SUBJECT TEACHING GUIDE

G1306 - Dynamics of Marine Structures: Noise and Vibrations in Ships

Degree in Marine Engineering

Academic year 2023-2024

1. IDENTIFYING DATA					
Degree	Degree in Marine Engineering			Type and Year	Optional. Year 4
Faculty	School of Maritime Engineering				
Discipline	Subject Area: Optional Subjects Optional Module				
Course unit title and code	G1306 - Dynamics of Marine Structures: Noise and Vibrations in Ships				
Number of ECTS credits allocated	6	Term		Semester based (2)	
Web					
Language of instruction	Spanish	English Friendly	No	Mode of delivery	Face-to-face

Department	DPTO. INGENIERIA ESTRUCTURAL Y MECANICA
Name of lecturer	JAVIER SANCHEZ ESPIGA
E-mail	javier.sanchezespiga@unican.es
Office	E.T.S. de Ingenieros Industriales y de Telecomunicación. Planta: - 2. SALA - ASOCIADOS (S2049)
Other lecturers	

3.1 LEARNING OUTCOMES

- Capacity for organization and planning.
  Problem resolution.
  Autonomous learning.
  Ability to apply knowledge in practical situations.
  Capacity for analysis and synthesis.
  Ability to manage information.
  Oral and written communication in the language.
  Decision making.
  Ability to communicate with experts in other areas.
  Critical thinking.
  Adapting to new situations.
  Creativity.
  Ability to work autonomously.

4. OBJECTIVES

Present students with the basics of mechanical vibrations and their applications.
Particular attention to their application and maintenance of the monitored machines is provided.
Free vibrations, forced and random systems one and two degrees of freedom, with and without damping are studied, and an introduction to systems of n degrees of freedom is.
The vibration isolation problems and their transferability and vibrations in continuous systems, an introduction to random vibrations are addressed, and for your interest in the monitored, a chapter is devoted to experimental vibration measurements.
With all that is intended to provide knowledge of the basics of vibration, instrumentation and testing existing today in the design and maintenance of machines.
Provide the knowledge to the student to be able to face practical problems both design and test and maintenance of systems and components.
Provide the student's ability to raise dynamic tests in the study of the dynamic behavior of machines.

6. COURSE ORGANIZATION	
	CONTENTS
1	Introduction to vibration. TOPIC 1. 1. The concept of vibration. 2. Concept of degree of freedom system parameters. 3. Classification of systems. 3.1. Discrete systems and continuous systems. 3.2. Linear and nonlinear systems. 3.3. Defined and semidefined systems. 4. Classification of vibrations. 4.1. Vibrations deterministic and random vibrations. 4.2. Free vibrations and forced vibrations. 5. Equations of dynamics.
2	2 VIBRATIONS discrete systems. SYSTEMS WITH A DEGREE OF FREEDOM ITEM 2. Systems with 1 degree of freedom I. 1. Basic discrete system and generalized systems of 1 dof 2. Effect of the static forces. 3. Vibrations induced by the movement of the support. 4. Free Vibrations. 5. Coulomb damping. ITEM 3. Systems with 1 degree of freedom II. 1. forced vibrations. Types of solicitations. 2. Response to harmonic excitation. Transfer function. Dynamic amplification factor. Offset. 3. Response to an impulse, step and ramp function. ITEM 4. SYSTEMS 1 degree of freedom III. 1. Measure the damping ratio. eleven. Method logarithmic decrement. 1.2. Methods based on dynamic amplification factor. 1.3. Method energy loss per cycle. 2. Structural Damping. 3. Vibration Isolation. Transmissibility. ITEM 5. SYSTEMS 1 degree of freedom IV. 1. Answering a general excitement. 2. Method of the convolution integral. 3. Periodic Functions: complex Fourier series. 4. Periodic functions: Fourier transform (TDF). 5. Method of Laplace transform (TDL).

3	VIBRATIONS three discrete systems. Systems with multiple degrees of freedom. ITEM 6. Systems with two degrees of freedom. 1. Introduction. 2. Equations of motion. Matrix formulation. 3. undamped free vibration: vibration modes. 4. Natural Coordinates. 5. Forced Vibrations in systems with 2 d.o.f. ITEM 7. SYSTEMS N degrees of freedom. 1. Degrees of Freedom: continuous and discrete systems. 2. Systems of local and general coordinates. 3. Matrix rigidity, inertia and damping. 4. Applications of dynamic analysis of mechanical systems. 5. modal analysis based concept
4	4 DIMENSIONAL VIBRATIONS IN CONTINUOUS SYSTEMS ITEM 8. VIBRATIONS IN AXES AND BEAMS I. 1. Introduction. 2. Axial vibrations. 3. axes torsional vibrations in uniform circular section. 4. Other boundary conditions. ITEM 9. VIBRATIONS IN AXES AND BEAMS II. 1. Free bending vibrations in beams. 2. Orthogonality of the vibration modes. 3. Effects of shear and rotary inertia. 4. Analysis of the dynamic response. ITEM 10. SHAFT AND APPROXIMATE METHODS BEAMS. 1. axial and torsional vibrations: Holzer method. 2. Bending vibrations. Myklestad-Thomson method. 3. Method of transfer matrices. 4. Energy Methods: Method of Rayleigh and Rayleigh-Ritz method.

