L-4/T-2/NAME **Date: 29/09/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2016-2017

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

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks

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

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. A 11,000 MT payload cargo ship makes 10 round voyages per annum with 60% load factor. The voyage costs are $30,000 per trip, annual operating cost $290,000 and trip freight rate is $15 per tonne after commission. The ship cost is $3,000,000 and her expected life is 15 years, 8% discount rate, zero resale value and 50% tax rate. Calculate the Net Present Value (NPV) of cash flow using the following method. **(35)**

   (i) No tax

   (ii) Free depreciation

   (iii) Straight line depreciation

2. (a) Point out the important irregular cash flow in case of ship investment. **(5)**

   (b) Mention advantages and disadvantages of the following contracts in suipbuilding: **(15)**

   (i) LSFP (ii) CPIF (iii) CPFF

   (c)The building cost (P), annual operating cost (Y), annual cargo capacity (C) and annual revenues (R) for four (4) different cargo ship designs are presented in the following Table. Assume a life of 25 years and interest rate 10%. Calculate AAC and RFR. Which design should be selected? **(15)**

A	B	C	D
P ($) 4000	4200	4500	4900
Y ($) 600	610	620	630
C (tonnes) 50	55.5	62	64.5
R ($) 1000	1110	1240	1290

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

   (b) Briefly describe the importance of uncertainty and sensitivity analysis in ship design. **(10)**

   (c) In a new diesel propeller bulk carrier, fitting of an exhaust-gas waste-heat generating plant to provide electrical power at sea is estimated to cost $300,000 more than the equivalent system using only diesel alternators. The equipment reduces

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Contd... Q. No. 3(c)

auxiliary fuel consumption by 1.0 tonne 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? As a first approximation, it may be assumed that differences in maintenance costs, weights and space are negligible. Find also actual rate of return. **(15)**

4. Approximately 1.25 M tonnes of mineral Ore per annum require to be transported between Mine and Smelter, 2,000 mile apart. A comparison of economic performance between a self loading bulk carrier of about 60,000 dwt tonnes and a conventional ship using existing shore discharging plant is to be made. Port limitations restrict the ship to 225 m overall length and 13 m draft. Available machinery fixes ship speed at about 15 knots. Flag-of-convenience ship owner requires 10% rate of return over 16-year life of ship. **(35)**

Both alternatives:

Breadth restricted to 32.3 m for possible Panama Canal transits. Adequate cubic capacity exists for the cargo stowage factor.

Dimensions 210 m b.p × 32.3 m × 17.7 m depth × 13.1 m draft, same hull form.

Fuel consumption 50 tonnes HFO + 2 tonnes DO per day.

HFO cost $ 120/tonne and DO cost $180/tonne.

Port charges $ 20,000/RT

Time at loading port 1.5 days

Two 8-hour shifts per day worked at discharging part, plus one day manoeuvring and miscellaneous time per call.

Basic ship price $18 *M.*

Shore Discharging Gear:

1,000 tonnes per hour, at cost of $0.90 per tonne.

Self Unloading Gear:

2,000 tonnes per hour.

Weight of gear plus structure 2,300 tonnes.

Additional cost $9.08 M.

Additional maintenance $90,000, engineers $50,000 *p.a.*

Additional diesel oil consumption during discharge 0.5 tonnes per working hour.

Additional three days out of service per annum

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Contd... Q. No. 4

Additional information

	Conventional	Self-unloading
Displacement, tonnes	73500	73500
Lightship, tonnes	13250	15550
Days in service per annum	350	to be calculated
Maximum payload, tonnes	59128	to be calculated
Crew cost, $	600,000	to be calculated
Daily running cost, $	800,000	800,000
Maintenance of self-unloading gear, $	—	90,000

From the above data, calculate the following items for both conventional and self-unloading vessel:

(i) Total operating cost per annum

(ii) Total annual cost

(iii) Cost per tonne cargo

SECTION – B

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

5. (a) With a neat sketch, illustrate the divisions of responsibility for operting economics between charterer and owner in different types of chartering. **(8)**

(b) Which economic criteria do you think is the best for comparison of alternative ship design? Describe the criterion and mention why that is the best. **(12)**

(c) A manufacturing company is planning to replace an old machine with a new CNC machine. The related financial data are given below: **(15)**

Purchase price of New machine = Tk. 90 lacs

Installation and Employee training cost = Tk. 20 lacs

Savings and annual maintenance cost = Tk. 0.5 lac

Increase in profit- From year 1 to 5: Tk. 12 lacs; From year 6 to 12: Tk. 18 lacs; From year 13 to 20: Tk. 15 lacs

Overhauling cost at the end of 10th year = Tk. 5 lacs

Salvage Value = Tk. 10 lacs

The company wants 10% return on its investment, decide whether the company should purchase the new CNC machine.

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6. (a) Explain different Incoterms that apply to sea and inland waterway transport only. **(10)**

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

Ship related data:

30,000 tonnes d.w. Summer draft 10.4 m

37,500 w.m. grain. Speed 14.5/15.5 knots loaded/ballast

32 tonnes high viscosity fuel per day plus 1.5 tonnes diesel oil at sea or in port. Daily running costs £2900 excluding capital charges.

Cargo related data:

28,000 tonnes grain. Loading rate 7,000 tonnes per day, discharging 4,000. loading charge $1.00 per tonne. Freight: $16.00 per tonne, free discharge. Brokerage etc. 5 percent. Assume £1=$1.30.

Other necessary data:

Distance between New Orleans to Rotterdam: 5000 miles

Bunkering time at New Oreans: 0.5 day

Waiting time for berthing at Rotterdam: 2 days

Charges during U.K. port leaving: £7,000

Harbour dues at New Oreleans: $20,000

Miscellaneous charges at New Orleans: $6,000

Harbour dues at Rotterdam: $30,000

Miscellaneous charges at Rotterdam: $2,000

HVF cost $100/tonne

Diesel oil cost $170/tonne

Determine the surplus for the shipowner per day.

