L-2/T-2/NAME **Date : 01/07/2015**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2013-2014

Sub : **MATH 283** (Statistics, Partial Differential Equation and Matrices)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Symbols have their usual meaning.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Find the integral surface of the differential equation

$2y(z-3)p + (2x-z)q = y(2x-3)$ which passes through the circle $z=0, x^2+y^2=2x$. **(13)**

(b) Solve the following first order PDEs:

(i) $x^2(y-z)p + y^2(z-x)q = z^2(x-y)$ **(10)**

(ii) $z - px - qy = p^2 + q^2$ **(12)**

2. Solve the following linear PDEs:

(i) $\left(D_x^3 + 4D_x^2D_y + 4D_xD_y^2\right)z = 4\sin(2x+y)$ **(10)**

(ii) $\left(D_x - D_y - 1\right)\left(D_x - D_y - 2\right)z = e^{2x-y} + x$ **(12)**

(iii) $\left(x^2D_x^2 - D_y - 4xyD_xD_y + 4y^2D_y^2 + 6yD_y\right)z = x^3y^4$ **(13)**

3. (a) Express the matrix A as a sum of symmetric and skew-symmetric matrix, where **(10)**

$$A = \begin{bmatrix} -1 & 7 & 1 \\ 2 & 3 & 4 \\ 5 & 0 & 5 \end{bmatrix}$$

(b) If $A = \begin{bmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{bmatrix}$, Show that $A.(adjA) = |A|I$. Hence find A^{-1}. **(13)**

(c) Find the rank of the matrix $\begin{bmatrix} 0 & 1 & 3 & 5 \\ 1 & -3 & 0 & 2 \\ 2 & -6 & 2 & 0 \end{bmatrix}$ reducing it to canonical form. **(12)**

4. (a) Discuss the consistency of the following system of equations **(17)**

$$2x + 3y + 4z = 11$$
$$x + 5y + 7z = 15$$
$$3x + 11y + 13z = 25$$

If found consistent, solve it.

Contd P/2

MATH 283(NAME)

Contd ... Q. No. 4

(b) If $A = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 2 & 1 & 4 & 3 \\ 3 & 0 & 5 & -10 \end{bmatrix}$, find two nonsingular matrices P and Q such that PAQ is in normal form. **(18)**

SECTION – B

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

5. (a) You are given the following incomplete frequency distribution. It is known that the total frequency is 1000 and the median is 413.11. Estimate by calculation the missing frequencies and find the value of the mode and 3rd quartile. **(17)**

Class interval	Frequency
300-325	5
325-350	17
350-375	80
375-400	?
400-425	326
425-450	?
450-475	88
475-500	9

(b) Calculate coefficient of variation from the following table. **(18)**

Class interval	Frequency
300-400	30
400-500	46
500-600	58
600-700	76
700-800	60
800-900	50
900-1000	20

6. (a) Calculate the first four moments about an arbitrary origin from the following data.

Marks	No. of Students
0-10	5
10-20	12
20-30	48
30-40	40
40-50	15
50-60	7
60-70	3

From the moment so computed find the moments about mean. Also calculate the values of β_1 and β_2 and comment on the nature of the distribution. **(20)**

(b) The following table gives the values of two variables.

X:	56	42	72	36	63	47	55
Y:	147	125	160	118	149	128	150

Find the regression line of Y on X and X on Y. **(15)**

Contd P/3

MATH 283

7. (a) A bag contains 8 green and 10 white balls. Two drawings of 4 balls are made such that (i) the balls are replaced before the second trial (ii) the balls are not replaced before the second trial. Find the probability that the first drawing will give 4 green and the second 4 white balls in each case. **(18)**

   (b) A factory finds that, on average, 20% of the bolts produced by a given machine will be defective for certain specified requirements. If 10 balls are selected from the day's production of this machine find the probability that (i) exactly 2 will be defective (ii) more than 5 will be defective, by using binomial distribution and Poisson distribution in both the cases. **(17)**

8. (a) Reduce the quadratic form $5x_1^2 + 4x_2^2 + 15x_3^2 + 14x_2x_3 + 16x_3x_1 + 6x_1x_2$ to the canonical form. Also write down the corresponding equations of transformation. **(18)**