5	5 random vibrations ITEM 11. INTRODUCTION TO RANDOM VIBRATIONS. 1. General. 2. probability density function. 3. Mean, mean square value and variance. 4. Correlation and regression. 5. Average across multiple records. 6. autocorrelation and cross correlation. ITEM 12. Spectral density. 1. Spectral Density. 2. Process broadband and narrowband processes. 3. spectral density of the velocity and acceleration of a process x (t). 4 cross spectral densities. ITEM 13. RANDOM RESPONSE OF MECHANICAL SYSTEMS excitations. 1. Average value. 2. Autocorrelation. 3. spectral density. 4. rms value. 5. Cross correlation. 6. cross-spectral densities.
6	6 Experimental measurement of vibrations. ITEM 14. Introduction to vibration measurement. 1. Introduction. 2. Basics of vibration measurement. 3. Applications of vibration measurement. Monitored machines. ITEM 15. Instrumentation. 1. Introduction. 2. Sensors. 3. Dynamic signal analyzers. 4. Chain measure. 5. Calibration. ITEM 16. INTRODUCTION TO SIGNAL ANALYSIS OF VIBRATIONS. 1. Introduction. 2. signal processing techniques. 3. Sources of error. 4. Modal Analysis.

7	7 CONTROL OF VIBRATIONS ITEM 17. Vibration Control I. 1. Introduction. 2. Basics of vibration isolation. 3. Theoretical Foundations of vibration isolation. 4. Practical aspects of vibration isolation. ITEM 18. Vibration Control II. 1. Isolation of shocks. 2. vibration absorbers. 3. Vibration dampers. 4. Systems of several degrees of freedom. 5. Use of non-linear spring elements.

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
Final Exam	Written exam	Yes	No	50,00
Lab practices	Laboratory evaluation	Yes	Yes	10,00
term exams	Written exam	Yes	Yes	40,00
TOTAL				100,00

Observations

For the final grade are considered two alternatives:
Alternative 1.
to. Get a score of 5 or more points in the average assessment activities carried out during the course, also requiring that each a minimum of 4 points is obtained.
b. Laboratory Practice: During the course Laboratory Practice, which will be graded with score range between 0 and 1 are performed.
He qualified with 1 to every student who has attended and performed, with due use, all the practices planned during the course.
Those other students who are not in the above case should undertake a review of laboratory practices, which qualification shall be between 0 and 1.
The final mark will be the product of the average score of the evaluation activities and corresponding to the labs, being necessary to pass the course, achieve a score of 5 or more points.
Alternative 2.
to. Get a score of 5 or more points in the final examination of the ordinary or extraordinary call
b. Laboratory Practice: During the course Laboratory Practice, which will be graded with score range between 0 and 1 are performed.
He qualified with 1 to every student who has attended and performed, with due use, all the practices planned during the course.
Those other students who are not in the above case should undertake a review of laboratory practices, which qualification shall be between 0 and 1.
The final mark will be the product of the scores achieved in the final exam and laboratory practice, being necessary to pass the course, achieve a score of 5 or more points.
Note: The scores of the evaluation activities shall be applied only during the course in which they take place.

Observations for part-time students

To get a score of 5 or more points in the final examination of the ordinary or extraordinary call

8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC

Benson H. Tongue, "Principles of vibration", Oxford University Press, 2002
Argyris, J., Mlejnek, H.P., "Dynamics of Structures", North-Holland, 1991.
Bottega, W. J., "Engineering Vibrations", Taylor & Francis Group, 2006.
He, J., Fu, Z-F, "Modal Analysis", Butterworth Heinemann, 2001
Inman, D.J., "Engineering Vibration", Prentice Hall, 1996.
Meirovitch, L. "Elements of vibration analysis", McGraw-Hill, 1986.
Newland, D.E., "Vibraciones aleatorias y análisis espectral", AC, 1983.
Rao, S. S., "Mechanical Vibrations", Addison-Wesley, 1.995.