(c) Airplane ticket price will increase 8% in each of the next four years. The cost at the end of the first year will be $180. How much should be put away now to cover a student's travel home at the end of each year for the next four years? Assume interest rate 5%. **(5)**

7. (a) Write short notes on: **(3×4=12)**

(i) Shipping system after 1950

(ii) Ship size trend

(iii) Product differentiation in shipping.

(b) In order to encourage initial sales, the manufacturer of a novel type of deck crane offers a 'buy how, pay later' deal. The equipment would cost $120,000 if purchased now, but the manufacturer is willing to accept instead a lump sum of $130,000 paid in three years' time. What rate of interest implied? Does it look a good deal financially? Give an explanation to support your answer. **(10)**

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Contd... Q. No. 7

(c) Find the average annual cost of a ship that has an investment cost of \$6,000,000, a predicted resale value of \$3,000,000 after 5 years and operating cost as listed in the table below. The interest rate is 20%. **(13)**

Year	1	2	3	4	5
Operating cost (M: million)	\$1M	\$1.2M	\$3M	\$3M	\$3.2M

8. (a) Prove that, **(15)**

$$A = G\left[\frac{1}{i} - \frac{n}{(1+i)^n - 1}\right]$$

Where, G = gradient amount

A = Uniform annual worth equivalent to series of gradients

i = interest rate

n = number of years

(b) John Deree expects the cost of a tractor part to increase by \$5 per year beginning 4 years from now. If the cost in year 1-3 is \$60, determine the present worth in year 0 of the cost through year 10 at an interest rate of 12%. **(10)**

(c) Consider the following cash flow of a project. **(10)**

Year	0	1	2	3	4	5
Cash flow (\$)	–10,000	4,000	4,500	5,000	5,500	6,000

Find the rate of return of the project.

L-4/T-2/NAME **Date: 01/09/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2016-2017

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**.

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

1. (a) What is shoreline survey? Show with the help of neat sketches how will you do shoreline survey if: **(10)**

   (i) the stream width is narrow.

   (ii) the stream is very wide.

   (b) What is a three-point-problem in hydrographic surveying? Show with the help of neat sketches how is it solved graphically. Describe all three methods. **(15)**

   (c) During a hydrographic survey at sea, the soundings were located by observing three shore stations A, B and C, having co-ordinates (metres) of 0-0, 500N – 1000 E, 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 distances AP, BP and CP. **(10)**

2. (a) Explain how spring and neap tides are occured. **(10)**

   (b) Draw a neat sketch of a current meter and name all its parts. Explain the method of gauging the flow of a stream by means of a current meter. How are the constants of such meters determined? **(10)**

   (c) The following results were obtained in the rating tests of a current meter; **(10)**

n = number of revolutions per second	v = velocity in metres per second
0.4	1.50
1.1	4.90
1.6	6.83
2.2	8.98

Find the constant a and b in the Calibrating formula.

$$v = an + b$$

by theory of least squares.

(d) 90°-V notch is used to gauge a stream. Determine the flow corresponding to a head of 0.72 m. **(5)**

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NAME 447

3. (a) Discuss various types of open water disposal of dredged materials. **(6)**

(b) "Maximum percent solids of dredging material varies with velocity in the suction line, the type of solid being dredged and inversely as the square root of diameter of suction pipe" — Justify the statement. **(15)**

(c) How would you determine the depth of an inland navigational channel? **(10)**

(d) Determine the production rate for 20 inch dredge, with 15.12 feet per second velocity. Assume specific gravity of the slurry = 1.5. **(4)**

4. (a) Discuss velocity of sound correction in echo sounding. **(6)**

(b) In order to determine the constants of a tacheometer distances, 201 m and 400 m were accurately measured and readings on a stadia rod on the upper and lower wire were taken as follows: **(9)**

at 201 m	2.00 m	4.00 m
at 400 m	0.50 m	4.50 m

Determine the values of constants and find the distance when the readings of the other stadia wires were 1.5 m and 4.5 m. The line of sight being horizontal in all cases.

(c) For oscillation of water in a closed rectangular basin, derive the following expression, **(20)**

$$\phi = \frac{Hg}{2\delta} \frac{\cosh k(h+z)}{\cosh kh} \cos\frac{n\pi x}{a} \cos\frac{m\pi y}{b} \sin\delta t$$

SECTION – B

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

5. (a) List the organizations related to the inland waterways transport in Bangladesh. Briefly discuss their functions. **(15)**

(b) Mention some advantages of inland waterways transport. Discuss the classification of inland waterways of Bangladesh. **(20)**

6. (a) What is the difference between intermodalism and multimodalism? **(10)**

(b) What are the factors that affect intermodalism? Write down the advantages and disadvantages of intermodal transport. **(15)**

(c) Describe intermodal transport chain. **(10)**

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NAME 447

7. (a) Define Articulated Tug Barge (ATB) system. Briefly discuss the advantages of ATB over Towed Barge System. **(15)**

(b) Draw the schematic view of the midship section of typical barge types on the basis of cargo carried. **(10)**

(c) Classify marine salvage. **(10)**

8. Write short notes on the followings (Any five): **(35)**

(i) Lighter barge

(ii) Harbour tug

(iii) RoRo vessel

(iv) Hydrofoil ship

(v) Salvage tug

(vi) Water bus

L-4/T-2/NAME **Date: 01/09/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2016-2017

Sub: **NAME 461** (Hydro-elasticity)

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**.

1. (a) Explain the following terms: **(15)**

hydroelasticity, slamming, whipping and springing.