   (b) State Cayley-Hamilton theorem and verify the theorem for the matrix. **(17)**

$$A = \begin{bmatrix} 2 & 6 & 5 \\ 4 & 3 & 1 \\ 1 & 7 & 4 \end{bmatrix}$$

L-2/T-2/NAME **Date : 08/07/2015**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2013-2014

Sub : **NAME 223** (Marine Hydrodynamics)

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) Define streamline. Describe the characteristics of the streamline flow pattern. **(18)**

   (b) Derive the equation of continuity for one dimensional fluid flow. **(7)**

   (c) Show that in a two-dimensional incompressible steady flow field the equation of continuity is satisfied with the velocity components given by: **(10)**

$$u = \frac{k\left(x^2 - y^2\right)}{\left(x^2 + y^2\right)^2}, \quad v = \frac{2kxy}{\left(x^2 + y^2\right)^2}$$

   where k is an arbitrary constant.

2. (a) Derive Euler's equation of motion for a non-viscous fluid. Hence prove the Bernoulli equation. **(20)**

   (b) Show that the two-dimensional irrigational flow stream function $\Psi = U\left(r - \frac{a^2}{r}\right)\sin\theta$ represents pattern of steady flow in the x-direction, past a cylinder of radius a, of an infinite fluid whose undisturbed velocity is U. Determine the potential function and find the distribution of velocity on the boundary of the cylinder. **(15)**

3. (a) Derive the Navier-Stokes equation for the motion of viscous fluid and determine the solution of those equations for steady two-dimensional flow between fixed parallel plates. **(25)**

   (b) What do you mean by 'displacement thickness', 'momentum thickness' and 'energy thickness'? **(10)**

4. (a) State and prove Blasius's Theorem. **(20)**

   (b) How can you derive the expression of forces for the flow past a profile of any cross section with circulation? **(15)**

Contd P/2

NAME 223

SECTION – B

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

5. (a) A sink A, of strength Q is at (–a, 0) and a source B of equal strength is at (a, 0). With uniform flow in the positive x-direction, show that the location of the stagnation points is given by **(20)**

$r_s = a\sqrt{1-\frac{2m}{aU}}$ and sketch the pattern of flow for the cases $m < \frac{aU}{2}$ and $m > \frac{aU}{2}$

where U is the uniform flow and m = $m = \frac{Q}{2\pi}$.

(b) A source of strength Q is situated at the origin in a uniform stream with velocity U, parallel to the x-axis. Show that the half body represented by $\Psi = \frac{1}{2}Q$ attains half of its maximum thickness at its intersection with the y – axis. **(15)**

6. A long circular cylinder lies in an air stream having a velocity of 180 ft/sec. In addition there is a flow around the cylinder with a circulation of – 4350 ft^2/sec. Neglecting all viscous and compressibility effects determine: **(35)**

   (i) the maximum velocity due to the air stream alone.
   (ii) the velocity at the cylinder surface due to the circulation alone.
   (iii) the maximum velocity
   (iv) the location of the stagnation points
   (v) the maximum and minimum pressures.
   (vi) the lift force per foot length of cylinder.

   Given: Density of air = 0.00237 slugs/ft^3.
   Diameter of cylinder = 4 ft.

7. (a) If w = f(z) where w = ϕ + iΨ and z = x + iy, find the values of ϕ and Ψ in terms of x and y for the following function of z: **(5⅔×3=17)**

$$\text{(i) } z^2 \text{ (ii) } z + \frac{1}{z} \text{ (iii) } \ln z.$$

   (b) Identify the following z – plane patterns and diameter for each, the velocity V and the direction of flow, α at the point z = 3 + 4i. **(6×3=18)**

   (i) w = 3z
   (ii) w = 4 ln z
   (iii) $w = 3\left(z + \frac{5}{z}\right) + 4i \ln z$

Contd P/3

NAME 223

8. (a) Explain what do you mean by analytic function? Prove for complex velocity, $\frac{dw}{dz} = |V| . e^{-i\alpha}$ where the symbols have their usual meaning. **(12)**

(b) For the pattern $w = 2z^2$, determine the magnitude and direction of the velocity at the point (3, 2). **(8)**

(c) Considering the transformation $w = z^2$, determine the corresponding values of w, ϕ, Ψ and $\frac{dw}{dz}$ and the change in w corresponding to a change $\delta z = 0.5 + 0.2i$. **(15)**

L-2/T-2/NAME **Date : 02/08/2015**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2013-2014

Sub : **EEE 261** (Electrical and Electronic Technology for 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**.

