Course Title	Marine systems monitoring, automation and control				
Course Code	MAEN505				
Course Type	Required				
Level	Master's Level				
Year / Semester	1 / 2				
Teacher's Name	Dr. Photis Vrionides, Dr. Marios Lestas				
ECTS	8	Lectures / week	3	Laboratories / week	0
Course Purpose and Objectives	The aim of this course is to develop knowledge and understanding of: • Mathematical modelling and its fundamentals • Control theory and its basic applications • Rationale and procedures for modelling, simulation and analysis of marine machinery systems • Integrated analysis of propulsion, transmission and stabilisation systems				
Learning Outcomes	By the end of the course students will be able to: • Demonstrate knowledge on using mathematical modeling and control theory for the design and assessing marine systems monitoring, automation and control. • Categorize and compare marine systems monitoring, automation and control, analyzing their construction, use and maintenance characteristics.				
Prerequisites	MAEN500 pass, only for those not holding a degree in marine related fields (no background in shipping).	Required			
Course Content	• Introduction to control engineering, open and closed loop systems, mathematical modelling of mechanical, hydraulic and electrical system components, linearisation, solution of 1st and 2nd order differential equations, Laplace transforms and their application, initial and final value theorem, state-space representation, transfer functions, block diagrams, poles and zero, time response, Routh-Hurwitz stability theorem, frequency response methods, relative stability, design of feedback control systems, bode diagrams, nyquist diagrams, gain and phase margins, closed loop analysis, root locus diagram and controller design. Marine system identification. • Modelling, control and simulation of hydraulic (actuators, motors and pumps) and electric systems (passive and active networks, DC/AC motors and actuators), on-board ships for applications of governing speed of an engine, power transmission, ship dynamic stability and manoeuvring, system identification, controllability and observability assessment techniques.				
Teaching Methodology	The course will be delivered through lectures, discussions, and presentations augmented by consultations with staff during office hours, home and library study.				
Educational activities encourage	During the course attending, the students will be encouraged to construct and present written semester assignments concerning aspects like:				

the active participation of students in the learning process	• analysis of real marine systems monitoring, automation and control. • comparison of real marine systems monitoring, automation and control.
Recommended software packages	The educational activities and the laboratory exercises could be conducted using the software: • Labview and Matlab for gathering and assessing the affecting technical parameters of the ship's systems monitoring, automation and control.
Recommended laboratory exercises/tests that students could attend in FU laboratories and/or in collaborating ship companies	Parallel with the course attending, the students will be recommended to attend seminars, educational visits to the ship's engine room and experiments conducted in the FU Electrical Engineering Department laboratories, co-organized by the FU and the collaborating ship company, concerning aspects like: • technical parameters affecting the ship's systems monitoring, automation and control.
Recommended synergies between teaching and research that could provide the students engagement in research activities	The students will be encouraged to create and present papers in marine focused conferences, based on their semester assignments, in order to produce the base of their MSc Dissertation, concerning aspects like: • comparing the factors affecting the ship's systems monitoring, automation and control.
Bibliography	**Textbooks:** • Sorensen Asgeir, (2013). Marine Control Systems. Propulsion and Motion Control of Ships and Ocean Structures. • Fernandez, E.A. and Majumder, J., (2007). Marine Control. • Perez, T., (2005). Ship Motion Control: Course Keeping and Roll Stabilisation Using Rudder and Fins. Springer. • Hans P. Geering, H.P., (2007). Optimal control with engineering applications. Springer. **Other Reading:** • Khac Duc Do, Jie Pan (2009). Control of ships and underwater vehicles: design for underactuated and nonlinear marine systems. Springer-Verlag London. • Fossen, T.I, (2011). Handbook of Marine Craft Hydrodynamics and Motion Control. • Martelli M., (2017). Marine Propulsion Simulation: Methods and Results. • Leigh, J.R., (2004). IEE Control Series Control theory: a guided tour. The Institution of Engineering and Technology • Paul Enright, P., (2000). Classical feedback control with MATLAB. Marcel Dekker • Roy, G.J., (1994). Notes on Instrumentation and Control (Marine Engineering Series). **Journals:** • IMechE Journal of Engineering for the Maritime Environment (JEME)

	• IMarEST Journal of Marine Engineering and Technology (JMET) • Journal of Marine Science and Technology • Ocean Engineering • SNAME and RINA journals • Marine Structures, Elsevier • Canadian Shipping and Marine Engineering, ProQuest • International Journal of Marine Science; Richmond • Journal of Marine Research; New Haven • Marine Technology Society Journal; Washington • Maritime Studies; Canberra • Naval Engineers Journal. Wiley
Assessment	Final Exam: 60% Course Work/Assignment: 40%
Language	English