CORK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ

Semester 1 FINAL Examinations 2009/10

School: National Maritime College of Ireland

Programme Title: Bachelor of Science (Ordinary) in Nautical Science
Higher Certificate in Science in Nautical Studies

Programme Code: CR_SNASC_7
CR_SNASC_6

Module Title: General Ship Knowledge

Module Code: NAUT6020

External Examiner(s): Capt. M Purcell, Capt. Shane Begley, Capt. Paul O'Regan,
Internal Examiner(s): Mr V Gough, Mr Peter Walter, Mr. Clive Hotham.

Instructions: Candidates must attempt 4 questions as follows;
Section 1: Answer question 1;
Section 2: Answer two questions
Section 3: Answer question 5 (a) or (b);
All questions carry equal marks
Calculators may be used but all working in obtaining an answer must be shown.
Use separate Answer Books for each Section.

Duration: 2 Hours

Sitting: December 2009

Requirements for this examination: Arklow Wave Stability Book; at least three examination books.

Note to Candidates: Please check the Programme Title and the Module Title to ensure that you are attempting the correct examination. If in doubt please contact an Invigilator.
SECTION 1
STABILITY

Answer all questions from this section

1. (a) Using the Arklow Wave Stability Book find the following:
   (i) the displacement at the summer marks;
   (ii) the DWA in water of RD 1.009;
   (iii) the freeboard at the Tropical draft;
   (iv) the coefficient of fineness of the waterplane area at a draft of 6.40;
   (v) height of the centre of buoyancy above the keel at a draft of 4.82 m.

   (7 marks)

(b) The Arklow Wave arrives alongside in port at a displacement of 6325 tonnes KG = 4.97 m. She discharges No. 3 W.B.T. (P & S) which was filled with saltwater ballast and then proceeds to load the following:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Weight</th>
<th>VCG</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 1 Cargo hold</td>
<td>1200</td>
<td>4.76</td>
</tr>
<tr>
<td>No. 2 Cargo hold</td>
<td>1700</td>
<td>4.69</td>
</tr>
<tr>
<td>No. 3 Cargo hold</td>
<td>1840</td>
<td>4.66</td>
</tr>
<tr>
<td>No. 4 Cargo hold</td>
<td>1410</td>
<td>4.45</td>
</tr>
<tr>
<td>Fuel Oil</td>
<td>170</td>
<td>0.70</td>
</tr>
<tr>
<td>Diesel Oil</td>
<td>67.27</td>
<td>3.82</td>
</tr>
<tr>
<td>Fresh water</td>
<td>125</td>
<td>9.70</td>
</tr>
</tbody>
</table>

Using the information contained in the Arklow Wave Stability Book and an allowance of 0.2 m for the free surface effect, calculate the value of the \( G_0 \text{M} \) when she completes loading.

   (16 marks)

(c) The Arklow Wave is alongside at a mean draft of 3.88 metres, if the Mate were to transfer 100 tonnes of ballast from the Aft Peak tank to the F. Pk. tank calculate the change of trim and state whether this would be 'by the head' or 'by the stern'.

   (7 marks)
SECTION 2
SHIP CONSTRUCTION
(Use separate Answer Book)

Answer two questions from this section

2. Discuss, with the aid of sketches if appropriate, five structural features of ONE of the following types of ship:
   a) Oil Tanker
   b) Gas Carrier
   c) RoRo Vessel

   (20 marks)

3. Draw a half midships cross section of ONE of the following types of ship, labelling all parts.
   a) General Cargo Vessel
   b) Bulk Carrier
   c) Container Vessel

   (20 marks)

4. Explain the stresses that a ship is subject to at the forward end of the vessel and show with the aid of a sketch the structural members that form the construction of the vessel to withstand these stresses.

   (20 marks)
SECTION 3
SHIPBOARD OPERATIONS

(Use separate Answer Book)

Answer either (a) or (b) from this section

5. (a)
Outline the safety precautions taken prior to and during discharge of cargo from an oil tanker.

OR

5 (b)
Describe 6 different types of containers commonly loaded on container vessels. Include in your answer an example of the type of cargo for which each is designed and any special precautions when loaded on the vessel.

(30 marks)
STABILITY

(a) (i) the displacement at the summer marks 17876.68 (1 mark)

(ii) the DWA in water of RD 1.009 117.76 (1 mark)

(iii) the freeboard at the Tropical draft 2.793 (1 mark)

(iv) the Cw at a draft of 6.40 0.8226 (1 mark)

(v) the VCB at a draft of 4.82 2.48 (1 mark)

(b) ITEM | Weight | VCG | V-Moment
--- | --- | --- | ---
Arklow Wave | 6325.00 | 4.97 | 31435.25
No. 1 Hold | 1200.00 | 4.76 | 5712.00
No. 1 Hold | 1700.00 | 4.69 | 7973.00
No. 1 Hold | 1840.00 | 4.66 | 8574.40
No. 1 Hold | 1410.00 | 4.45 | 6274.50
Fuel Oil | 170.00 | 0.70 | 119.00
Diesel Oil | 67.27 | 3.82 | 256.97
Fresh water | 125.00 | 8.70 | 1087.50
Ballast | -1149.52 | 3.09 | -3552.02
Total | 11687.75 | 4.95 | 57880.60

KG = 4.95
GG₀ = 0.20
KG₀ = 5.15 (2 marks)
TKM = 9.16 (2 marks)
G₀M = 4.01 (2 marks)

(c) Trim moment = 100 x 121.54 (2 marks)
   = 12154

MTC = 145.45 (1 mark)

