SUBJECT TEACHING GUIDE

G1089 - Steam and Gas Turbines I

Degree in Marine Engineering

Academic year 2019-2020

1. IDENTIFYING DATA					
Degree	Degree in Marine Engineering			Type and Year	Compulsory. Year 3
Faculty	School of Maritime Engineering				
Discipline	Topic				
Course unit title and code	G1089 - Steam and Gas Turbines I				
Number of ECTS credits allocated	6	Term		Semester based (1)	
Web					
Language of instruction	Spanish	English Friendly	No	Mode of delivery	Face-to-face

Department	DPTO. CIENCIAS Y TECNICAS DE LA NAVEGACION Y DE LA CONSTRUCCION NAVAL
Name of lecturer	SERGIO GARCIA GOMEZ
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Other lecturers	ANTONIO VEGA OMAÑA

3.1 LEARNING OUTCOMES
- Knowing solve the main, auxiliary and propulsion systems and ship refrigeration and air conditioning Legislation
- Knowing solve problems fluidomecánicas systems and machines. in internal combustion engines, in steam turbines. in gas turbines. in steam generators, heat transfer, regulation and control machinery and marine systems. in electric propulsion systems. power electronics. in the calculation, selection, installation and maintenance of marine propellers and knowledge of classification societies and know how to solve problems inspection
- Operate the main and auxiliary machinery and the corresponding control systems.
- Management of the operation of the machinery of the Propulsion installation.
- Plan and schedule operations.

4. OBJECTIVES
Knowing the Rankine cycle changes to improve thermal performance. Knowing and applying the equations fundamental movement of the compressed fluid and thermal turbomachinery (steam turbines and gas). Know and identify the various parts, uses more employees and types of motor thermal turbomachinery (axial and radial) both thermal, conventional and nuclear, land and sea plants. mechanical and thermodynamic study the constituent parts of a steam turbine, energy transformations in fixed and mobile elements. powers and yields. Gas turbines. Study the ideal and real cycles of gas turbines, Brayton cycle, yields and modifications.
Train the student in relation to the steam and gas turbines at the operational level , in accordance with the provisions of Table A-III / 1 of the Code of training, certification and guard for seafarers, as amended (STCW -78/2010). The student will achieve knowledge, understanding and sufficiency about: - Basic construction and operating principles of the systems of marine steam turbine machines. - Basic construction and operating principles of marine gas turbine machine systems. - Basic construction and operating principles of the machine systems, including: fluid flow and characteristics of the lubricating oil, fuel and cooling systems. - Preparation, operation, fault detection and necessary measures to prevent breakdowns in the following control systems and machines: main machine and related auxiliary machines. - Preparation, operation, fault detection and necessary measures to prevent breakdowns in control systems and machines for auxiliary propulsion machinery and related systems. - Preparation, operation, fault detection and necessary measures to prevent breakdowns in the following control systems and machines: steam boilers, steam turbines, associated auxiliary and steam systems.
Train the student in relation to steam and gas turbines at the management level , in accordance with the provisions of table A-III / 2 of the Code of training, certification and guard for seafarers, as amended (STCW-78/2010). The student will achieve knowledge, understanding and sufficiency about: - Project characteristics and operating mechanisms of the main machines and related auxiliary machinery: marine steam turbines. - Project characteristics and operating mechanisms of the main machines and related auxiliary machinery: marine gas turbines. - Theoretical knowledge: Propulsion characteristics of diesel engines, steam and gas turbines, including speed, power and fuel consumption. - Theoretical knowledge: Thermal cycle, thermal performance and thermal balance of steam turbines and marine gas turbines.