1. (a) Derive the induced torque equation of an induction motor. **(10)**

   (b) Briefly explain starting torque, pullout torque and full-load torque of a typical induction motor using its torque-speed characteristic curve. **(10)**

   (c) A 50 Hz, 15 hp, 460 V three phase four pole wye connected induction motor is driving a centrifugal pump at 1480 rpm. The combined friction windage and stray losses are 170 W. Motor parameters (in ohm per phase) referred to stator are: **(15)**

$R_1 = 0.20$	$R_2 = 0.25$	$X_M = 42.00$
$X_1 = 1.20$	$X_2 = 1.29$	$R_C = 317.00$

   Determine: (i) Air gap power, P_{AG}

   (ii) Mechanical power developed, P_{conv}

   (iii) Developed torque, τ_{ind} and

   (iv) Efficiency, η

2. (a) Describe the speed control method of induction motors by changing the lime frequency. **(10)**

   (b) The following test data are taken on a 7.5 hp, four-pole, 208 V, 60 Hz, design A, Y-connected induction motor having a rated current of 28A. **(10)**

DC test Data	No-load test Data	Blocked Rotor test Data
$V_{DC} = 13.6$ V	$V_{line} = 208$ V	$V_{line} = 25$ V
$I_{DC} = 28.0$A	$I_{line} = 8.17$A	$I_{line} = 27.9$A
	$P_{in,3\phi} = 420$ W	$P_{in,3\phi} = 920$ W
	f = 60 Hz	f = 15 Hz

   Determine R_1, R_2, X_1, X_2 and X_M of the motor.

   (c) Briefly explain the effect of the factors that cause the difference between the internal generated voltage(E_A) and the output voltage(V_ϕ) of a synchronous generator. **(15)**

3. (a) What will happen to the terminal voltage(V_ϕ) if a lagging load is added to the synchronous generator? How to restore the terminal voltage(V_ϕ) to its previous level? **(10)**

   (b) What is an infinite bus? Using house diagram and phasor diagram briefly explain the effect of increasing set points of an alternator connected to an infinite bus. **(10)**

Contd P/2

EEE 261(NAME)

Contd ... Q. No. 3

(c) A 480 V, 100 kW, two pole, three phase, 60 Hz synchronous generator's prime mover has a no-load speed of 3630 rpm and a full-load speed of 3570 rpm. It is operated in parallel with a 480 V, 75 kW, four pole, 60 Hz synchronous generator whose prime mover has a no-load speed of 1800 rpm and a full-load speed of 1785 rpm. The total loads supplied by the two generators is of 100 kW, 0.85 pF lagging. **(15)**

Determine: (i) The speed drops of gen.1 and gen.2;

(ii) The operating frequency, f_{ysm};

(iii) The power supplied by each of the generators.

4. (a) What are the differences between synchronous machine and induction machine from the electrical point of view? Briefly explain the operations of synchronous generator and synchronous motor using the magnetic field diagram. **(10)**

(b) Is a synchronous motor's field circuit more vulnerable to overheating when it is operating at a leading or at a lagging power-factor? Explain using phasor diagrams. **(10)**

(c) A 480 V, 50 Hz, 400 hp, 0.8 pF leading, four pole, Δ-connected synchronous motor has a synchronous reactance of 1.1 ohm and negligible armature resistance. Ignore all the friction, windage and core losses. **(15)**

(i) If the motor is supplying 400 hp at 0.8 pF lagging. What is the magnitude and angle of E_A and I_A?

(ii) What is the maximum possible induced torque at this conditions?

(iii) If $|E_A|$ is increased by 15%, what is the new magnitude and angle of I_A?

