

MASSACHUSETTS MARITIME ACADEMY

DEPARTMENT OF MARINE TRANSPORTATION

STABILITY & TRIM (MT4241)

I. LEARNING OBJECTIVES

This course is designed to meet all stability, knowledge based assessments, which form part of the requirements for Officer in Charge of a Navigation Watch (STCW Regulation II/4).

This course builds critical thinking and problem solving skills. Extensive use of homework, computer based training software and in class demonstrations using models will enable the student to analyze and experiment with the principles of stability. The objective of this course is to enable the student to internalize the material presented and to build the mental model necessary to competently function as Officer in Charge of a Navigation Watch.

LEARNING OUTCOMES

Building on the principles of stability, the student will be able to use tables and diagrams of stability and trim data to calculate initial stability, drafts and trim for any given configuration of loading. The student will be able to compute both longitudinal and transverse stability for any condition during the load-out or discharge through the use of the traditional stability booklet and state of the art stability software. The student will be able to interpret stability information and to identify factors adversely affecting stability. Finally, the student will be able to explain the fundamentals of damage stability assessment and the fundamental actions to be taken in the event of partial loss of intact buoyancy.

II. INSTRUCTOR

Capt. Patrick J. Modic

III. TEXT

STABILITY AND TRIM FOR THE SHIP'S OFFICERS

LaDage and Van Gemert edited by George, Fourth Edition

IV. GRADING

"If something exists, it exists in some amount. If it exists in some amount, then it is capable of being measured." Rene Descartes, Principles of Philosophy, 1644

- A. The objective of the assigned homework is to motivate and direct the student's learning. The homework is designed to reinforce knowledge-based fundamentals and to build critical skills in evaluating problems and accurately calculating stability and trim solutions. Test questions will be drawn from the homework or will be very similar in spirit. Keep up with the work.
- B. The instructor intends to administer integral assessments every other week during the semester. The purpose of these tests are:
 - to measure the student's progress and provide feedback
 - to provide motivation
 - to ensure that the STCW Assessment standards are met**Approximately one third of each test will be based on material found solely in the assigned readings.**
- C. Students who miss a test due to an authorized absence must personally notify the instructor prior to the test missed. Students who do not follow this procedure will be considered an unauthorized absentee and will receive a grade of zero for the test missed.
- D. The final examination will be administered during the day and period scheduled by the Registrar's office.
- E. The final examination will be approximately one third of the final grade. The final grade will be the numerical sum of all earned points divided by the total points possible.

V. STCW ASSESSMENTS

- A. Knowledge-based assessments will be conducted as part of this course. Students will be required to achieve a minimum grade of 70% for this course to satisfy the knowledge component of STCW. Individuals failing to achieve a minimum grade of 70% will be required to retake this course and achieve a minimum grade of 70% prior to graduation.

VI. MISCELLANEOUS

- A. A strong foundation in algebra and trigonometry is a pre-requisite for this course. Building on previously learned computer skills, students are encouraged to use excel worksheets on their personal computers to facilitate “number crunching” while completing homework assignments. Further, students are encouraged to program their personal, programmable calculators with any and all stability functions for use while completing homework and during tests.
- B. Self-directed tutoring is available through computer-based training, CBT. A CBT disk on the principles of stability is available from the instructor for copying.
- C. Each student is responsible for assignments and work covered in the class whether he/she is present or not.
- D. Attendance in this STCW Course is mandatory. **More than four (4) absences from classroom lectures will result in failure of the course.** Further, class attendance is a regimental requirement. All unauthorized absences will be reported to the Commandant's Office (This means no cuts).
- E. Office hours are established to allow the student the opportunity to consult with the instructor. Office hours are the ideal forum to discuss individual homework and answer additional questions. If you are having a problem, do not hesitate to see your instructor. The instructor will be pleased to schedule tutoring.
- F. Massachusetts Maritime Academy is committed to providing reasonable accommodations to students with documented disabilities. Students who believe that they may need accommodations in this class are required to contact Mrs. Fran Tishkevich, Director of Disability Compliance (Ext.2208).
- G. Electronic communication devices, any telecommunication device that emits an audible signal, vibrates, displays a message, or otherwise summons or delivers a communication to the possessor including but not limited to: cell phones, iPhones and Blackberries, are prohibited from this class. In the event of a medical condition or personal circumstance necessitating the cadet to be in touch with a doctor or a parent, a reasonable accommodation will be made between the instructor and the cadet. Failure to comply with this directive will result in the following class two report offence, *Disobedience of a Direct Order*.
- H. You will be treated and expected to behave as the professionals you are aspiring to be.