6. COURSE ORGANIZATION	
	CONTENTS
1	1. Steam Turbine: Machine fluid. Turbomachinery. Definition of steam turbine. Historical evolution of the steam turbine. Description of The steam turbine. Classification of steam turbines.
2	2. cycles of steam turbines. Rankine cycle. Trends and changes Rankine cycle: performance improvements. Rankine cycle intermediate reheating. Increase performance internal turbine to reduce the humidity. Regenerative cycle. Regenerative cycle intermediate reheating. Real Rankine cycle. Returns.
3	3. Steam flow in the crowns of nozzles. nozzles Steam Turbines. Main equations compressed fluid motion: Equation of State, Continuity Equation, Equation Number of Movement equation Energy Conservation. subsonic, sonic and supersonic flow in a duct anyone. Output speed of the steam nozzle. average velocity in any section of the nozzle. Critical parameters of a nozzle. Spending and speed steam through a nozzle. Curvilinear nozzle axis.
4	4. Crowns moving blades. Introduction. triangles speeds. fundamental equation of turbomachines: Euler equation. application turbines steam and gas. Second Embodiment Equation Euler. Third form of the Euler equation. study action blades. Study of reaction blades. Practice 1: Introduction, recognition and Outlining a conventional steam plant a vessel. Practice 2: fixed bodies turbines steam. Nozzles.
5	5. turbines action. Introduction. Simple turbine pressure single speed. Simple pressure turbine and Multiple speed. Multiple turbine pressure single speed for each pressure jump. multiple turbine Multiple pressure and speed. Characteristics Turbines action. Powers and yields. Practice 3: moving parts of steam turbines. Palettes. Practice 4: Design of a moving blade section.
6	6.Turbinas radial flow reaction. Reaction turbine simple and compound. Turbines action-reaction or axial flow reaction. Responsiveness. Limit. Rotation speed corresponding condition degree single reaction. Operation responsiveness 1/2. Action-reaction turbine composed. Comparison reaction between the turbines and action. powers and Returns. Practice 5: Presentation and analysis Steam turbine simulator

7	7. Gas turbines: General Ideas. Cycles gas turbines. The combustion turbine pressure constant. simple open cycle. Brayton cycle ideal. Brayton modifications ciclo.Ciclo Real. TG internal performance regardless of losses in ducts. internal performance depending TG Rc and the maximum and minimum temperatures. TG internal performance depending on Rc, Rtoic and Rtoit. internal performance of the TG taking into account losses duct before and after the turbine. Recovery heat. Cycle ideal and real. Heat recovery. Cycle ideal and real.

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
Description Theory and exercises exam	Written exam	No	Yes	30,00
Description Theory and exercises exam	Written exam	No	Yes	30,00
Description Classroom Practices	Others	No	Yes	20,00
Description Group work	Work	Yes	No	10,00
Laboratory practices	Laboratory evaluation	Yes	No	10,00
TOTAL				100,00

Observations

- FEBRUARY CALL:
1. Theory (60%)
1st partial exam (30%): topics and date to be agreed.
2nd partial exam (30%): topics and date to be agreed.
Recoverable in the final exam.
Final exam: of the subject not passed in the partial exams, on a date fixed in the examination calendar approved in the Board of the Center. The approved in theory is a condition to compute the rest of the parts of the subject in the final grade.
2. Practices in Classroom (20%)
Resolution and delivery of the problems proposed during classroom (will be resolved in class by a student with support of the teacher).
Classroom practices are recoverable in the final exam.
Final exam: for those students who do not pass it by course, on a date set in the exam calendar approved by the Board of the Center.
The approved in classroom practices is a condition to compute the rest of the parts of the subject in the final grade.
3. Group work (10%)
3.1) Prepare the assigned work. The work in its final form will be sent as an attachment to sergio.garcia@unican.es 48 hours before the date set in the exhibition calendar, as well as all students enrolled in the course. The contents of the works will be considered part of the subject, being able to be asked in the theory exam.
3.2) Oral exhibition according to exhibition calendar. Exhibition (30 min) of the work in its final form and assessment and questions by the teacher and the classmates (15 min). To qualify, it is a condition to participate in the act of exhibition and defense of work. Not recoverable in the final exam.
4. Laboratory practices (10%)
Minimum compulsory attendance at 80% of the hours of practices. Positive evaluation of the memory of practices carried out. Not recoverable in the final exam.
- CALL FOR SEPTEMBER: Examination of the entire syllabus of the subject on a date fixed in the examination calendar approved by the Board of the Center.

Observations for part-time students

Students who are enrolled part-time will not be able to perform the continuous assessment and will present the final exam, enough to obtain a maximum grade of 8.

8. BIBLIOGRAPHY AND TEACHING MATERIALS
BASIC
- Kostyuk A. &Frolov V. Steam and Gas Turbines. MIR, Moscú. 1988.
- Mataix C. Turbomáquinas Térmicas: Turbinas de Vapor, Turbinas de Gas y Turbocompresores. Editorial Dossat 2000. 3ª Edición. Madrid. 2000.
- Schegliaev A.V. Turbinas de Vapor. Editorial Mir. Moscú. 1985.
- Troyanovsky B.M., Filippov G.A., Bulkin A.E. Turbinas de Vapor y de Gas de las Centrales Nucleoeléctricas . MIR, Moscú. 1987.
- Pérez del Rio J. Tratado General de Máquinas Marinas. Máquinas de Vapor. Editorial Planeta. Volumen VII. Madrid. 1972.
- Mattingly J.D. Elements of propulsión. Gas turbines and Rockets. American Institute of Aeronautic and Astronautics. 2006.