MERCHANT SHIPPING SECRETARIAT
GOVERNMENT OF SRI LANKA
CERTIFICATE OF COMPETENCY EXAMINATION

GRADE   : CHIEF MATE ON SHIPS OF 500 GT OR MORE (UNLIMITED)
SUBJECT   : SHIP'S STABILITY
DATE   : 01ˢᵗ April 2019

Time allowed **THREE hours**	Total marks : 180
ANSWER ALL QUESTIONS	Pass marks : 60%

Formulae and all intermediate steps taken in reaching your answer should be clearly shown. You may draw sketches wherever required. Electronic devices capable of storing and retrieving are **not** allowed.

1. Derive the following formula with an aid of a diagram;

     $GZ = KN - KG \times \sin\theta$ **(05 marks)**

   a) A vessel has a displacement of 85,000 t, KG_{solid} of 10.68 m, FSM of 6761 tm. With the aid of Data sheet -1 and Data sheet – 2 draw a GZ curve and determine the following;   **(16 marks)**

      i)   Maximum GZ and the angle at which it occurs   **(03 marks)**
      ii)   The range of positive stability and   **(03 marks)**
      iii)   The angle of heel at which the deck edge would immerse   **(03 marks)**

2. A general cargo vessel which is fully loaded with cargo in holds and few machineries on deck in a port at Tropical Zone for a destination in the Winter Atlantic Zone, during the winter months.

   a) State the minimum statutory requirements for the ships stability throughout the voyage according to Load Line Convention.   **(15 marks)**

   b) Describe the various causes of any deterioration in the ship's stability during the voyage.   **(05 marks)**

   c) Draw specimen GZ curves to show the effects of:

      i)   A transverse shift of cargo, while maintaining a positive GM: **(05 marks)**
      ii)   Developing a negative GM, without a transverse shift of cargo. **(05 marks)**

3. a). Explain in brief the effects on a vessel's stability if she is bilged.   **(05 arks)**

b). A box-shaped vessel 100 m long and 12 m wide is floating at an even keel draught of 6 m in SW. The compartment at the forward end, 10 m long and 12 m broad, is empty. Find the new draughts forward and aft if this compartment is bilged.

(25 marks)

4. a. Explain the precautions to take to avoid excessive stresses on a ship's structure during sea voyage.

(05 arks)

b. A box shaped barge of 40 m length and 5 m beam has a light displacement of 164 t. It has four identical holds, each 10 m long. 596 t of bulk cargo is loaded and trimmed level within the holds as follows;

No. 1 hold: 198 t   No. 2 hold : 100 t
No. 3 hold : 100 t   No. 4 hold : 198 t
Draw the SF & BM curves according to scale.

(25 arks)

5. a. The trim of a vessel changes when the vessel moves into water of different density. Analyze this statement.

(10 arks)

b. A vessel is about to enter a river port over a bar where the maximum depth of water is 9.20 m. She has to maintain a clearance of 0.5 m. Currently, she draws 8.4 m forward and 9.0 m aft. How much ballast water she should discharge from after peak (LCG – 103 m aft of amidships) in order to trim the vessel to a safe condition for river transit. Assume the density remains constant throughout. Vessel's hydrostatic particulars are as follows;

MCTC - 125   TPC   - 25
LCF   - amidships   LBP   - 212 m
Also calculate the draft forward.

6. a. A vessel, initially upright, with a timber deck cargo, has the following particulars:

Displacement - 10,000 t   KG   - 9.336 m
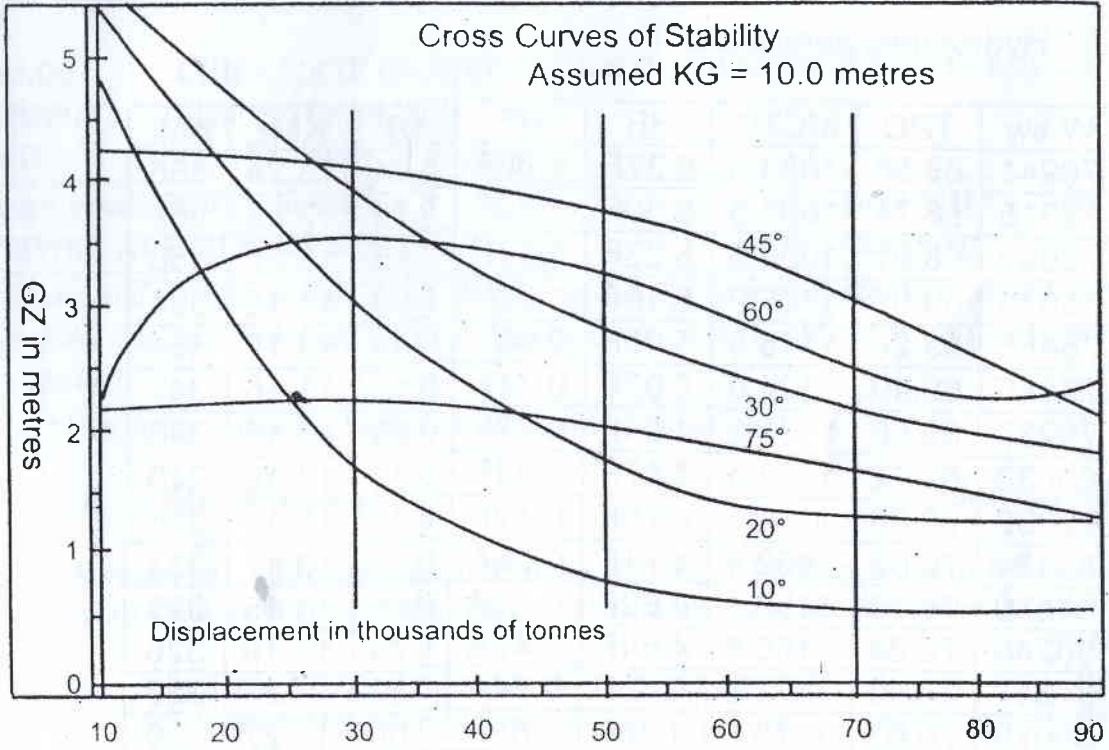
KB   - 4.26 m   BM   - 5.13 m

60 t of FO (RD 0.90), is transferred from the settling tank (previously full & now empty), to a rectangular DB (double bottom) tank, (previously empty and now slack). There is a transverse distance between centroids of 4.0 m and a vertical distance between centroids of 6.00 m. Remember the settling tank is above the DB tank.

The DB tank dimensions are length 12.00 m & breadth 10.00 m.

Calculate the final list assuming the KM & KB remains constant throughout.

(30 marks)

Cross Curves of Stability
Assumed KG = 10.0 metres

GZ in metres

45°
60°
30°
75°
20°
10°

Displacement in thousands of tonnes

Data Sheet – 2

Hydrostatic particulars

d	W sw	TPC	MCTC	HB	HF	kB	KM$_T$	KM$_L$
11.00	70941	68.58	1083.0	5.37F	1.96F	5.64	13.24	366
11.20	72315	68.74	1091.3	5.30F	1.72F	5.75	13.22	362
11.40	73693	68.91	1099.5	5.23F	1.47F	5.85	13.20	358
11.60	75074	69.07	1107.8	5.16F	1.22F	5.95	13.18	354
11.80	76458	69.24	1115.9	5.09F	0.98F	6.06	13.17	351
12.00	77845	69.40	1124.0	5.02F	0.74F	6.16	13.16	347
12.20	79237	69.56	1131.3	4.94F	0.53F	6.26	13.16	343
12.40	80633	69.72	1138.4	4.87F	0.32F	6.37	13.16	340
12.60	82032	69.88	1145.5	4.79F	0.12F	6.47	13.16	336
12.80	83434	70.03	1152.4	4.71F	0.08A	6.58	13.17	333
13.00	84839	70.19	1159.1	4.62F	0.27A	6.68	13.18	329
13.20	86246	70.34	1165.8	4.54F	0.46A	6.79	13.19	326
13.40	87657	70.49	1172.3	4.46F	0.64A	6.89	13.21	323
13.60	89070	70.63	1178.8	4.38F	0.81A	7.00	13.22	320
13.80	90485	70.78	1185.1	4.29F	0.98A	7.10	13.25	316
14.00	91904	70.92	1191.3	4.21F	1.14A	7.21	13.27	313
14.20	93324	71.06	1197.4	4.13F	1.29A	7.31	13.30	310
14.40	94747	71.19	1203.3	4.04F	1.44A	7.42	13.33	308
14.60	96173	71.32	1209.2	3.96F	1.58A	7.52	13.36	305
14.80	97600	71.45	1215.0	3.88F	1.72A	7.63	13.39	302
15.00	99030	71.57	1220.7	3.79F	1.84A	7.73	13.43	299

d = draft in metres, K = keel, H = amidships, LOA 245 m,

LBP 236 m, GT 42000 Tons, NT 28000 Tons

Light W 14000 t, Load W 98000 t, Deadweight 84000 t.