L-4/T-2/NAME **Date : 24/03/2024**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2021-2022

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 value can be assumed for any missing data.

1. (a) Make a comparative study among steam turbine, diesel engine and gas turbine. **(25)**

   (b) What are the prospects of fuel cell power? **(10)**

2. (a) How shaft generator works? **(17)**

   (b) What are the advantages and disadvantages of shaft generator? **(18)**

3. (a) With neat sketches describe the operation of a bow thruster. **(10)**

   (b) How a bow thruster is used for maneuvering a ship? **(15)**

   (c) Enumerate some maintenance work of bow thruster. **(10)**

4. (a) How zero emission ship concept is applied in E/S Orselle? **(10)**

   (b) Write short notes on regenerative fuel cell. **(10)**

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

   L_{WL} = 72 m, B_{MLD} = 22 m, D = 5 m, T = 4 m, 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: $C_B X(^{2/3}cV^3/(1.03xC)$ where, Δ = Displacement, V = Ship speed, C = coefficient, and B_{MLD} is increased by 3.5% considering DWT, C_D and speed be the same as before, what will be the change of EEDI?

Contd P/2

NAME 423

SECTION – B

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

The symbols have their usual significance.

5. (a) Explain the engine-propeller matching problem and its solution. **(15)**

   (b) A ship has a diesel engine of maximum continuous rating 6000 KW at 120 rpm directly connected to the propeller, which is designed to operate in the average service condition at the continuous service rating of 85 percent maximum rated power and 95 percent rated rpm. (i) If the service margin is 20 percent, determine the propeller rpm in the fully loaded trial condition at which the maximum rated power of the engine will be absorbed. (ii) If due to exceptionally bad weather the power demand of the propeller increases by 40 percent over that in the trial condition, what is the maximum rpm at which the propeller can be run if 10 percent overloading of the engine over the maximum rated torque is permitted? **(20)**

6. (a) Explain why a wheel of larger diameter is required in fixed paddles in comparison to that of feather paddles and also draw a comparison of the two. **(15)**

   (b) A feathering paddle wheel consists of paddles pivoted about points on a circle of radius 2.0 m. The arm attached at right angles to each paddle is of length 0.30 m and the link attached to this arm is on a straight line which passes through appoint 0.25 m forward of the centre of the paddle wheel. The waterline is 1.8 m below the centre. Determine the angles of the paddle to the vertical when its pivot enters and leaves the surface of water. What would be the angle of the paddles entering and leaving water if the paddles were fixed instead-of feathering? **(20)**

7. (a) Explain why and where (in which types of ships) controllable pitch propeller are often fitted. **(15)**

   (b) Derive the expressions for ideal jet efficiency and jet efficiency taking into losses applying axial momentum theory. **(20)**

8. (a) What are the major problems of supercavitating propeller in terms of blade strength and its performance in off design conditions? **(15)**

   (b) Explain how you will mitigate the undesirable effects of the complex flow at the stern of a ship to some extent by fitting device to improve the nature of the flow into the propeller. **(20)**

18/05/2024

L-4T-2/NAME Date: ~~27/04/2024~~

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2021-2022

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

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks.

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

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. **Q. No. 1 is compulsory.**

Answer any **TWO** from the rest.

1. (a) Approximately 1.25 M tonnes of Mineral Ore per annum required to be transported between Mine and Smelter, 2000 miles apart. A comparison of economic performance between a self-loading bulk carrier of about 60,000 dat 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. FoC ship owner requires 10% rate of return over 16-year life of ship. **(25)**

Both alternatives:

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

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

Fuel consumption 50 tonnes HFO + 2 tonnes DO/day HFO cost \$120/tonne and DO cost \$180/tonne

Port charges \$20,000/R_T

Time at loading port 1.5 days

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

Basic ship price \$18.0 M

Share Discharging Gear:

1000 tonnes/hour at cost of \$0.90/tonne

Self unloading Gear:

2000 tonnes/hour

Weight of gear plus structure 2300 tonnes

Additional cost \$9.08 M

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

Additional diesel oil consumption during discharge 0.5 tonnes/working hour

Additional three days out of service per annum.

