

Course: EN-4151 APPLIED NAVAL ARCHITECTURE

Credits: 3

Professor: F. Murray

Semester SPRING '23

Office: Room 222A Harrington

Text: Stability and Trim for the Ship's Officer

Prerequisite: EN 3112 – Strength of Materials

Student Hours:

Rm 222A Harrington, **0900- 1000**, or email me, ...or stop by anytime.

Office phone: 508-830- 5279 **Email: fmurray@maritime.edu**

Grading: This course is an STCW knowledge-based assessment course requiring a minimum grade of C-, or 70%, for the semester grade. In accordance with the Engineering Department STCW grading policy, a *grade lower than 70% receives an F for the course.*

The semester grade will be assigned as follows:

Quizzes (0%), Exam #1 (20%), Exam #2 (20%), Final Exam #3 (30%)

In addition to the three exams, there are three graded homework assignments: each worth 10%.

So, you will only have **six (6) grades** for the entire semester.

Attendance:

If you miss a class, you are responsible for catching up with the material that was missed.

Notes

1. Quizzes are designed to let you know if you are keeping up.

If you haven't a clue how to do the quiz, you are behind.

2. Our disability resource contact is Dr. Elaine Craghead, ABS bldg., rm 320.

She may be reached at 508-830-5120 or ADacompliance@maritime.edu

Students having accommodations need to notify me of them.

3. Cadets attending class will be in the correct classroom uniform.

4. No food or drink is allowed in the classroom

Learning Outcomes:

Upon completion of this course, it is expected the Student:

1. Will be able to calculate, or estimate, the area and volume of tanks and other ship shapes.
2. Will have a general knowledge of the principal structural members of a ship.
3. Will be able to explain why a ship floats.
4. Will be able to draw a diagram showing the key parameters involved with measuring a ship's stability.
5. Will be able to explain the effect of load changes on stability.
6. Will be able to use a ship's hydrostatic curves-of-form to obtain displacement and other initial stability information.
7. Can clearly explain how the ship's center of gravity changes when moving weights.
8. Can clearly explain the effect of free surface and be able to calculate the free surface correction if given a ship's loading condition.
9. Will have a working knowledge of the causes and effects of stress on a ship's hull.
10. Will understand what structural hull loads are, and, be able to calculate basic longitudinal hull stress for a simplified loading.
11. Will understand the importance of maintaining watertight integrity.
12. Will be able to estimate a ship's power requirement given speed and resistance data.

STCW Learning Objectives

Demonstrate knowledge and understanding of the following STCW elements:

- [OICEW-D2.1](#) Stability, trim and longitudinal stress
- [OICEW-D2.2](#) The fundamentals of watertight integrity
- [OICEW-D2.3](#) The fundamental actions to be taken in the event of partial loss of intact buoyancy
- [OICEW-D2.4](#) General knowledge of the principal structural members of a ship and the proper names for the various parts

APPLIED NAVAL ARCHITECTURE – Spring 2023

DATE Lesson #	TOPIC
Wed 1 Mar Lesson #1	Administrative issues. Nomenclature, Finding Areas HW Find Area under curve
Fri 3 Mar Lesson #2	More nomenclature, dimensions, finding Area, finding Center of area. HW Find Vol of liquid in tank

Mon 6 Mar Lesson #3	Relationships: Underwater volume, weight, specific weight Sectional area & volume, calculating the weight of a barge
Wed 8 Mar Lesson #4	Weight down, buoyant force up, center of buoyancy, center of gravity,
Fri 10 Mar Lesson #5	Combined center of gravity, Volumes, Archimedes Principle HW Find combined CG for fuel tanks

Mon 13 Mar Lesson #6	Forces are transmitted through the ship's structure. Area-Moments-of-Inertia, parallel axis theorem
Wed 15 Mar Lesson #7	Graded Assignment #1 is going out. Find the Volume and Center of Gravity Due: Wed 22 March in class
Fri 17 Mar Lesson #8	Area moment of inertia for a composite piece. Hull pressure forces, more parallel axis theorem

Mon 20 Mar Lesson #9	Metacenter, metacentric height, righting arm, righting moment
Wed 22 Mar Lesson #10	Positive and negative stability Pg 31 Text, Angle of Loll, Transverse shifting of weight already onboard Graded Assignment #1 is due today.
Fri 24 Mar Lesson #11	Stability triangle, list triangle, why does a ship float? Intro to the Trim & Stability Booklet

