

Course: EN-4151 APPLIED NAVAL ARCHITECTURE

Credits: 3

Professor: F. Murray

Semester FALL '22

Office: Room 222A Harrington

Text: Stability and Trim for the Ship's Officer

Prerequisite: EN 3112 – Strength of Materials

Student Hours:

Rm 222A Harrington, **1100 – 1200**, or email me, or stop by my office 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-C1.1 Characteristics and limitations of materials used in construction and repair of ships and equipment
- 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 – FALL 2022

DATE Lesson #	TOPIC
Wed 7 Sep Lesson #1	Administrative issues. Nomenclature, Finding Areas HW Find Area under curve
Fri 9 Sep Lesson #2	More nomenclature, dimensions, finding Area, finding Center of area. HW Find Vol of liquid in tank

Mon 12 Sep Lesson #3	Relationships: Underwater volume, weight, specific weight Sectional area & volume, calculating the weight of a barge
Wed 14 Sep Lesson #4	Weight down, buoyant force up, center of buoyancy, center of gravity,
Fri 16 Sep Lesson #5	Combined center of gravity, Volumes, Archimedes Principle HW Find combined CG for fuel tanks

Mon 19 Sep Lesson #6	Forces are transmitted through the ship's structure. Area-Moments-of-Inertia, parallel axis theorem
Wed 21 Sep Lesson #7	Graded Assignment #1 is going out. Find the Volume and Center of Gravity Due: Wed 28 September
Fri 23 Sep Lesson #8	Area moment of inertia for a composite piece. Hull pressure forces, more parallel axis theorem

Mon 26 Sep Lesson #9	Metacenter, metacentric height, righting arm, righting moment
Wed 28 Sep 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 30 Sep Lesson #11	Stability triangle, list triangle, Why does a ship float? Intro to the Trim & Stability Booklet

Mon 3 OCT Lesson #12	GUEST SPEAKER ? Finance CLAS ? Or, simply do the LICENSE EXAM CALCULATIONS LESSON PLAN THAT YOU ALREADY HAVE
Wed 5 Oct 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 7 Oct Lesson #14	Free Surface formula, introducing the virtual center of gravity HW Weight addition

Mon 10 Oct	Columbus Day Holiday, no class
Tue 11 Oct Lesson #15	A Dean's Monday – we have class today. Developing the Free Surface Correction formula Calculating a tank's Free Surface Correction (FSC),
Wed 12 Oct Lesson #16	Calculating a SHIP'S total Free Surface Correction for ALL tanks. Noon Report, Trim & Stability summary sheet
Fri 14 Oct Lesson #17	Free Surface example problems

Mon 17 Oct	Review for exam #1
WED 19 OCT	EXAM #1 Wed 19 OCTOBER
Fri 21 Oct Lesson #18	CG License exam preparation Do some calculations

	Start: STABILITY at LARGE ANGLES of Heel
Mon 24 Oct 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
Wed 26 Oct Lesson #20	Application of trim and stability information. Graded Assignment #2 - Trim & Stability calculations Due: Wed, 2 Nov, in class
Fri 28 Oct Lesson #21	Some ship structural pieces, hogging, sagging, Model the ship as a Box-Beam,

	Start: LONGITUDINAL HULL STRENGTH
Mon 31 Oct Lesson #22	Flexure Formula, Video – Why ships sink
Wed 2 Nov Lesson #23	Framing Systems , develop ship strength curves; Ship's Weight curve, Buoyancy curve, and Load curve Graded assigninment #2 is due today.
Fri 4 Nov Lesson #24	Ship Strength curves - Barge example Develop barge's Weight per foot $W(x)$, $B(x)$, $L(x)$ Shear Force $V(x)$, Bending Moment Curve $M(x)$ Graded Assignment #2 is due. (Trim & Stability calcs)

Mon 7 Nov Lesson #25	More Ship Strength curves, Strength calculations, Class example problem
Wed 9 Nov Lesson #26	Intro to Section Modulus, Ship construction, Subdivision and "Tonnage"
Fri 11 Nov	HOLIDAY – VETERAN'S DAY – NO CLASS

Mon 14 Nov Lesson #27	Understanding fundamental actions to be taken in the event of loss of intact stability. Ballast water management
Wed 16 Nov Lesson #28A	Review for Exam #2
Fri 18 Nov	EXAM #2 FRIDAY 18 NOV – this is the Friday before Thanksgiving week.....you still have a Monday class

Mon 21 Nov Lesson #29	CG license exam calculations Graded Assignment #3 going out: Find volume of a tank Due: Fri 2 Dec
	THANKSGIVING BREAK - Hooray
	See you Monday 28 Nov, 2022

Mon 28 Nov Lesson #30	RESISTANCE to the SHIP moving through the water Intro to Ship Resistance, 3 types of resistance
Wed 30 Nov Lesson #31	Towing a model, Effective Horsepower (EHP) Use of models, Law of Corresponding speeds Ship Resistance and Modeling, scale factors
Fri 2 Dec Lesson #32	Explosive limits, Inert Gas systems Graded Assignment #3 is due

Mon 5 Dec Lesson #33	Ship-model power and speed relations Hull speed, Power along basic drive train
Wed 7 Dec Lesson #34	Ship's Trim and draft marks. Ship propeller basics.
Fri 9 Dec Lesson #35	Drydocking information, More CG license exam calcs

Mon 12 Dec	Review for Exam #3
Wed 14 Dec	Last DAY OF CLASSES. Your FINAL EXAM (Exam #3) will be given in class on this day