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Contd... Q. No. 1(a)

Additional information:

	Conventional	Self-unloading
Displacement, tonnes	73,500	73,500
Lightship, tonnes	13,250	to be calculated
Days in service per annum	350	to be calculated
Maximum payload, tonnes	59,128	to be calculated
Crew cost, $	600,000	to be calculated
Daily running cost, $	800,000	80,000
Maintenance of self-unloading gear, $	—	90,000

From the above data, calculate the following item for both.

(i) Total operating cost p.a.

(ii) Total annual cost

(iii) Cost per tonne cargo

Additionally, comments which option is better/worse if shore discharging cost below/above 90P.

(b) 'To get more realistic comparison of the above problem, investigation of uncertainties is necessary'— Do you agree with this statement? Justify your answer with suitable example. **(10)**

2. (a) Consider a 40,000 tonne deadweight Oil Products Carrier bought by a Flag-of-Convenience ship owner for a total of $18.0 M cash. It is operated on a five year time charter at $9.0 per tonne deadweight per month after commissions and then sold for $13.0 M cash. Assume that crew cost are $7,00,000 in first year, rising by 10% p.a. and other operating costs are fixed at $6,00,000 p.a. Annual trading period 11.5 month. **(25)**

(i) Calculate NPV at 10% discount rate to assess whether the investment is profitable.

(ii) Find IRR.

(b) With a block diagram, show the decision chart for choice of economic criteria for marine problem. **(10)**

3. (a) A passenger ship has an investment cost of $28.0M, 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 5th, 10th, 15th, 20th and 25th year, interest rate is 22%. **(20)**

(i) Find the AAC of the investment.

(ii) Find NPV of the investment considering annual income $5.0 M p.a.

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Contd... Q. No. 3

(b) Mention the important factors that contributed to transform the shipping industry during the period 1869-1950. **(5)**

(c) Mention the salient features of the liner and trans shipping system in the period mention in Q. No. 3(b). Also explain why shipping system change after 1950. **(10)**

4. (a) A 11,000 MT payload cargo ship makes 10 round voyage per annum with 60% lead 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 $3.0 M and her expected life is 15 years, 8% discount rate, zero resale value and 50% tax rate. Calculate NPV of cash flow using the following methods. **(30)**

   (i) No tax

   (ii) Free depreciation

   (iii) Straight line depreciation

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

SECTION – B

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

5. (a) Illustrate the supply and demand curve and the factors affecting the maritime economy. **(10)**

(b) A bulk carrier is carrying full cargo of grain from New Orleans to Rotterdam after ballast voyage from U.K. **(25)**

Ship data:

33,000 tonnes DWT, draft 10.5 m 37,500 w.m. grain, Speed 14.5 knots on the loaded condition and ballast voyage and consider 5% Sea margin to allow for water conditions and other delays. The ship requires 35 tonnes high viscosity fuel per day and 1.8 tonnes diesel oil at sea or in port.

Operating cost of the vessel is $5500 per day.

Cargo Data: 28,000 tonnes grain loaded at a rate of 7,000 tonnes per day, Cargo discharging rate is 4,000 per day. Loading charge $1.50 per tonne. Freight: $18.00 per tonne, consider 10% broker's commission.

Other necessary data:

Distance from New Orleans to Rotterdam: 5000 mile

The port time of 3 days loading and 2 days discharging (total 5 days) includes time waiting for berth, documentation, loading and discharging, bunkering.

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

Harbour dues at New Orleans: $25,000

Harbour dues at S Rotterdam: $35,000

High viscosity fuel cost $100/tonne

Diesel oil cot $170/tonne

Calculate the total voyage time, total port disbursements cost, and surplus per day.