(b) Derive the expressions of dry and wet natural frequencies for the hydroelastic analysis of a plate. **(20)**

2. (a) Describe the various types of VLFS. What are the advantages of pontoon type VLFS over the traditional land reclamation solution? **(15)**

(b) State the basic assumption you made for the hydroelastic analysis of VLFS. Draw a mathematical model for a pontoon type VLFS under a wave action. **(20)**

3. (a) State the assumptions you made in strip theory. Derive the expression of hydrostatic force and its moment on a floating body. **(15)**

(b) Deduce the expression of wave-induced force and its moment on a sphere floating half submerged. **(20)**

4. (a) What is D. Alembert's paradox? Show that the steady drag force acting on a circular cylinder per unit length is zero. **(15)**

(b) What is the Morison equation? Derive the expression of force acting on a circular cylinder using the Morison equation. **(20)**

SECTION – B

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

Symbols have their usual meaning. Assume suitable value for any missing data.

5. (a) Write down the governing equation and boundary conditions of plane and regular surface waves on constant depth. **(17)**

(b) Is analytic solution to the mathematical problem described in 5(a) possible? Explain. **(10)**

(c) State the assumption and limitations of linear wave theory. **(8)**

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NAME 461

6. (a) Linearize the following boundary conditions using order of magnitude analysis: **(20)**

   (i) Kinematic surface boundary condition

   (ii) Dynamic surface boundary condition

   (b) Define the following (i) Group velocity (i) Wave shoaling (iii) Diffraction of water waves. **(15)**

7. The linear wave theory is based on an exact solution to the Laplace equation but with the use of linear approximation of the boundary conditions. Use separation of variables to show that the solution to Laplace equation based on such boundary conditions yields: **(35)**

$$\varphi = -\frac{ag}{\omega}\frac{\cosh k(z+h)}{\cosh kh}\sin(\omega t - kx)$$

   where the symbols have their usual meaning.

   Hence derive the dispersion relationship.

8. (a) Use the velocity potential expression given in question 3 to obtain expressions for particle velocity field and pressure field. **(15)**

   (b) Derive the expression of particle path for linear waves. Hence show that the particle path for deep water waves is circular. **(20)**

L-4/T-2/NAME **Date : 11/09/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B.Sc. Engineering Examinations 2016-2017

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. Assume suitable value for any missing data. Symbols have their usual meanings.

SECTION – A

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

1. (a) Describe and explain the working principle of a two stage vapour compression refrigeration system with water intercooler, liquid subcooler and liquid flash chamber. **(20)**

   (b) Define the following : (i) NPSHA (ii) Cavitation of pumps, (iii) Static suction and discharge head, (iv) Dynamic suction head. **(15)**

2. (a) Compute the discharge pressure head in meters, total power required is KW, and overall pumping system efficiency for model 1040A with a 10 inch impeller and model 1230A with a 12 inch impeller given in figure for question no. 2(a) when the pumps are placed in series. The pumps are to be operated at a rotational speed of 1750 rpm and at a design discharge of 0.03155 m^3/s. **(15)**

   (b) Distinguish between positive displacement and dynamic pumps. **(7)**

   (c) Describe briefly the following ship piping systems: **(13)**

   (i) Ballast system (ii) Fire fighting system (iii) Engine cooling system

3. (a) What are steam traps? Describe the operating principle of mechanical, temperature and thermodynamic traps. **(17)**

   (b) Describe and explain some of the causes of pipe failure in ships. **(18)**

4. (a) Distinguish between comfort and process air conditioning system. **(12)**

   (b) Explain the working principle of two ram hydraulic steering gear. **(13)**

   (c) Write short note on anchor windlass. **(10)**

SECTION – B

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

5. (a) What are the advantages of compound compression with intercooler over single stage compression? **(8)**

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NAME 429

Contd... Q. No. 5

(b) An air refrigeration used for food storage provides 25 TR. The temperature of air entering the compressor is 7°C and the temperature at exit of cooler is 27°C. **(12)**

Find: (i) C.O.P of the cycle

(ii) power/TR required by the compressor.

The quantity of air circulated in the system is 3000 kg/h. The compression and expansion both follows the law $pv^{1.3}$= constant and take $\gamma = 1.4$ and $C_p = 1$ kJ/kg K for air.

(c) 1.5 kW per tone of refrigeration is required to maintain the temperature of -30°C in the refrigerator. If the refrigeration cycle works on reversed Carnot cycle, determine the following: **(10)**

(i) C.O.P of the cycle

(ii) Temperature of the sink

(iii) Heat rejected to the sink per tonne of refrigeration

(iv) Heat supplied and E.P.R, if the cycle is used as heat pump

(d) What is the main drawback of the open cycle air refrigerator and how is it rectified. **(5)**

6. (a) A water cooler using R-12 works on the condensing and evaporating temperature of 26°C and 2°C respectively. The vapour leaves the evaporator saturated and dry. The average output of cold water is 100 kg/h cooled from 26°C to 6°C. **(17)**

Allowing 20% of useful heat into water cooler and volumetric efficiency of the compressor as 80% and mechanical efficiency of the compressor and the electric motor as 85% and 95% respectively.

Find : (i) Volumetric displacement of the compressor

(ii) Power of the motor.

Data for R-12 is given bleow:-

Temperature °C	Pressure bar	Enthalpy kJ/kg		Entropy kJ/kg K		Specific heat kJ/kg K		Specific volume of vapour m^3/kg
		liquid	vapour	liquid	vapour	liquid	vapour	
26	6.69	60.64	198.10	0.2270	0.6865	0.996	0.674	0.026
2	3.297	37.92	188.39	0.1487	0.6956	1.067	0.620	0.052

(b) A vapour compression refrigeration machine with Freon-12 as refrigerant has a capacity of 12 tonne of refrigeration operating between -28°C and 26°C. The refrigerant is subcooled by 4°C before entering the expansion valve and the vapour is superheated by 5°C before leaving the evaporator. The machine has a six-cylinder single-acting compressor with stroke equal to 1.25 times the bore. It has a clearance of 3% of the stroke volume. **(18)**

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Contd... Q. No. 6(b)

Determine:

(i) Theoretical Power required

(ii) C.O.P

(iii) Volumetric efficiency

(iv) Bore and stroke of the cylinder.