Mon 27 Mar Lesson #12	Students will do some problems done in class
Wed 29 Mar Lesson #13	Intro to Ship's Trim & Stability Booklet Adding a weight, calculating angle of list, start Free Surface HW Taking moments about an axis
Fri 31 Mar Lesson #14	Free Surface formula, introducing the virtual center of gravity HW Weight addition

Mon 3 Apr Lesson #15	Developing the Free Surface Correction formula Calculating a tank's Free Surface Correction (FSC),
Wed 5 Apr Lesson #16	Calculating a SHIP'S total Free Surface Correction for ALL tanks. Noon Report, Trim & Stability summary sheet
Fri 7 Apr Lesson #17	Free Surface example problems

Mon 10 Apr	Review for exam #1
WED 12 Apr	EXAM #1 Wed 12 APRIL '23
	COMMENCE SPRING "PAUSE" AFTER LAST CLASS ON THURSDAY 14 APR. No class on MONDAY, 17 APR, it is Patriot's Day. A Holiday for us. Next class is Wed., 19 April, '23

	Start: STABILITY at LARGE ANGLES of Heel Chap7
Wed 19 Apr Lesson #19	Transverse Stability at large angles of heel, Static Stability Curve, Assumed KG, Intact Stability Criteria using Righting Arm curves HW Static Stability going out – draw corrected curve
Fri 21 Apr Lesson #20	Application of trim and stability information. Graded Assignment #2 is going out: Trim & Stability calculations Due: Fri 28 Apr, in class

	Start: LONGITUDINAL HULL STRENGTH Chap 10
Mon 24 Apr Lesson #21	Some ship structural pieces, hogging, sagging, Model the ship as a Box-Beam,
Wed 26 Apr Lesson #22	Flexure Formula, Video – Why ships sink
Fri 28 Apr Lesson #23	Framing Systems , develop ship strength curves; Ship’s Weight curve, Buoyancy curve, and Load curve Graded assignment #2 is due today.

Mon 1 May Lesson #24	Ship Strength curves - example problem Develop the first three curves, Weight per foot $W(x)$, Buoyancy per ft $B(x)$, Loading per ft $L(x)$ Develop Shear Force $V(x)$, Bending Moment Curve $M(x)$
Wed 3 May Lesson #25	More Ship Strength curves, Strength calculations, Class example problem
Fri 5 May Lesson #26	Intro to Section Modulus, Ship construction, Subdivision and “Tonnage”

Mon 8 May Lesson #27	Understanding fundamental actions to be taken in the event of loss of intact stability. Ballast water management
Wed 10 May	Review for exam #2
Fri 12 May	EXAM #2 FRIDAY 12 MAY '23

	<p>LICENSE EXAM WEEK</p> <p>MON 15 MAY thru THURS 18 MAY</p> <p>There is NO NAV ARCH class on FRI 19 MAY</p> <p>HENCE, THERE ARE NO NAV ARCH CLASSES THE <u>ENTIRE</u> WEEK....Mon 15th – Fri 19th</p> <p>Good luck on CG exam. See you MONDAY, 22 MAY</p>	
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Mon 22 May Lesson #30	RESISTANCE to the SHIP moving through the water Intro to Ship Resistance, 3 types of resistance Graded Assignment #3 is going out: Find tank volume. Due: Fri 26 May in class
Wed 24 May Lesson #31	Towing a model, Effective Horsepower (EHP) Use of models, Law of Corresponding speeds Ship Resistance and Modeling, scale factors
Fri 26 May Lesson #32	Explosive limits, Inert Gas systems Graded Assignment #3 is due

MONDAY	29 MAY - MEMORIAL DAY HOLIDAY
Tue 30 May Lesson #33	A Dean's Monday Ship-model power and speed relations Hull speed, Power along basic drive train
Wed 31 May Lesson #34	Ship's Trim and draft marks. Ship propeller basics.
Fri 2 Jun Lesson #35	Drydocking information Review for Exam #3

Mon 5 Jun	Last DAY OF CLASSES. Your FINAL EXAM (Exam #3) will be given in class on this day
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