TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology
Department of Mechanical & Automotive Engineering
UNIVERSITY EXAMINATION FOR:
Diploma in Marine Engineering
Diploma in Nautical Sciences
EMR 2225 & 2227 : SHIP STABILITY II
END OF SEMESTER EXAMINATION
SERIES: AUGUST 2019
TIME: 2 HOURS
DATE: Pick Date **Aug 2019**

Instruction to Candidates:

You should have the following for this examination

- *Student I.D. Card & Examination Pass*
- *Answer booklet*
- *Non-Programmable scientific calculator*

This paper consists of **FIVE** questions. Attempt question **ONE** and any other **TWO** questions.

Maximum marks for each part of a question are as shown.

Do not write on the question paper.

Question ONE

a) Discuss the law of Archimedes as applicable to ships. (**3 marks)**

b) A ship 90 m long is floating at drafts 4.5 m *F* and 5.0 m *A*. The centre of flotation is 1.5 m aft of amidships. TPC 10 tonnes. MCT 1 cm. 120 tonnes m. Find the new drafts if a total weight of 450 tonnes is loaded in a position 14m forward of amidships. **(8 marks)**

c) With the aid of sketches, illustrate forces acting on a ship during the following trim conditions.

i. Even keel
ii. Trim by aft
iii. Trim by fore **(9 marks)**

Question TWO

a) A ship of 8000 tonnes displacement has a GM = 0.5 m. A quantity of grain in the hold, estimated at 80 tonnes, shifts and, as a result, the centre of gravity of this grain moves 6.1m horizontally and 1.5m vertically. Find the resultant list. **(8 marks)**

b) A ship arrives in port with displacement 6000 tonnes and KG 6m. She then discharges and loads the following quantities:

Discharge
- 1250 tonnes of cargo KG 4.5 metres
- 675 tonnes of cargo KG 3.5 metres
- 420 tonnes of cargo KG 9.0 metres

Load
- 980 tonnes of cargo KG 4.25 metres
- 550 tonnes of cargo KG 6.0 metres
- 700 tonnes of bunkers KG 1.0 metre
- 70 tonnes of FW KG 12.0 metres

During the stay in port 30 tonnes of oil (KG 1 m) are consumed. If the final KM is 6.8 m, find the GM on departure. **(12 marks)**

Question THREE

a) Differentiate between a pressed tank and a slack tank explaining how slack tanks affect ship's stability. **(5 marks)**

b) A ship's displacement is 4500 tonnes and KG 5m. The following cargo is loaded:
- 450 tonnes KG 7.5 m
- 120 tonnes KG 6.0 m
- 650 tonnes KG 3.0 m.

Find the amount of cargo to load in a 'tween deck (KG 6 m) so that the ship sails with a GM of 0.6 m. (The load KM is 5.6 m) **(6 marks)**

c) Sketch transverse sections through a ship, showing the positions B, G and M, when the ship is in:
- i. Stable equilibrium
- ii. Unstable equilibrium
- iii. Neutral equilibrium **(9 marks)**

Question FOUR

a) Differentiate between tonnage and displacement as used in ships. **(4 marks)**

b) Correction of the angle of loll should be done as soon as possible. Discuss precautions and measures taken to correct the angle of loll. **(6 marks)**

c) A ship of 9900 tonnes displacement has KM. 7.3 m, and KG. 6.4 m. She has yet to load two 50 tonne lifts with her own gear and the first lift is to be placed on deck on the inshore side (KG 9 m and centre of gravity 6 m out from the centre line).

When the derrick plumbs the quay its head is 15m above the keel and 12 m out from the centre line. Calculate the maximum list during the operation. **(10 marks)**

Question FIVE

a) A ship is floating at drafts of 6.1 metres F and 6.7 metres A. The following cargo is then loaded:

20 tonnes in a position whose centre of gravity is 30 metres forward of amidships.
45 tonnes in a position whose centre of gravity is 25 metres forward of amidships.
60 tonnes in a position whose centre of gravity is 15 metres aft of amidships.
30 tonnes in a position whose centre of gravity is 3 metres aft of amidships.

The centre of flotation is amidships, MCT 1 cm = 200 tonnes m, and TPC = 35 tonnes. Find the new drafts forward and aft. **(10 marks)**

b) With the aid of a well labeled sketch, show the following on a GZ-cross curve of stability defining each of them:

i. Initial metacentric height
ii. Angle of contra flexure
iii. Range of stability
iv. Angle of vanishing stability
v. Negative stability **(10 marks)**