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6. (a) Describe the responsibilities of the freight market when chattering ships for **(17)**

   (i) Bareboat charter

   (ii) Time charter

   (iii) Single voyage charter.

   (b) Describe the following terms used in shipbuilding economics. **(18)**

   (i) The world Scale Index

   (ii) Contract of Affraightment

   (iii) Demolition Market

7. (a) What is the ISM Code? What should be the basic objective of safety management in a company? **(5)**

   (b) "Modern safety management is based on a combination of proactive and reactive approaches"— discuss how these approaches are coordinated with each other. **(15)**

   (c) You have been commissioned to carry out a risk analysis for the safe operation of ship in Bangladesh. What potential risks have been identified? Suggest some measures to reduce these risks. **(15)**

8. (a) Briefly explain the main features of three maritime transportation systems available in today's shipping market. **(17)**

   (b) Mention the advantages and disadvantages of the following contracts in shipbuilding: **(18)**

   (i) CPFF

   (ii) CPIF

   (iii) LSFP

L-4/T-2/NAME Date: 22/04/2024

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B.Sc. Engineering Examinations 2021-2022

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 to question no. **1 is compulsory**.

Answer any **TWO** questions form the rest.

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

1. (a) What are the objectives of safe manning in ship? Which factors must be taken into account to establish the minimum safe manning of a ship? . **(15)**

   (b) Explain the general problems of ship-recycling in perspective of Bangladesh. **(15)**

   (c) Draw a schematic diagram showing the maritime zones of Bangladesh and explain the territorial waters according to UNCLOS. **(15)**

2. (a) Discuss the fitness of UNCLOS for the purpose in the 21st century. **(5)**

   (b) Discuss the problem form ballast water discharge from ship. **(8)**

   (c) Describe ballast water management plan according to BWM convention. **(12)**

   (d) What are the principal conditions that must be satisfied before assigning freeboard to any ship? **(5)**

3. (a) Make a list of data and plans required for the freeboard calculation of a ship. Draw a flowchart showing the overall procedure for the calculation of the required freeboard according to ILLC. **(12)**

   (b) Discuss the surveys of passenger ships under SOLAS convention. **(10)**

   (c) Explain the discharge standards of residues of noxious liquid substances according to MARPOL convention. **(8)**

4. A double skin segregated ballast crude oil tanker has the following particulars: **(30)**

   L_{BP} = 223.00 m
   L_{WL} = 230.00 m at 85% D
   B = 32.23 m
   D = 20.50 m
   Deadweight = 70,000 tonnes
   Draft aft in ballast condition = 7.70 m
   Propeller diameter, D_P = 6.85 m
   Steel mass = 11,371 MT
   Outfit mass = 1,507 MT
   Engine plant mass = 822 MT

   From hydrostatic data,

   Displacement = 34,000 MT at draft 6.00 m

   Displacement = 35,800 MT at draft 7.00 m

Contd..... Page/2

NAME 449

(Continuation Q. no. 4)

In addition, tankers 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 = 171.00 m
Height of double bottom = 2.02 m
Width of wing tank spare = 2.10 m

(i) Find the minimum SBT capacity in m^3 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) Is the limiting size and arrangement of cargo tank ok after side and bottom damage? Justify your answers.

SECTION – B

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

5. (a) "There are various functions and vital roles that the International Maritime Organization (IMO) plays as an organization as well as an International leader in the maritime department" - briefly discuss and justify this statement. **(20)**

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

(c) Differentiate between flag state control and port state control. **(8)**

6. (a) Distinguish between the followings: **(20)**

i) Celestial and Terrestrial navigation
ii) Navigational aids and Aids to navigation
iii) LRIT and GMDSS
iv) GPS and AIS

(b) As a Naval Architect, you are assigned to design a cruise ship of passenger capacity 250 plying between Chottogram and Kolkata. You need to select Life Saving Appliances (LSA) for this ship. Choose different LSA with justification. **(15)**

7. (a) According to the Inland Shipping Ordinance 1976, briefly discuss the following regulations: **(15)**

i) Approval of design and plan of an inland ship
ii) Inquiry into shipping casualty
iii) Protection of Inland water from pollution

(b) Discuss the fire main system onboard a ship. **(10)**

(c) What are the advantages of foam fire extinguishers over water fire extinguishers? **(10)**

8. (a) Distinguish between give-way vessel and stand-on vessel. **(5)**

(b) According to COLREGs, what are the conduct of vessels during **(20)**

i) head-on situation,
ii) crossing situation,
iii) overtaking situation,
iv) in restricted visibility.