The speed of compressor is 1000 r.p.m. The following properties of Freon-12 may be used:

Sat. temp., °C	Pressure bar	Sp.volume of vapour m^3/kg	Enthalpy kJ/kg		Entropy kJ/kg K	
			liquid	vapour	liquid	vapour
-28	1.093	0.1475	10.64	175.11	0.0444	0.7153
26	6.697	0.0262	60.67	198.11	0.2271	0.6865

Specific heat of liquid refrigerant is 0.963 kJ/kg K and specific heat of super heated vapour = 0.615 kJ/kg K.

7. (a) Mentioning the deviations between the theoretical and actual vapour compression cycle, briefly explain the various processes of actual vapour compression cycle. **(15)**

(b) Discuss about the effect of suction pressure and discharge pressure on the refrigerating capacity of a system. Which of these two effects is more severe? **(10)**

(c) Define the following terms: **(10)**

(i) 1TR

(ii) Degree of saturation

(iii) Dew point temperature

(iv) Absolute humidity

(v) Relative humidity

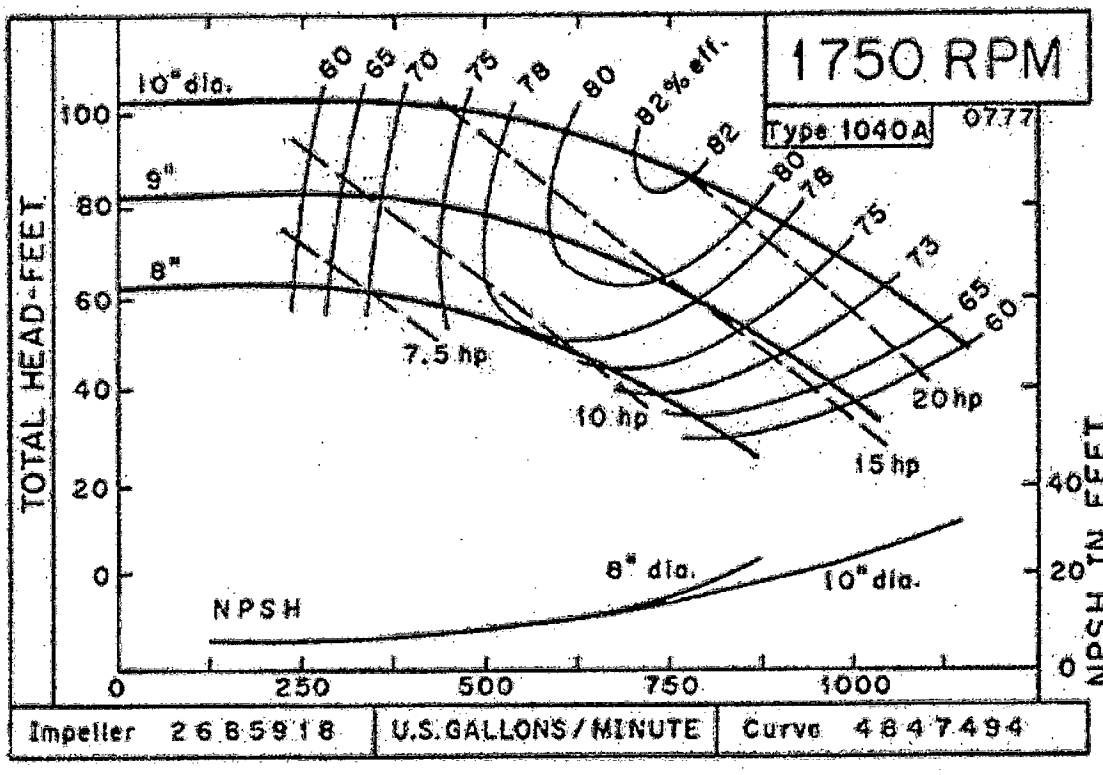
8. (a) As there is no such refrigerant which can be used under all operating conditions, in order to select a correct refrigerant, some specific properties of the refrigerants are compared with the operating condition. Name such thermodynamic, chemical and physical properties. **(10)**

(b) Derive an expression for the equivalent diameter of circular duct corresponding to a rectangular duct of sides 'a' and 'b', for the same pressure loss per unit length, when (i) the quantity of air passing through both the ducts is same (ii) the velocity of air flowing through both the ducts is same. **(17)**

(c) Write short notes on the following topics: **(8)**

(i) Friction factor for ducts

(ii) By-pass factor of Heating and Cooling coil.