SECTION – B

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

5. (a) Assuming that the diodes in the circuits of Fig. for Q. 5(a) are ideal, find the values of labeled voltages and currents. **(10)**

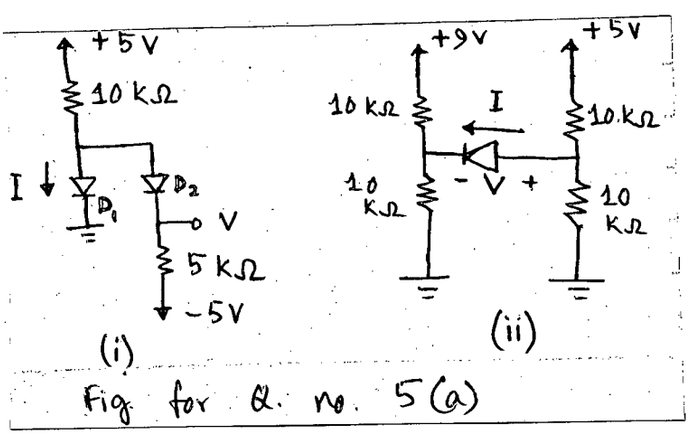

Fig for Q. no. 5(a)

EEE 261(NAME)

Contd ... Q. No. 5

(b) Input and output wave shapes of a clipping circuit is drawn in the Figure of Q. 5(b). Design the circuit using constant voltage drop (0.7 V) model and level the input and output terminals. **(10)**

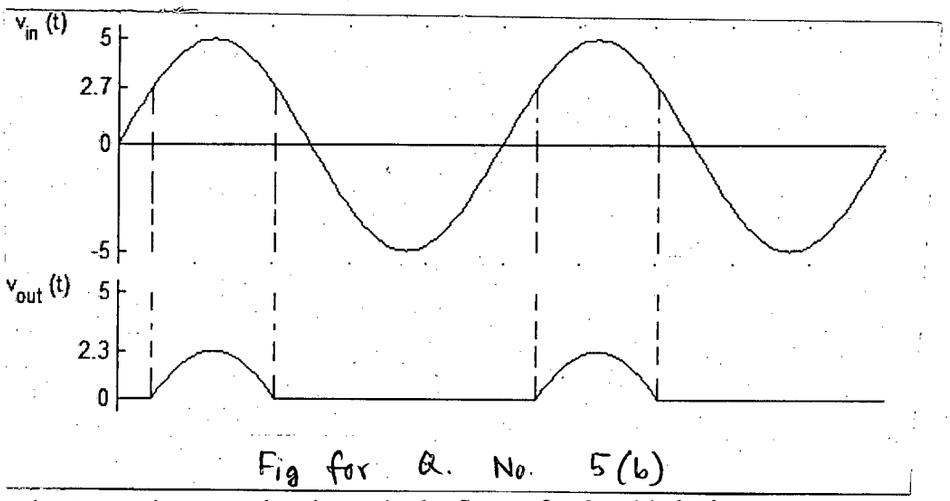

Fig for Q. No. 5(b)

(c) For the Zener shunt regular shown in the figure, for Q. 5(c) the known parameters are: **(15)**

$V_Z = 9.1$ V at $I_Z = 9$ mA

$r_Z = 30\ \Omega$

$I_{Zk} = 0.3$ mA

For a nominal Zener current of 10 mA, determine the value of current (I_R) that must flow through the supply resistor R? Calculate the line regulation (mV/V) and load regulation (mV/mA)? Consider, $R_L = 1$ kΩ

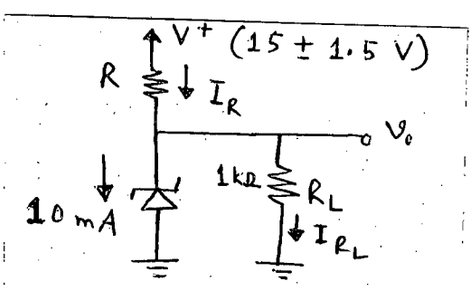

Fig for Q. No. 5(c)

6. (a) For the peak rectifier circuit shown in the figure for Q. 6(a), obtain the expression of V_r, i_{Dav} and i_{Dmax}, where the symbols carry their usual meaning. **(20)**