(c) Distinguish between isolated danger marks and safe water marks according to IALA Maritime Buoyage System. **(10)**

For question no.4

- **Annex I, Regulation 1(18):**

"Length" (L) means 96 percent of the total length on a waterline at 85 percent of the least moulded depth measured from the top of the keel, or the length from the foreside of the stem to the axis of the rudder stock on that waterline, if that be greater.

- **Annex I, Regulation 13:** Segregated ballast tanks, dedicated clean ballast tanks and crude oil washing; new oil tankers of 20,000 tons deadweight and above

a) the moulded draught amidships (d_m) in meters (without taking into account any ship's deformation) shall not be less than: $d_m = 2.0 + 0.02\ L$

b) the draughts at the forward and after perpendiculars shall correspond to those determined by the draught amidships (dm) as specified in subparagraph (a) of this paragraph, in association with the trim by the stern of not greater than 0.015L; and

c) in any case the draught at the after perpendicular shall not be less than that which is necessary to obtain full immersion of the propeller(s).

- **Annex I, Regulation 13F:** Prevention of oil pollution

a) Required width of wing tanks or spaces,

$w = 0.5 + DWT/20000$ (m) or $w = 2.0$ m, whichever is lesser

The minimum value of $w = 1.0$ m

b) Required height of double bottom tanks or spaces

$h = B/15$ (m) or $h = 2.0$ m, whichever is the lesser.

The minimum value of $h = 1.0$ m

- **Annex I, Regulation 22:** Damage assumptions

a) Side damage

(ii) Transverse extent (t_c) (inboard from the ship's side at right angles to the centerline at the level corresponding to the assigned summer freeboard);

B/5 or 11.5 meters, whichever is less

b) Bottom damage

(iii) Vertical extent from the base line (v_s):

B/15 or 6 meters, whichever is less

- **Annex I, Regulation 23:** Hypothetical outflow of oil

(1) The hypothetical outflow of oil in the case of side damage (O_c) and bottom damage (O_s) shall be calculated by the following formulae with respect to compartments breached by damage to all conceivable locations along the length of the ship to the extent as defined in regulation 22 of this Annex.

(a) For side damages:

O_c = hypothetical flow after side damage

$$= \sum W_i + \sum K_i C_i$$

where: W_i = volume of a wing tank, in cubic meters, assumed to be breached by the damage; W_i for a segregated ballast tank may be taken equal to zero.

C_i = volume of a center tank, in cubic meters, assumed to be breached by the damage; C_i for a segregated ballast tank may be taken equal to zero.

$$K_i = 1 - \frac{b_i}{t_c}$$

when b_i is equal to or greater than t_c, K_i shall be taken equal to zero.

(b) For bottom damages:

O_s = hypothetical flow after bottom damage

$$= \frac{1}{3}\left(\sum Z_i W_i + \sum Z_i C_i\right)$$

Where,

$$Z_i = 1 - \frac{h_i}{v_s}$$

when h_i is equal to or greater than v_s, Z_i shall be taken equal to zero.

b_i = width of wing tank under consideration, in meters, measured inboard from the ship's side at right angles to the centerline at the level corresponding to the assigned summer freeboard.

h_i = minimum depth of the double bottom under consideration, in meters; where no double bottom is fitted, h_i shall be taken equal to zero.