Change of trim = 83.56 (2 marks)

by the head (1 mark)
SHIP CONSTRUCTION

1. Discuss, with the aid of sketches if appropriate, five structural features of ONE of the following types of ship:

d) Oil Tanker (three marks for each point mentioned)

i. Designed to carry petroleum liquids in bulk
ii. Double hull design required for new buildings
iii. Speed 14-15 knots
iv. High block coefficient
v. Machinery and accommodation aft
vi. Twin longitudinal bulkheads creating centre and wing tanks
vii. Longitudinal strength main deck and outer bottom
viii. Side shell stiffened by longitudinals or transverse frames
ix. High powered cargo pumps in pumproom
x. Crude oil tankers up to 400,000 dwt (ULCC)
xii. Oil tight bulkheads usually corrugated
xiii. Cofferdams fitted for’d and aft of cargo space
xiv. Small circular oil tight hatch covers
xv. Open rails fitted at least half of length of weather deck
xvi. Strong permanent fore and aft gangway fitted at level of superstructure deck
xvii. Fitted with numerous outfit items i.e. inert gas plant, gauges, tank washing machines etc.

e) Gas Carrier (three marks for each point mentioned)

i. Specialist carriers designed to liquid gas in bulk
ii. Separate inner tank
iii. Secondary barrier
iv. Double hull structure with water ballast space
v. Up to 60,000 dwt / 140,000m3
vi. Speeds of 12-16 knots
vii. Accommodation and engine room aft
viii. Expensive insulation in non pressurised vessels
ix. LNG carried at - 164 °C
x. May be Self supporting/membrane or spherical type
xi. LPG carried to -45 °C
xii. Can be carried in fully pressurised or semi pressurized/semi refrigerated ships.
xiii. If fully pressurised up to 18 bar
xiv. Prismatic, spherical or cylindrical
xv. Bulkheads and cofferdams between cargo tanks
xvi. Cargo pumping pipe work no interconnection with other systems
xvii. Reliquifaction plants may be fitted (LPG)

f) RoRo Vessel (three marks for each point mentioned)

i. Designed to carry wheeled cargo that can be loaded horizontally into vessel

ii. Speeds 18 – 22 knots

iii. Sizes vary, commonly 16,000 dwt

iv. “Ulysses” – Irish Ferries Worlds largest - 4,000 lane meters

v. Clear decks uninterrupted by transverse bulkheads

vi. Cargo carried above waterline but below upper deck

vii. Deck heights sufficient to accommodate various types of vehicles

viii. Up to 10 vehicle decks on designated car carriers

ix. Transverse strength maintained by deep close spaced web frames in conjunction with deck beams

x. Lower decks subdivided by watertight bulkheads with watertight hydraulic operated doors

xi. Moveable ramps fitted to allow access to different levels and create a greater loading area

xii. Bow and/or stern doors may be fitted. Stern door may be set at an angle to ships centre line

xiii. Fitted with low height medium speed diesel engines

xiv. Medium hull coefficient

xv. On Ro Ro ferries passenger accommodation extends along the vessels length above vehicle decks

xvi. Some Ro Ro vessels may be designed to carry containers on deck

2. Draw a half midships cross section of ONE of the following types of ship, labelling all parts.

d) General Cargo Vessel
e) Bulk Carrier
3. Explain the local stresses that a ship is subject to at the forward end of the vessel and show with the aid of a sketch the structural members that form the construction of the vessel to withstand these stresses.

**Panting**

**Panting** is the term used to describe the vibrations of the shell plating and, framing in the positions which are especially liable to fluctuating water pressures when the ship is at sea and encountering waves. Although all parts of the shell plating will be
subject to fluctuating water pressures by the movement of the ship and waves, the
effect will be most pronounced when the ship is pitching, - and more severe forward
than aft due to the ship's forward motion.

Water pressure on the forward shell plating will be increased when the bows drive
into an oncoming wave, while seconds later, the crest of the wave will have passed
aft, relieving the water pressure temporarily until the bows are driven into the next
wave. This fluctuating pressure will cause a 'panting' or 'in and out' working of the
side shell plating which will be increased by the forward motion of the ship.

To resist this, the ship's structure must be strengthened for 15 –20% of the ship's
length from forward.

This stiffening is made up of horizontal side stringers, known as “panting stringers”,
fitted at about 2m intervals below the lowest deck. Panting beams are fitted across
the ship at alternate frame spaces and are bracketed to the panting stringer. The
intermediate frames are connected to the panting stringer by brackets. A partial
wash bulkhead or a series of pillars is fitted on the centre line to further support the
structure.

The above stiffening arrangement is fitted forward of the collision bulkhead. Aft of the
collision bulkhead the strength of the attachment of the side frames to the tank
bracket is increased in the panting region and intercostal side stringers may be fitted
between the frames and in line with the panting stringers forward of the bulkhead.
Alternatively, the thickness of the side plating in the panting region may be
increased, depending upon the length of the vessel.

Pounding

When a ship is lightly loaded and forced at speed through waves, the fore end tends
to rise out of the water on me wave, and then beat down heavily m to the crest of the
following wave. This is known as pounding, and subjects the bottom of the hull, for
about 1/5th of the ships length, to a series of impulsive forces which would result in
buckling of the plating if stiffening was inadequate or pounding excessive.

The forward part of the bottom structure is stiffened to resist pounding by increasing
the thickness of shell plating and stiffening it with additional fore and aft and
transverse plate floors. Lightly loaded ships are particularly susceptible to pounding
in head seas, and this can always be remedied by a timely reduction of speed, which
can avert damage.
Figure 20.1 Fore end construction
SHIPBOARD OPERATIONS

1. ISGOTT 5th Edition. Student Notes
2. Shipboard Operations, Lavery. Student Notes