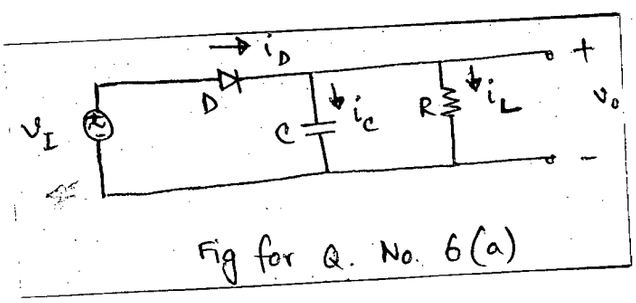

Fig for Q. No. 6(a)

Contd P/4

EEE 261(NAME)

Contd ... Q. No. 6

(b) Determine the voltages at all nodes and the currents through all branches for the shown in Fig. Q. 6(b). What is the largest value that R_D can have while the transistor remains in the saturation mode? $\left(V_t = 1\text{V}, k_n' \frac{W}{L} = 1mA/V^2\right)$ **(15)**

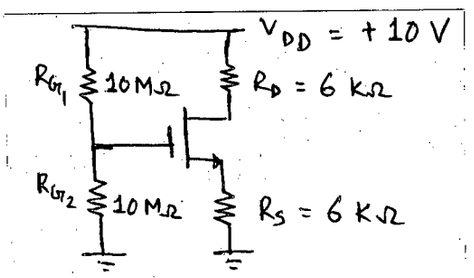

Fig. for Q. No. 6(b)

7. (a) Calculate the value of α and β for the transistor used in the circuit of Fig. for Q. 7(a). **(15)**

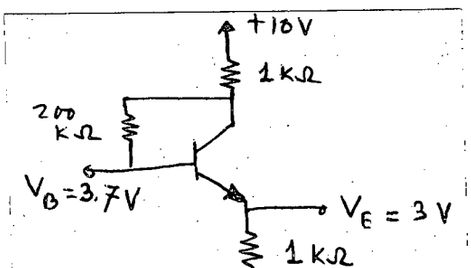

Fig. for Q. No. 7(a)

(b) Using small signal equivalent circuit model of circuit of Q. No. 7(b), find input resistance (R_{in}) and voltage gain (V_o/V_{sig}). Assume, β = 100 and r_e = 250 Ω. **(20)**

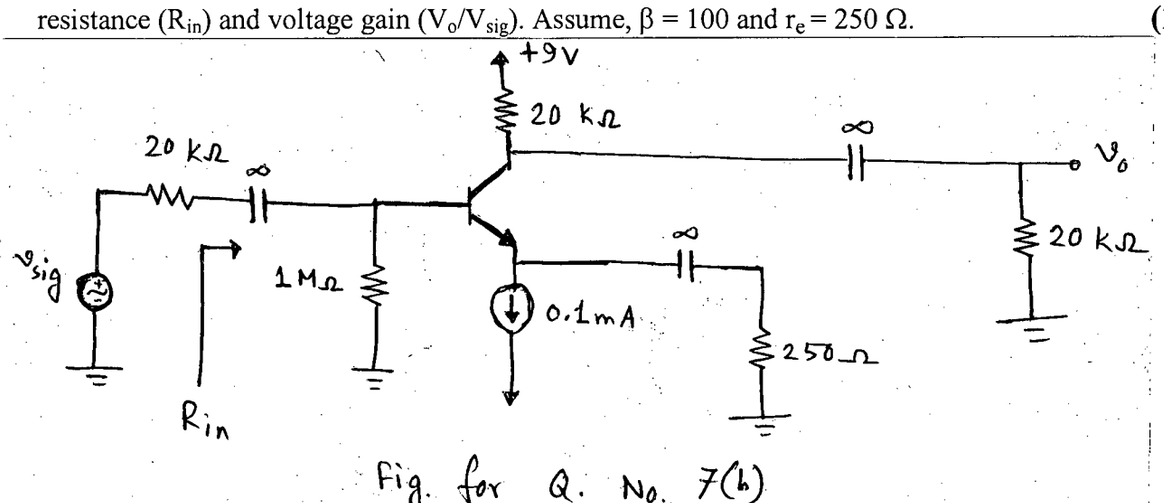

Fig. for Q. No. 7(b)

8. (a) What are the turn-on methods of a SCR? Discuss the regenerative process of a SCR. **(10)**

