MASSACHUSETTS MARITIME ACADEMY
DEPARTMENT OF MARINE TRANSPORTATION

STABILITY & TRIM (MT4241)

SPRING 2016

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 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 understand the effect of cargo, including heavy lifts, on the seaworthiness and stability of the ship. The student will be able to interpret stability information and identify factors adversely affecting stability. The student will be able to explain the fundamentals of damage stability assessment with respect to the effects of flooding on transverse stability and reserve buoyancy. Finally, the student will understanding the fundamentals of watertight integrity and will be able to use floodable length curves to determine the survivability of a vessel 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 real learning is in doing the homework**. 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, accurately calculating stability and trim solutions. Ideally, the homework will engender questions. The students will come into **class with the homework completed and with questions.** Keep up with the work. To be successful in this course of study, **students must dedicate themselves to at least nine (9) hours of study for every three hours of class**. Nine hours of cramming the night before a test is a recipe for failure.

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
   Problems on a test will be drawn from the homework or will be very similar in spirit. **Approximately one third of the theory questions 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 course grade prior to the final examination will be the numerical sum of all earned points divided by the total points possible.

E. The final examination will be administered only in the period designated by the Registrar during final examination week at the end of the semester.

F. The final course grade will be the sum of the pre-final score weighted at 66% and the final examination score weighted at 34%.

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. Each student is responsible for assignments and work covered in the class whether he/she is present or not.

C. Class attendance in this STCW Course is mandatory. (This means no cuts).

- **Monday-Wednesday-Friday Schedule: more than four (4) absences from scheduled classroom lectures will result in failure of this STCW course.**
- **Tuesday-Thursday Schedule: more than three (3) absences from the scheduled classroom lectures will result in failure of this STCW course.**

Administratively sanctioned absences are absences just as absence due to illness are absences. All absences will be reported to the Commandant's Office.

D. In order to facilitate a resolution within a reasonable period, a student shall have seven calendar days from the time a test or other grading point is returned to address a clerical error in grading or to challenge a test question. This "statute of limitation" regarding the maximum time a student may seek redress shall be absolute.

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.

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. **This is your first and only warning.** 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.	SUBJECT	READING
1	**Course Introduction:** Curriculum and Objectives, Assignments, Text. Grading and Attendance Six Motions of a Vessel	**ADREA** **DOREA** **Case Study** **Canary Packet** **pp.1-7**
	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 Transverse Metacenter Stable, Neutral and Unstable Equilibrium Metacentric Height and Metacentric Radius	**LaDage** **pp.31-46** **Stability** **Diagram** **Handout** **Canary Packet** **p.9**
2	Height of the Metacenter Height of the Center of Buoyancy Metacentric Radius **Movement of the Center of Gravity**: Calculations for: Vertical Center of Gravity Calculating GG' (Shift of Center of Gravity) **Movement of the Center of Gravity**: Finding KG when Loading and Discharging. **Containership Bays-Tiers-Rows**	**LaDage** **pp. 47-68**

WK.	SUBJECT	READING
3	**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 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. Trim and Stability Booklets: Inspection of Contents Introduction to the S.S. American Mariner Booklet	**LaDage** **pp. 69-86**
4	Calculating GM Stability versus Stowage The Relationship of GM to Rolling Period Proportionate Loss of Stability Effects of Negative GM on a Vessel Practical Methods of Calculating GM. Long Form Method of Calculating GM	**LaDage** **pp. 87-110** **Canary Packet** **pp.11-13**
5	**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 *T.V. ENTERPRISE* Inclining Experiment Power Point Presentation. **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.	**LaDage** **pp. 111-126**

WK.	SUBJECT	READING
6	**Effects of Slack Tanks:** Free Surface Effects Surface Dimensions Effects of Specific Gravity and the Amount of Liquid in a Tank Effects of Weight and Vertical Position of Liquids Free Surface Corrections and Free Surface Constants	**LaDage** **pp. 161-184**
	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	**LaDage** **pp. 301-307**
7	**Curves of Statical Stability & Dynamic Stability:** Stability at Large Angles of Inclination Effects on GM Stability Curves Constructing Cross Curves of Stability (GZ) Drawing the Statical Stability Curve	**LaDage** **pp. 127-145**
	Correction for a Vertical Shift of G Correction for a Horizontal Shift of G	**LaDage** **pp. 146-156**
8	Effect of Hull Form on Righting Arm Correcting for a Change in Displacement and a Transverse Shift of G Stability Criteria and Statical Stability Curve Analysis of Statical Stability Curve Summary of Analysis of Overall Stability Characteristics	

WK.	SUBJECT	READING
9	**Fresh Water Allowance:** Water Density and Displacement Use of the Hydrometer FWA Calculations	**Canary Packet** **pp.15-22** **LaDage** **pp. 5-18 & 200**
	Trim: Introduction to Longitudinal Stability Preliminary Definitions	
	Trimming Moments and MT1 Calculating MT1 Change of Draft at One End	**LaDage** **pp. 187-214**
10	LCF Method of Trim Calculations Effects of Trim on Draft	
	LCF Method of Trim Calculations (cont.)	
	Change of Trim Due to Large Weights LCG Method of Trim Calculations	
11	LCG Method of Trim Calculations (cont.)	
	Use of Trim Tables	
	Effect of Trim on Draft Effects of Trim on Displacement and Transverse Stability Effects on Trim when Passing From Salt to Fresh Water.	
12	**Angle of Loll** Inclination due to unstable equilibrium Calculating the upsetting moment Identifying angle of loll on Static Stability Curve	**Canary Packet** **pp.31-40**
	MV STELLAMARE Casualty SS EASTLAND Casualty	
	Actions To Be Taken In The Event Of Partial Loss Of Intact Stability: Effects of Flooding on Transverse Stability Lost Buoyancy Method Added Weight Method	**LaDage** **pp. 276-299** **Canary Packet** **pp.41-46**

WK.	SUBJECT	READING
13	Remedial Measures to Improve Transverse Stability Effect of Grounding on Stability Effect of Flooding on Reserve Buoyancy Effect of Permeability on Floodable Length Ice Accretion and Stability Fundamentals	**SMITH** **VOYAGER** **Canary Packet** **pp.23-29**
	Damage Control Fundamentals and Actions List & Loll Flooding Fire Grounding Hull Damage	**Canary Packet** **pp.47-71**
	Introduction to Computer Based Stability Programs Vessel Specific, USCG Approved Computer Based Stability Programs Excel Work Sheet Stability Programs With And Without Hydrostatic Micros Practical Applications And Limitations Of Computer Based Stability Programs And Stability And Trim Considerations Course Review	**LaDage** **pp. 255-275**