4) In the case where bottom damage simultaneously involves four center tanks, the value of O_s may be calculated according to the formula

$$O_s = \frac{1}{4}(\Sigma Z_i W_i + \Sigma Z_i C_i)$$

- **Annex I, Regulation 24:** Limitation of size and arrangement of cargo tanks

The regulation says that cargo tanks sizes should be such that the hypothetical outflow O_C or O_S calculated in accordance with the provisions of Regulation 23 anywhere in the length of the ship does not exceed 30,000 m^3 or $400(DWT)^{1/3}$, whichever is the greater, but subjected to a maximum of 40,000 m^3.

- **Annex I, Regulation 24:** Limitation of size and arrangement of cargo tanks

4) The length of each cargo tank shall not exceed 10 meters or one of the following values, whichever is the greater:
(a) where no longitudinal bulkhead is provided inside the cargo tanks:

$$(0.5\frac{b_i}{B} + 0.1)L$$

but not to exceed 0.2L
(b) where a centerline longitudinal bulkhead is provided inside the cargo tanks:

$$(0.25\frac{b_i}{B} + 0.15)L$$

L-4/T-2/NAME

Date : 24/03/2024

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2021-2022

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 any missing data (if any).

1. (a) In how many ways multiple subsystems are represented? **(5)**

   (b) Explain the components of a typical block diagram with necessary figures. **(10)**

   (c) Discuss the three primary forms of interconnecting subsystems with necessary diagrams. For each form, state how the equivalent transfer function is found? **(20)**

2. (a) Consider a system as shown in the figure for question no. 2(a). **(10)**

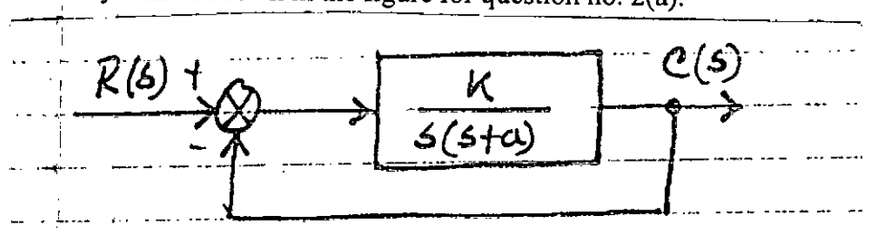

Fig. for Q. No. 2(a)

   Deduce the closed-loop transfer function and discuss how the value of K influence the damping of the system?

   (b) If the value of K= 25 and $\alpha = 5$, as shown in the system for question number 2(a), find the peak time, percent overshoot, and setting time. **(10)**

   (c) Design the value of gain K for the system given in question no 2(a), so that the system will respond with a 10% overshoot (take $\alpha = 5$). **(15)**

3. (a) Discuss the concept of stability, instability and marginal stability of a control system concerning natural response. **(10)**

   (b) Explain how a Routh table is constructed. How to interpret the table? **(15)**

Contd P/2

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Contd ... Q. No. 3

(c) Find the steady-state error for the system as shown below in figure for question number 3(c), if $T(s) = \frac{5}{s^2 + 7s + 10}$ and the input is a unit step. **(10)**

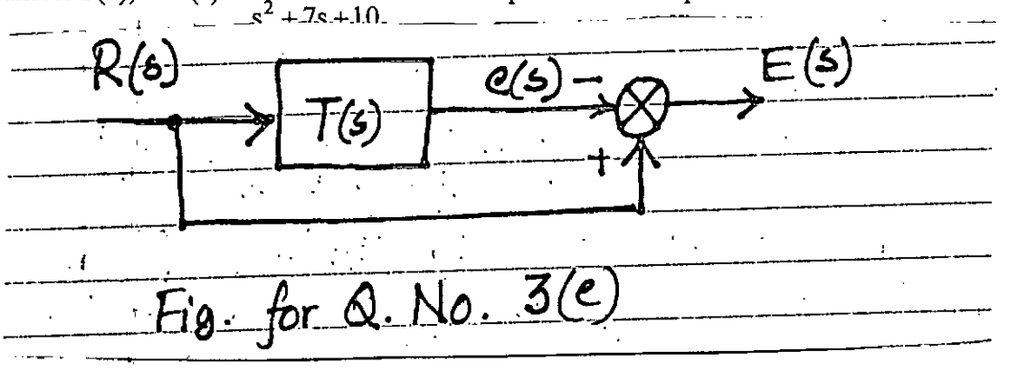

Fig. for Q. No. 3(c)

