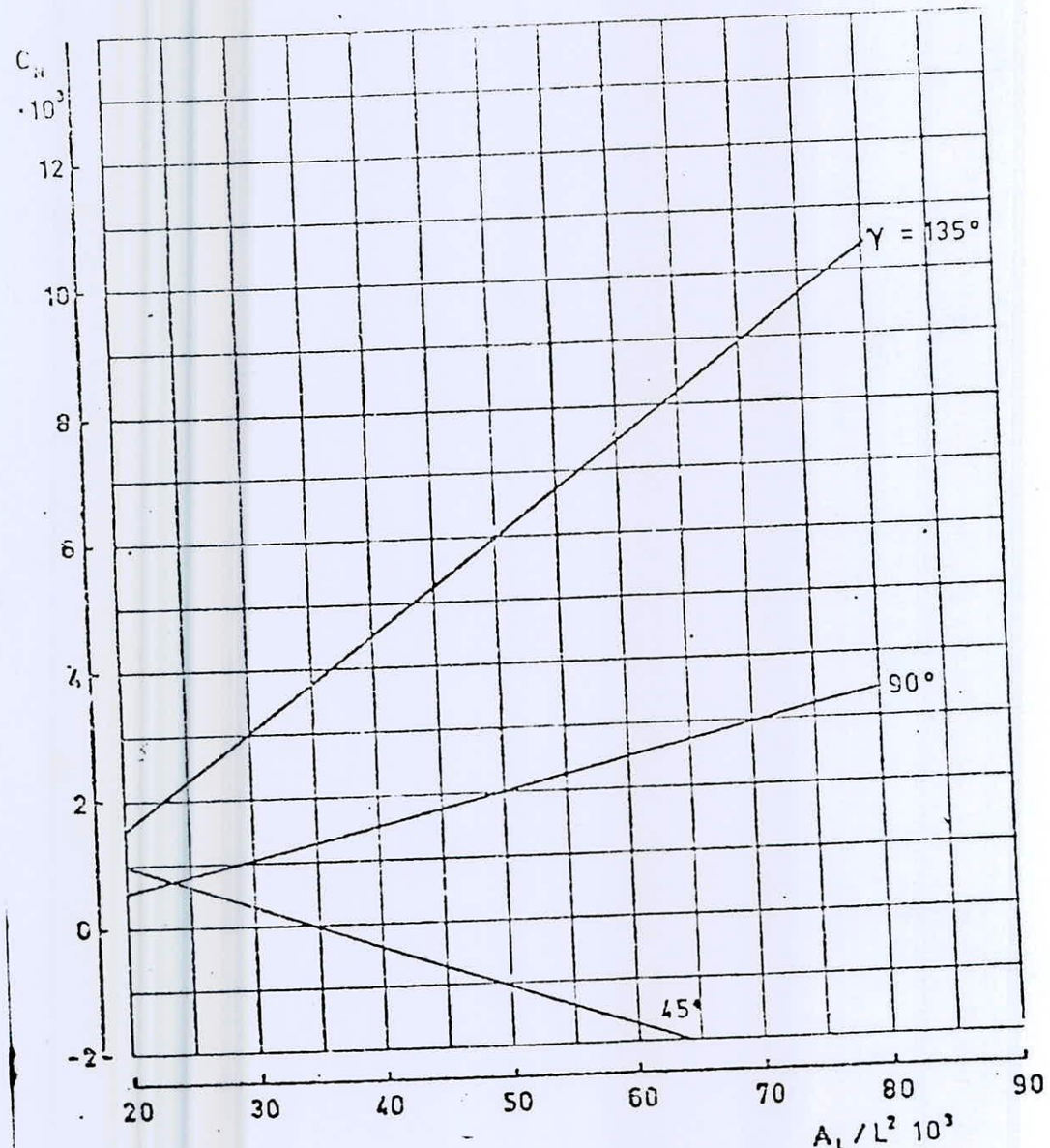
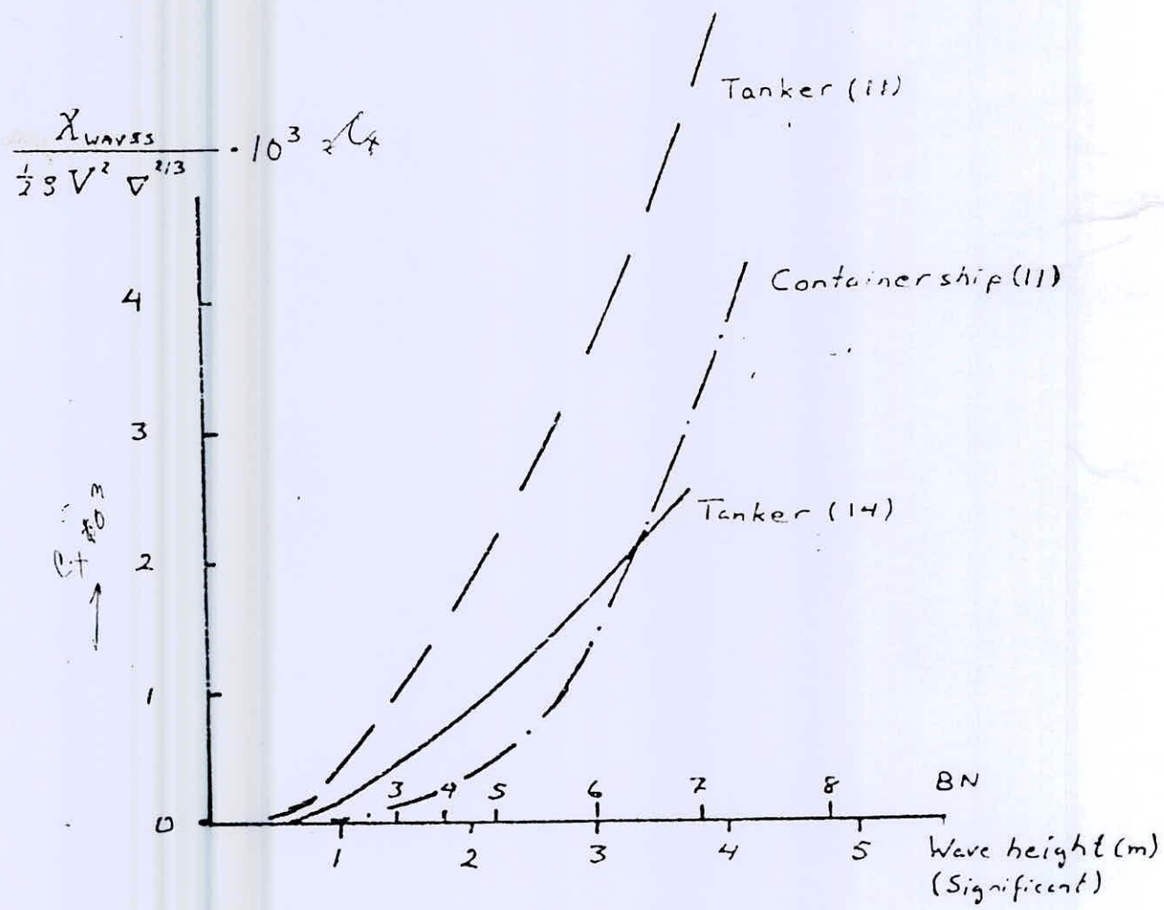