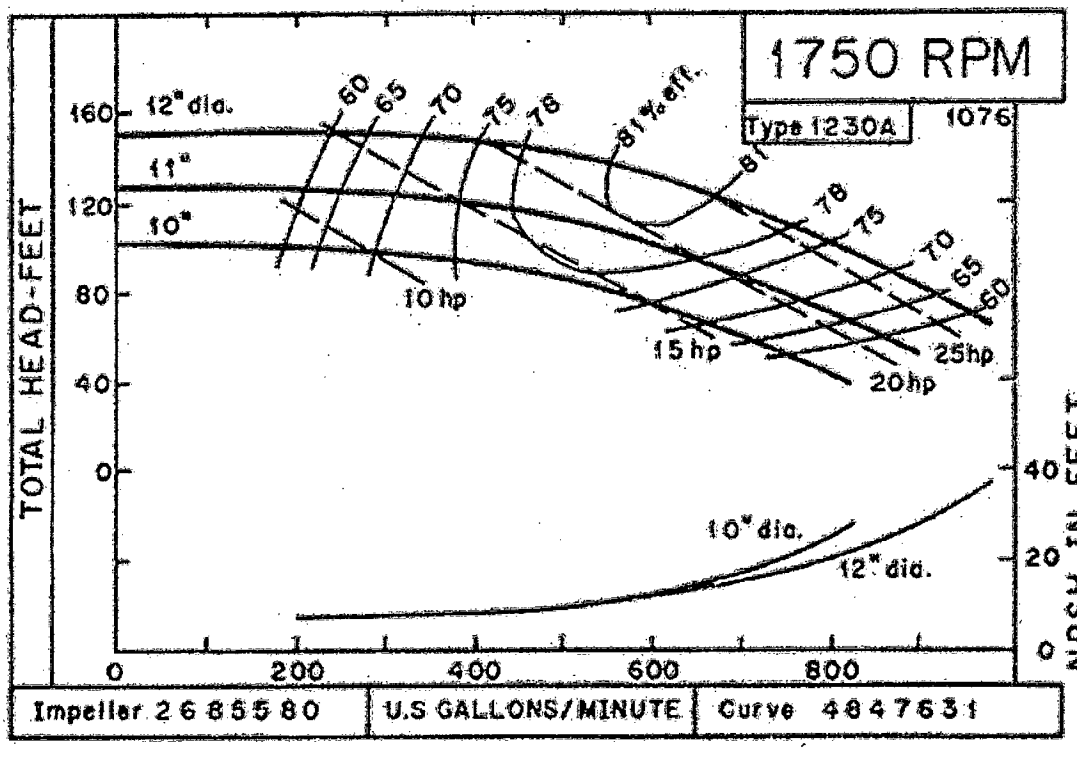


figure for question no. 2(a)

L-4/T-2/NAME **Date : 17/09/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2016-2017

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**.

Symbols have their usual meaning; **Question. no. 3 is compulsory to answer**; Assume reasonable value for missing data.

1. (a) Describe the function of Maritime Safety Committee (MSC) and the Marine Environment Protection Committee (MEPC) of IMO. **(6)**

   (b) With neat Sketch describe the Fire Triangle. **(6)**

   (c) Write short notes on the Fire Tetrahedron. **(7)**

   (d) Classify fire according to:

   (i) ISO Standard 3941 **(10)**

   (ii)NFPA 10

   (e) Explain the extinguishment of flammable gases. **(6)**

2. (a) What do you mean by Navigation? Describe the branches of Navigation. **(7)**

   (b) Why is it necessary for ships to have Load Lines? Draw a Load Line Mark for a ship according to the 1966 Load Lines convention. **(18)**

   (c) List the name of the instruments with its function to navigate a ship for the following;

   (i) Direction measuring **(10)**

   (ii) Celestial Navigation

3. A double Skin segregated ballast Crude Oil Tanker has the following particulars: **(35)**

   LBP = 223 m

   LWL = 230 m at 85% D

   B = 32.23 m

   D = 20.5 m

   Dead weight = 70,000 tonnes

   Draft aft in ballast condition = 7.7 m

   Propeller diameter, D_P = 6.85 m

   Steel mass = 11,371 M Ton

   Outfit mass = 1,507 M Ton

   Engine Plant mass = 822 M Ton

   From Hydrostatic data,

   Displacement = 34,000 M Ton at draft 6 m and 35,800 M Ton at draft 7 m

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NAME 449

Contd ... Q. No. 3(a)

In addition the tanker has 6 nos. of cargo oil tank with centerline longitudinal bulkhead dividing each tank port and starboard side.

The total length of the cargo tank = 171 m

Height of double bottom = 2.02 m

Width of Wing tank space = 2.10 m

Based on the provided data,

(i) Find the minimum SBT capacity in cubic meter according to MARPOL if SBT contains salt water.

(ii) Estimate the available volume of ballast considering rectangular cross-sectional wing and double bottom tank. Comment whether the MARPOL requirements are fulfilled or not.

(iii) Suppose after side damage and bottom damage the corresponding hypothetical flows have been found 10,160 cubic meter and 500 cubic meter respectively. Is the limiting size and arrangement of cargo tank OK? Justify.

4. (a) Describe the requirements of a Life-buoy according to SOLAS. **(10)**

(b) Write short notes on the following:

(i) Life rafts **(25)**

(ii) Rescue boat

(iii) Rocket Parachute Flares

(iv) Hand Flares.

(v) Buoyant Smoke Signals.

SECTION – B

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

5. (a) What is UNCLOS? Draw a schematic diagram showing the different types of water and EEZ according to UNCLOS. **(13)**

(b) Describe the organizational structure of IMO. **(10)**

(c) Write short notes on:

(i) Territorial waters **(12)**

(ii) Archipelagic waters

6. (a) Draw the schematic diagram of a typical buoyant beacon. **(11)**

(b) For short-range navigation of ships, describe the following:

(i) Range lights **(24)**

(ii) Aeronautical lights

(iii) Shore lights

(iv) Bridge lights

Contd P/3

NAME 449

7. (a) Write short notes on:
   (i) Electronic Navigational charts (ENC)
   (ii) Raster Navigational Charts (RNC) **(35)**
   (iii) Electronic Chart Display and Information System (ECDIS)
   (iv) Ballast Water Management (BWM)
   (v) Automatic Identification System (AIS)

8. (a) Describe the procedure of the approval of design and plan of inland ships according to Bangladesh Inland shipping Ordinance 1976. **(5)**
   (b) What is COLREGs? According to COLREGs, describe the rules to avoid the risks of collisions. **(13)**
   (c) List the vessels in order of priority to avoid collisions according to COLREGs. **(5)**
   (d) What was the initial name of IMO? Mention the main purposes of IMO? **(6)**
   (e) Draw a schematic diagram showing the different navigational lights. **(6)**