4. Consider a system as shown in figure for question number 4. Here, the **(35)**

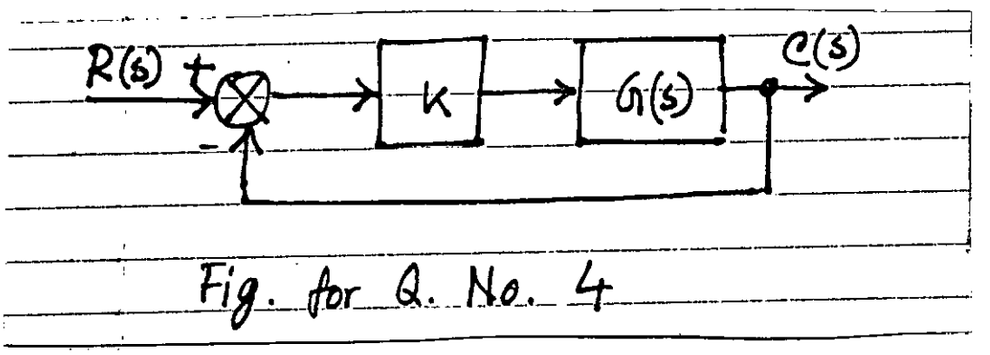

Fig. for Q. No. 4

Plant, $G(s) = \frac{\omega_n^2}{s^2 + 2\int \omega_n s + \omega_n^2}$.

Now,

(i) Deduce the equipment closed-loop transfer function, T(s) in terms of $\int$, ω_n, and K. What are the natural frequency and damping ratio of T(s)?

(ii) Deduce the general expression of roots of the equivalent system.

(iii) Draw the root locus. Use ω_n as the last two digits of your student ID and $\int = 5 \times \frac{M}{\omega_n}$. Here M is the last two digits of your student ID.

(iv) Find the highest value of gain so that there is no overshoot.

SECTION – B

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

5. (a) Describe a ship autopilot control system and draw it's block diagram. **(12)**

(b) With a suitable example, discuss how the performance of control systems can be measured. **(13)**

Contd P/3

NAME 467

Contd ... Q. No. 5

(c) A laser printer uses a laser beam to print copy rapidly from a computer. The laser is positioned by a control input *r(t)*, so that we have **(10)**

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

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)*?

6. (a) Define poles and zeros of transfer function and discuss their role in system response. **(15)**

(b) What is meant by analysis and design of control systems? **(10)**

(c) Find the Laplace transform of $3e^{-4t}$. **(10)**

7. (a) Write down how control systems can be tested. **(20)**

(b) Derive the expression of a transfer function for a heating system. **(15)**

8. (a) Construct a transfer function of a ship maneuvering model. **(10)**

(b) Write short notes on (a) Actuator and (b) Transducer. **(10)**

(c) Ships at sea undergo motion about their roll axis. Fins called stabilizers are used to reduce this rolling motion. The stabilizers can be positioned by a closed-loop roll control system that consists of components, such as fin actuators and sensors, as well as the ship's roll dynamics. Assume the roll dynamics, which relates the roll-angle output, $\theta(s)$, to a disturbance-torque input, $T_D(s)$, is **(15)**

$$\frac{\theta(s)}{T_D(s)} = \frac{2.25}{s^2+0.5s+2.25}$$

(i) Find the natural frequency, damping ratio, peak time, settling time, rise time and percent overshoot.

(ii) Find the analytical expression for the output response to a unit step input.

(iii) Plot the response.