(b) Draw the circuit diagram of a single phase controlled rectifier. Also show that, rms value for the output voltage, $v_{o_{rms}} = \frac{V_m}{\sqrt{2}}\sqrt{1 - \frac{\alpha}{\pi} + \frac{1}{2\pi} sin 2\alpha}$. **(15)**

(c) What is a RADAR? Draw the block diagram of a RADAR. **(10)**

L-2/T-2/NAME **Date : 06/08/2015**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2013-2014

Sub : **HUM 211** (Sociology)

Full Marks : 140 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) Discuss the contribution of agricultural revolution and transport revolution to the industrial revolution in Europe. **(13 ⅓)**

   (b) Industrial revolution begins division of labour in the creation of goods. Explain. **(10)**

2. (a) In what ways might globalization render the nation-state relatively weak? **(13 ⅓)**

   (b) Describe the social factors associated with the rapid population growth rate in Bangladesh. **(10)**

3. (a) How can the Government of Bangladesh reduce illegal international migration? **(13 ⅓)**

   (b) Point out five advantages and disadvantages of 'closed class system' and 'open class system'. **(10)**

4. Write short notes on any THREE of the following: **(23 ⅓)**

   (a) Human ecology

   (b) Population pyramid

   (c) Flying shuttle

   (d) Calculation of IMR, CDR and TFR

SECTION – B

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

5. (a) Explain how sociologists think themselves any from the familiar routines of daily life through sociological imagination. **(10)**

   (b) Write the principles and properties of interactionist perspective of sociology. **(13 ⅓)**

6. (a) What is socialization? Explain different types of socialization with suitable examples. **(10)**

   (b) Discuss C.H. Cooley's looking-glass self theory. **(13 ⅓)**

Contd P/2

HUM 211/NAME

7. (a) What is deviant behaviour? Illustrate the relationship between social stigma and deviant behaviour. **(10)**

   (b) Explain interactionist perspective of deviant behaviour. **(13 ⅓)**

8. Write short notes on any Three of the following: **(23 ⅓)**

   (a) Sociology and other social sciences.

   (b) Conflict theoretical perstpective.

   (c) Dominant ideology and popular culture.

   (d) Cultural relativism and ethnocentrism.

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2013-2014

Sub : **NAME 217** (Theoretical Ship Design)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Symbols have their usual meaning.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) A 110,000 tonnes dwt tanker is 258 m LBP, 43 m Breadth Mld and 14.20 m Draft Mld. A new similar design of 130,00 tonnes dwt is being considered. Estimate the new principal dimensions, displacement and the corresponding light weight. **(20)**

   (b) Mention the basic principles and the minimum heights of the following items according to load line convention. **(10)**

   (i) Door sill.

   (ii) Hatch coamings.

   (iii) Air pipes.

   (iv) Sounding pipes.

   (v) Side scuttles.

   (c) Draw a typical section of guard rail of a vessel and mention the dimensions according to load line convention. **(5)**

2. (a) The following information is known for a basic General Cargo Ship and a Similar new design: **(20)**

Item	Basic Ship	Dew Design
LBP (m)	140	145
B Mld (m)	19.5	20.5
Depth Mld (m)	12.6	12.3
C_B at SLWL	0.726	0.735
Aft deck sheer (m)	1.52	1.43
For'd deck sheer (m)	3.20	2.94
Residual steel additions (tones)	-	+ 39
Total finished steel weight (tones)	4035	?

Estimate the steel weight for the new design after modification have been made to the basic ship's Steel weight for Main dimensions, C_B, Sheer and residual additions.

(b) Define the following steel weight terms: **(8)**

(i) Net scantling steel weight (ii) Invoice steel weight (iii) Net steel weight. (iv) A nested plate.

(c) Sketch a propeller shaft from propeller itself to the engine room to show the location of ship powers along the shaft. **(7)**

Contd P/2

NAME 217

3. (a) Using the table of data, estimate the Wood and outfit weight for the new General Cargo ship by two methods for correcting for new Dimensions only.

Vessel	LBP (m)	BMld (m)	W & O weight
Basic ship	137.5	19.75	740
New design	145	20.50	?