L-4/T-2/NAME **Date: 23/09/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2016-2017

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

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks

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

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Classify design parameters to be considered for sea-keeping performance. **(10)**

   (b) Explain the influence of different design parameters on the performance of ships. **(25)**

2. (a) What is the approach to the added resistance due to wind, waves and steering to be made. **(10)**

   (b) Explain how you can calculate different components of added resistance due to wind, waves and steering. **(25)**

3. (a) Explain the effect of hull roughness upon the propulsion factors. **(15)**

   (b) How can you estimate the combined propeller and hull roughness penalties? **(20)**

4. (a) Is there any influence of propeller roughness on ship speed and power? Justify your answer. **(17)**

   (b) A cargo ship propeller has following particulars: **(18)**

   D = 5.25 m, P/D = 0.875, N = 4 (Blade nos.)

   The roughness (μm) of blade section has been measured and given in Table for Q. N. 4(b). Calculate APR considering the following weightage factor of propeller blade section:

Region	Weightage factor
0.2–0.5	0.07
0.5–0.7	0.22
0.7–0.8	0.20
0.8–0.9	0.26
0.9–Tip	0.23

Contd P/2

NAME 469

SECTION – B

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

5. (a) What is 'Weather Margin'? Mention and explain various factors that are responsible for loss of speed in a seaway. **(15)**

(b) Briefly discuss and derive the radiated energy approach for predicting added resistance of ship in a seaway. Also distinguish two extreme cases from the derivation. **(20)**

6. (a) A single screw medium speed cargo vessel has the following particulars: **(20)**

$L_{LWL} = 136$ m $\quad L_{BP} = 133$ m $\quad \frac{L_{BP}}{B} = 6.82$

$\frac{B}{T} = 3.25$ $\quad C_B = 0.552$ $\quad C_P = 0.576$

$C_M = 0.957$ $\quad C_{WP} = 0.670$ $\quad V = 15$ Knot

Wetted area = 2839 m^2, Bull roughness = 260 μm

Days out of dock = 182.5 days.

(i) Using ITTC formulation, calculate total frictional resistance including the roughness and fouling due to out of docks in service.

(ii) Using modified Towsin formula, calculate ΔC_f where AHR = 150 μm, γ = 1.004×10^{-6} m^2/s (water)

(b) Describe how the local boundary layer profile can be used to quantify power/resistance increase of ship due to roughness and fouling. **(15)**

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

$L = 4.8$ ft $\quad B = 0.684$ ft $\quad V = 1.415$ Knots

$\nabla = 0.7106$ ft^3 $\quad L_{WL} = L$ $\quad \omega = 6.49$ rad/sec (deep water)

$\zeta_a = 0.05$ ft $\quad z_a = 0.0307$ ft $\quad \theta_a = 0.0404$ rad

$\int b_n(\xi)d\xi = 3.171$ lb-sec/ft

$\int b_n(\xi)\xi d\xi = 0.045$ lb-sec

$\int b_n(\xi)\xi^2 d\xi = 8.815$ lb-sec-ft

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

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

(b) Explain the procedure of measuring hull roughness of ship. What are the main causes of roughness increase during service life of ship? **(15)**

8. Write short notes on **(35)**

(a) Experimental methods for predicting added resistance of ships.

(b) Havelock Theory

(c) Fouling of ship

(d) FR coatings

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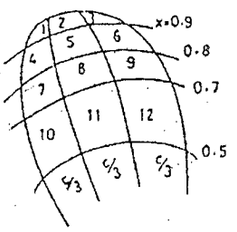
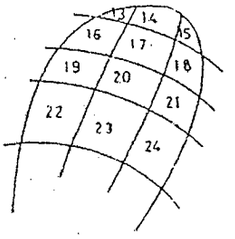
Table for Q.N. 4(b)



Face



Back

Location	R_a	P_c	Location	R_a	P_c
1	13.5	43	13	20.3	29
2	15.6	22	14	16.6	19
3	18.3	24	15	20.0	27
4	19.1	19	16	21.1	28
5	26.7	24	17	46.8	17
6	24.5	10	18	24.9	10
7	28.0	32	19	21.0	15
8	10.9	15	20	22.1	19
9	10.0	34	21	17.8	27
10	6.7	17	22	22.5	36
11	5.0	51	23	8.0	56
12	10.2	39	24	8.2	46

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

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

$$\varepsilon = |\varepsilon_z - \varepsilon_0|$$

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)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2016-2017

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**.

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

1. (a) For a typical spring-mass system derive a state variable model. Consider, **M** be the mass of the system; **b** be the damping coefficient; and **k** be the spring constant. Consider an input of **u(t)** for which the system responds. Also, consider two states x_1 and x_2 which represents the velocity and acceleration of the mass. Draw necessary figures. **(20)**

   (b) A helicopter is hovering under manual control in order to land on a moving ship. In adverse weather and sea conditions it is an extremely difficult task. The hovering condition is represented by the following matrix of state variable model: **(15)**

$$A = \begin{vmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -6 & -3 \end{vmatrix}$$

   Find the roots of the characteristic equation and comment on it.