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WK.	LECT.	SUBJECT	READING
1	1	Course Introduction: Curriculum and Objectives, Assignments, Text. Grading and Attendance Six Motions of a Vessel	Adrea Dorea Case Study LaDage pp.31-46
	2	Buoyancy: Archimedes' Principle Displacement: Draft, Freeboard Purpose of Load Lines and Reserve Buoyancy Plimsol Marks Initial Stability: Centers of Gravity and Buoyancy The Couple and Righting Moment Indicators of Initial Stability and Dynamic Stability	Stability Diagram Handout
	3	Transverse Metacenter Stable, Neutral and Unstable Equilibrium Metacentric Height and Metacentric Radius	
2	1	Height of the Metacenter Height of the Center of Buoyancy Metacentric Radius	pp. 47-68
	2	Movement of the Center of Gravity: Calculations for: Vertical Center of Gravity Calculating GG' (Shift of Center of Gravity)	
	3	Movement of the Center of Gravity: Finding KG when Loading and Discharging. Containership Bays-Tiers-Rows	

WK.	LECT.	SUBJECT	READING
3	1	Determining the Height of Metacenter: Calculating Block Coefficient Calculating Height of the Center of Buoyancy, KB Calculating Metacentric Radius, BM Ship's Lines, Hydrostatic Data: Tables and Curves	pp. 69-86
	2	Relationship of Tons per Inch, TPI, to Area of the Waterplane, AWP. Approximating BM fro Curved Water Planes Analysis of the Vertical Movement of KM with a change of displacement Analysis of the Movement of KM with a transverse inclination.	KM Handouts
	3	Stability Booklets: Inspection of Contents Introduction to the S.S. American Mariner Booklet	
4	1	Calculating GM Stability versus Stowage The Relationship of GM to Rolling Period Proportionate Loss of Stability	pp. 87-110
	2	Effects of Negative GM on a Vessel Practical Methods of Calculating GM.	
	3	Practical Problems	
5	1	The Inclining Experiment: Required Gear and Data Derivation of Formulae Precautions to be Taken During Inclining Experiment Conducting a "model" inclining experiment and determining lightship KG	pp. 111-126
	2	<i>T.V. ENTERPRISE</i> Inclining Experiment Power Point Presentation.	
	3	List and Its Correction: Practical applications and Solutions Calculating angle of list resulting from loading, shifting or discharging a weight. Calculating weight to load, shift or discharge to remove a given list.	

WK.	LECT.	SUBJECT	READING
6	1	Effects of Slack Tanks: Free Surface Effects Surface Dimensions Effects of Specific Gravity and the Amount of Liquid in a Tank	pp. 161-184
	2	Effects of Weight and Vertical Position of Liquids Free Surface Corrections and Free Surface Constants	
	3	Operation of Cross-over-Valves between Deep Tanks Free Surface Effects on Overall Stability Tankage Systems for the Deck Officer Anti Rolling Devices Bilge Keels, Antirolling Tanks, Fins and Gyro Stabilization	pp. 301-307
7	1	Fresh Water Allowance: Water Density and Displacement Use of the Hydrometer FWA Calculations	pp. 5-18 FWA Handout p. 200
	2	Trim: Introduction to Longitudinal Stability Preliminary Definitions	pp. 187-214
	3	Trimming Moments and MT1 Calculating MT1 Change of Draft at One End	
8	1	LCF Method of Trim Calculations Effects of Trim on Draft	
	2	LCF Method of Trim Calculations (cont.)	
	3	Change of Trim Due to Large Weights LCG Method of Trim Calculations	

WK.	LECT.	SUBJECT	READING
9	1	LCG Method of Trim Calculations (cont.)	
	2	Use of Trim Tables	
	3	Effect of Trim on Draft Effects of Trim on Displacement and Transverse Stability Effects on Trim when Passing From Salt to Fresh Water.	
10	1	Curves of Statical Stability & Dynamic Stability: Stability at Large Angles of Inclination Effects on GM Stability Curves	pp. 127-145
	2	Constructing Cross Curves of Stability (GZ) Drawing the Statical Stability Curve	
	3	Correction for a Vertical Shift of G Correction for a Horizontal Shift of G	
11	1	Effect of Hull Form on Righting Arm	pp. 146-160
	2	Correcting for a Change in Displacement and a Transverse Shift of G Stability Criteria and Statical Stability Curve	
	3	Analysis of Statical Stability Curve Summary of Analysis.	
12	1	Review of Dynamic Stability	
	2	Angle of Loll Inclination due to unstable equilibrium Calculating the upsetting moment Identifying angle of loll on Static Stability Curve	LOLL Handout
	3	Actions To Be Taken In The Event Of Partial Loss Of Intact Stability: Effects of Flooding on Transverse Stability Remedial Measures to Improve Transverse Stability	pp. 276-299

WK.	LECT.	SUBJECT	READING
13	1	Added weight Method for Statical Stability Effect of Grounding on Stability Effect of Flooding on Reserve Buoyancy Effect of Permeability on Floodable Length	
	2	Introduction to Computer Based Stability Programs Vessel Specific, USCG Approved Computer Based Stability Programs Excel Work Sheet Stability Programs With And Without Hydrostatic Micros	pp. 255-275
	3	Practical Applications And Limitations Of Computer Based Stability Programs And Stability And Trim Considerations	
14	1	Practical Stability and Trim Considerations Purpose of Ballasting Loading to Obtain a desired GM and Trim.	pp. 300-320
	2	Course Review	