Give reasoning why one method should give a slightly more accurate prediction. **(20)**

(b) Data for a selected basis ship with diesel machinery is as follows: **(15)**

P_B = 4700 kW, displacement = 15000 tonnes, Speed of ship, v = 16.5 knots, machinery weight = 675 tonnes. Estimate the machinery weight for a new similar design of displacement 14750 tonnes and speed of the vessel 15.25 knots.

4. (a) For a general Cargo basic ship and a new design particulars are given as follows: **(21)**

Item	Basic Ship	New design
LBP (m)	133	139
B. Mld (m)	19.5	20.5
Depth. Mld (m)	12.0	12.5
SLWL (m)	8.95	9.52
C_B at SLWL	0.75	0.745
Length of amidship's	20	21
Machinery space (m)		
Tank Top height (m)	1.22	1.5
Upper deck Camber (m)	0.35	0.35
Deck sheer forward (m)	2.75	2.80
Deck sheer aft	1.45	1.35
Tank Top ceiling (m)	0.075	0.075
Grain Capacity (m^3)	18750	?

Estimate the Final Grain Capacity and Bale Capacity for the new design.

(b) With a neat sketch describe the particular features of appearance and construction of following: **(14)**

(i) Tankers.

(ii) Containers ships.

SECTION – B

There are **FOUR** questions in this Section. Q. No. (8) is compulsory and Answer any **TWO** from the rest.

5. (a) Sketch a set of subdivision curves for a passenger ship. Include one example of two compartment flooding. Label the important parts on your diagram. **(9)**

(b) Define the following floodable and permissible length terms: **(6)**

(i) Margin line

(ii) Bulkhead deck

(iii) Criterion of service numeral

Contd P/3

NAME 217

Contd ... Q. No. 5

(c) Calculate the factor of subdivision when a ship has a subdivision length of 140 m and a criterion of service numeral of 54.5. **(8)**

(d) Calculate the criterion of service numeral when the total volume of machinery spaces below the margin line is 3625 cubic meter, the total volume of passenger space and crew spaces below the margin line is 2735 cubic meter and the total volume of ship from Keel to the margin line is 12,167cubic meter. **(12)**

6. (a) A vessel drawing 6.75 m forward, 7.75 m aft, MCT 1CM 140 tonnes-m, TPC 15 tons has cargo space available in Nos. 2 and 4 holds, 50 m forward and 40 m abaft the center of flotation which is at amidships. How much cargo should be loaded in each hold if the ship is to complete loading with a mean draft of 8.0 m and trimmed 15 cm by the stern? **(20)**

(b) Draw the hull weight distribution curve according to the following approximation: **(15)**

(i) PNA

(ii) Hughes

(iii) Prohaska

7. (a) Sketch the line diagram for solving ship resistance problem. Label the important points on the diagram. **(7)**

(b) A 7.32 m ship model has a welted surface Area (WSA) of 6.31 square meter. It is towed in fresh water at a speed of 3.0 knots. The total resistance is measured on the model and found to be 32 kN. Calculate: **(28)**

(i) Total resistance for a ship of 144.0 m length between perpendiculars in calm water conditions. Assume roughness coefficient 1.825 for the ship model and prototype.

(ii) If the wind and appendage allowance total 22 percentage, then proceed to estimate the final total resistance in sea conditions.

8. 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 heights of 2.6 m respectively.

The displacement at a moulded draft of 85% of the moulded depth is 22,700 cubic meter and the displacement in seawater at the summer load waterline is 19,420 tones with a corresponding tones immersion per cm of 25. The sheer of the freeboard deck in mm is as follows:

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

Determine the freeboards. **(35)**

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

Freeboards at intermediate lengths of ship shall be obtained by linear interpolation.
Freeboards for type A ships with length of between 365 metres and 400 metres should be determined by the following formula

$$f = -587 + 23L - 0.0188L^2$$

where f is the freeboard in mm. Freeboards for type A ships with length of 400 metres and above should be the constant value, 5605 mm.

For Question no. 8

Percentage of Deduction for Type `A' 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
Percentage of deduction for all types of superstructures	0	7	14	21	31	41	52	63	75.5	87.7	100

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

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.

For Question no. 8

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.

(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:

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

For Question no. 8