2. (a) Derive the equation of tracking error for the following closed loop control system in terms of sensitivity function and complementary sensitivity function as shown in Figure for Question No. 2(a). Also, discuss the role of loop gain. **(20)**

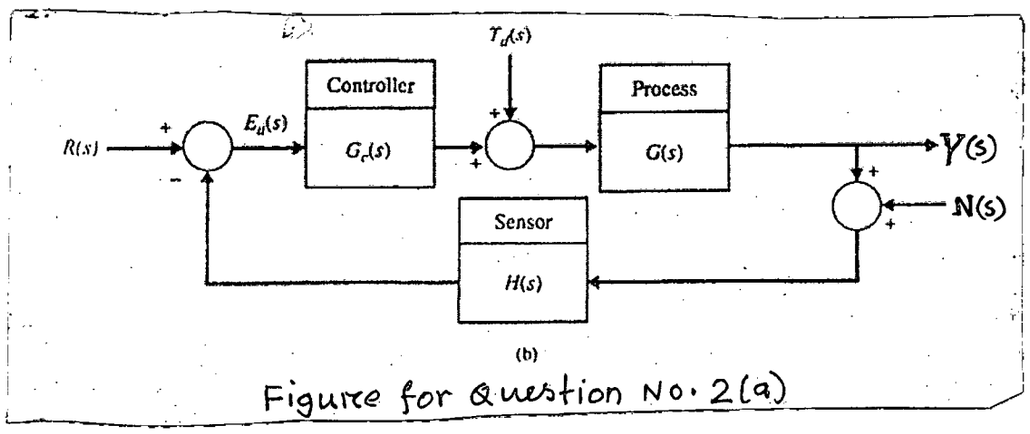


Figure for Question No. 2(a)

NAME 467

Contd... Q. No. 2

(b) An autonomous underwater vehicle is installed with a robotic arm and a camera which will be used to grab objects during underwater expeditions. The camera is used to close the feedback loop (unity feedback) to a microcomputer, which controls the arm. The transfer function for the process is, **(15)**

$$G(s)=\frac{K}{(s+5)^2}$$

(i) Calculate the expected steady-state error of the arm for a step command A as a function of K.

(ii) Name a possible disturbance signal for this system.

3. (a) Submersibles with clear transparent hulls have the potential to revolutionize underwater leisure. One small submersible vehicle has a depth-control system as illustrated in Figure for Question No. 3(a). **(25)**

(i) Determine the closed-loop transfer function $T(s)=Y(s)/R(s)$

(ii) Determine the sensitivity S_{K1}^{T} and S_{K}^{T}

(iii) Determine the steady-state error due to a disturbance $T_d(s)=1/s$.

(iv) Calculate the response $y(t)$ for a step input $R(s)=1/s$ when $K=K_2=1$ and $1<K_1<10$. Select K_1 for the fastest response.

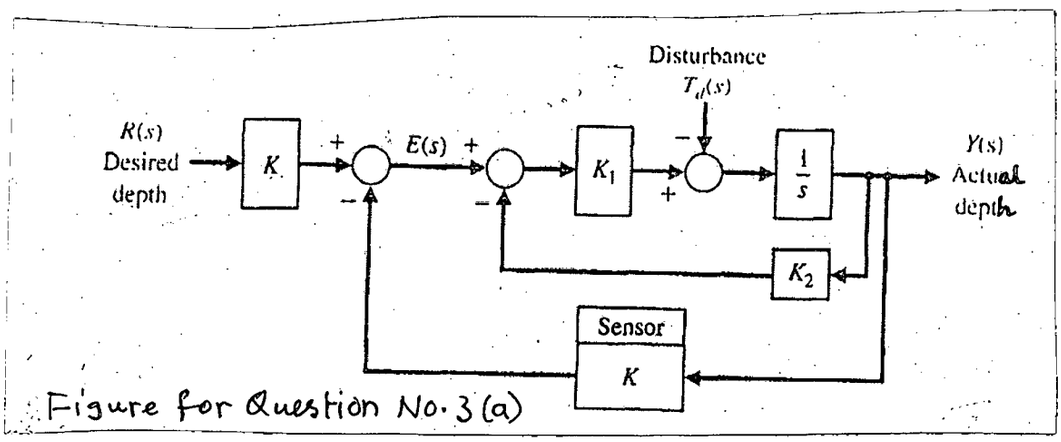


Figure for Question No. 3 (a)

(b) Briefly describe the following three test input signals: **(10)**

(i) Step

(ii) Ramp

(iii) Parabolic

4. (a) For a typical system, graphically show the impulse response for various root locations in s-plane. **(10)**

Contd P/3

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Contd... Q. No. 4

(b) Large welding robots are often used in various manufacturing industries. The welding head is moved to different positions on the specimens, and a rapid, accurate response is required. A block diagram of a welding head positioning system is shown in Figure for Question No. 4(b). Using Routh array determine the range of K and a for which the system will be stable. **(25)**

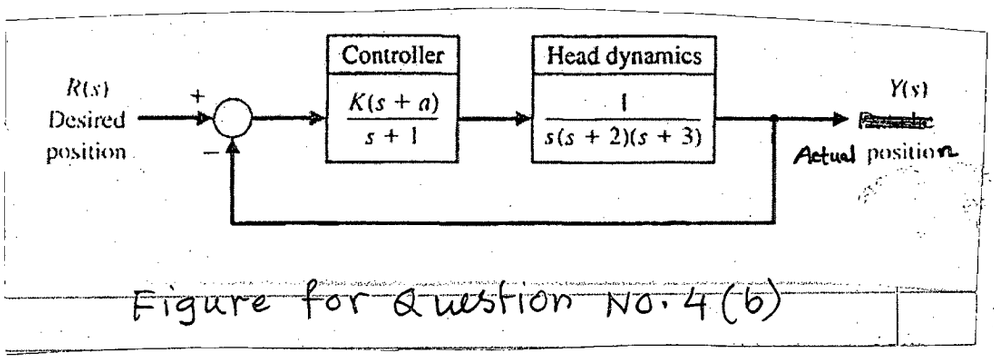

Figure for question No. 4(b)

SECTION – B

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

Symbols have their usual significances.