FIG 4 (3) LEVEL OF WIND COEFFICIENT C_N FOR TANKERS

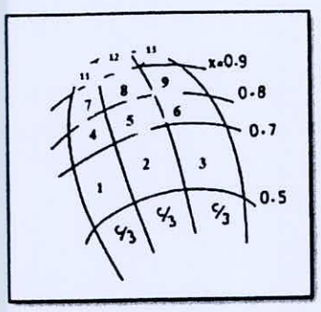
For Q. No. 2(a) - 3/4


$\frac{\chi_{WAVES}}{\frac{1}{2}\rho V^2 \nabla^{2/3}} \cdot 10^3 \approx C_4$
Tanker (11)
Containership (11)
Tanker (14)
4
3
2
1
0
1
2
3
4
5
3
4
5
6
7
8
BN
Wave height (m)
(Significant)

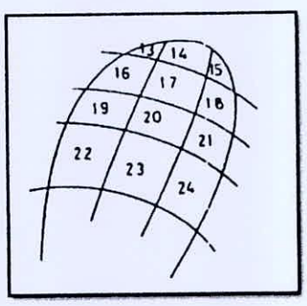
For Q. No. 2(a) -4/4

Figure for Q.No.8

Location	1			2		
Face	Ra(b)	Ra	Pc	Ra(b)	Ra	Pc
1	11.52	10.8	43	11.2	9.92	53
2	13.92	12.48	22	13.2	12.08	22
3	14.4	14.64	24	14.48	14.08	22
4	15.92	15.28	19	15.68	15.28	19
5	21.6	21.36	24	21.52	22.32	17
6	18.24	19.6	10	18.88	16.64	16
7	21.36	22.4	32	21.84	17.76	19
8	8.08	8.72	15	8.4	8	24
9	7.76	8	34	7.84	7.52	29
10	6.56	5.36	17	6	5.28	32
11	4.48	4	51	4.24	4.08	68
12	8.64	8.16	39	8.4	8.48	17
Back						
13	17.36	16.24	29	16.56	16.48	29
14	13.6	13.28	19	13.44	13.44	24
15	17.2	16	27	16.56	15.84	24
16	14.4	16.88	28	15.6	17.44	19
17	37.12	37.44	17	37.28	37.6	15
18	20.08	19.92	10	20	21.2	14
19	18.48	16.8	15	17.6	16.16	24
20	17.36	17.68	19	17.52	19.68	27
21	13.92	14.24	27	14.08	14.64	22
22	18.08	18	36	18	16.48	36
23	6.32	6.4	46	6.32	6.32	44
24	6.4	6.56	56	6.48	6.72	36



Face



Back