5. (a) Define control system. Describe the different types of control system. **(10)**

(b) A sailboat can not sail directly into the wind and travelling straight downward is usually slow. The shortest distance is rarely a straight line. The sailboats tack upwind- the familiar zigzag course- and jibe downward. A tactician's decision of when to tack and where to go can determine the outcome of a race. **(10)**

Describe the process of tacking a sailboat as the wind shifts direction. Sketch a block diagram depicting the process.

(c) Describe the basic principle of green engineering. **(15)**

6. (a) A laser printer uses a laser beam to print copy rapidly for a computer. The laser is positioned by a control input $r(t)$ so that we have, **(17)**

$$y(s) = \frac{4(s+50)}{S^2 + 30S + 200} R(s)$$

The input $r(t)$ represents the desired position of the laser beam.

(i) If $r(t)$ is a unit step input, find the output $y(t)$

(ii) What is the final value of $y(t)$?

Contd P/4

NAME 467

Contd... Q. No. 6

(b) A control engineer designed an innovative ship steering system. The system is represented by the block diagram as shown in Fig. for Q. No. 6(b), where $y(s)$ is the ship course, $R(s)$ is the desired course and $A(s)$ is the rudder angle. Find the transfer function $y(s)/R(s)$. **(18)**

7. (a) What is the function of smart grid? Describe the five key technologies required to implement a successful modern smart grid? **(10)**

(b) Describe the dynamic approach to system modeling. **(5)**

(c) A system is shown in Fig. for Q. No. 7(c) **(20)**

(i) Find the closed-loop transfer function $y(s)/R(s)$ where $G(s)=\frac{10}{S^2+2S+10}$.

(ii) Determine $y(s)$ when the input $R(s)$ is a unit step.

(iii) Compute $y(t)$.

8. (a) Describe three control systems that are installed in a ship. **(15)**

(b) Find the transfer function for $y(s)/R(s)$ for the idle speed control system for a fuel-injected engine as shown in Fig. for Q. No. 8(b). **(20)**

NAME 467: Control Engineering

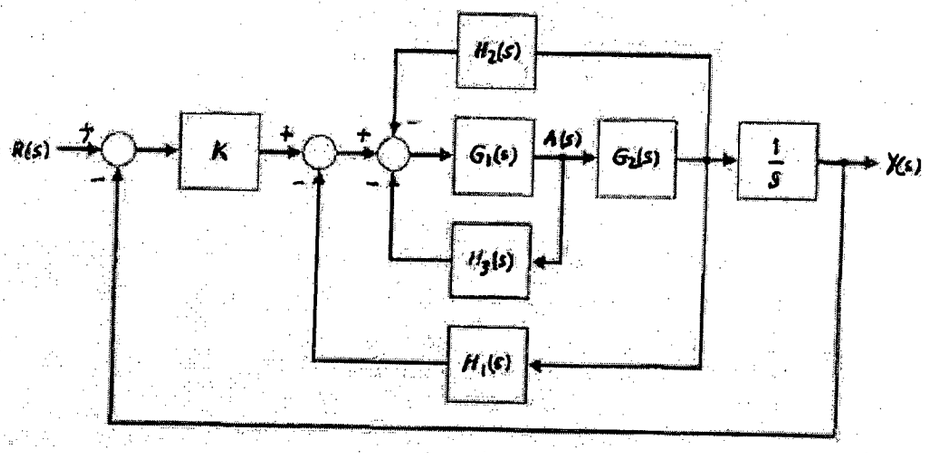

Figure for Q. No. 6(b)

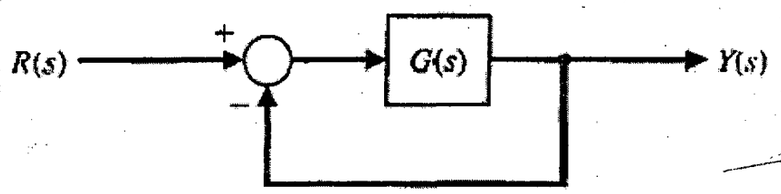

Figure for Q. No. 7(c)

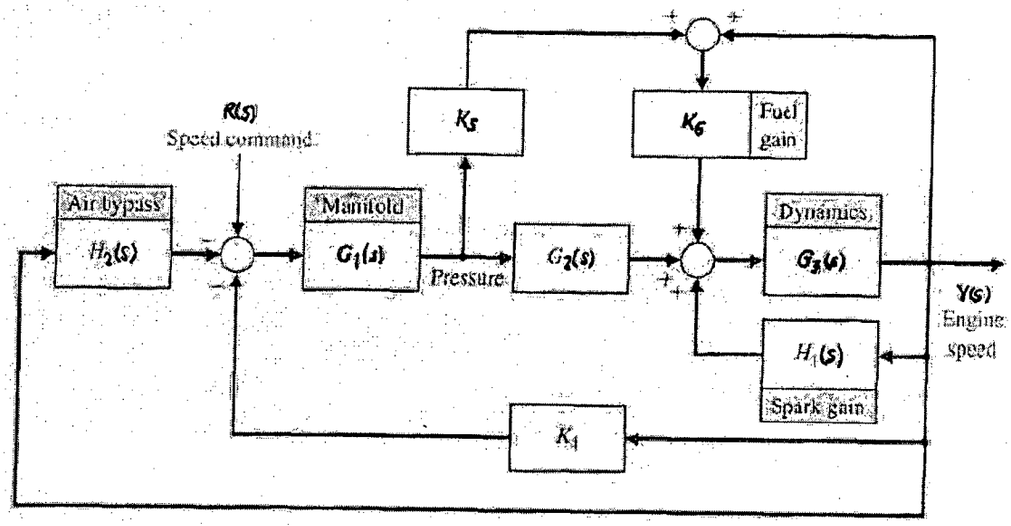

Figure for Q. No. 8(b)