INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Noise and vibrations			Field of study	Solids Mechanics and Structures		
Master in	Mechanical Engineering			School	School of Technology and Management		
Academic Year	2023/2024	Year of study	1	Level	2-1	ECTS credits	6.0
Type	Semestral	Semester	1	Code	5071-793-1105-00-23		

Workload (hours)	162	Contact hours	T	TP	PL	TC	S	E	OT	O
			-	30	30	-	-	-	-	-

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s): Manuel Teixeira Brás César

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. perform a dynamic analysis of mass – spring – damp systems and analyze the ambient and industrial noise.
2. understand the time and frequencies analysis concepts.
3. develope the formulation of the equations of motion for multi – degree – of - freedom systems.
4. perform the modal analysis of distributed parameter systems.
5. establish discrete models of continuous systems, such as: bars, lodes, beams and plates.
6. understand and analyzed the vibrations in simple continuous systems.
7. develop or modify simple mechanical systems so that its dynamic characteristics are the desired ones in particular application.
8. understand the noise and there dimensions, and quantify the effect in the human being. Analyze and measure ambient and industrial noise, and define control strategies.

Prerequisites

Before the course unit the learner is expected to be able to:
1. use the differential and integral calculus.
2. read and write in English.
3. Understand the Physics, mechanics and mechanics of materials concepts.

Course contents

The vibration systems. Lagrange equations, matrix motion equations. Undamped free vibration, natural frequencies and mode shapes. Orthogonality of eigenvectors. Expansion theorem. Response to initial excitation, Rayleigh's quotient. Response to harmonic and generic excitation. Natural coordinates, modal analysis, direct integration and spatial modal response. Continues systems: vibration of string, shafts and bending beams . Rayleigh and Rayleigh-Ritz methods. Introduction to the noise.

Course contents (extended version)

1. The vibration systems. Multi-degrees of freedom.
   - Generalized coordinates, potential and kinetic energy.
   - Lagrange equations.
   - Matrix motion equations.
   - Undamped free vibration, natural frequencies and mode shapes.
   - Orthogonality of eigenvectors and expansion theorem.
   - Response to initial excitation.
   - Rayleigh's quotient.
   - Response to harmonic and generic excitation.
   - Natural coordinates, modal analysis, direct integration and spatial model response.
2. Continuos vibration systems.
   - Vibration of string, shafts and bending beams
   - Rayleigh and Rayleigh-Ritz methods.
3. Noise.
   - Introduction to the noise.
   - Fundamental concepts of pressure, intensity and power waves.
   - The effect of noise in the human being.
   - Vibration and noise control, and measurement.

Recommended reading

1. Rao, S. S. , "Mechanical Vibrations", Addison-Wesley, 5ª ed. , 2011.
2. Kelly, S. G. , "Fundamentals of mechanical vibrations", McGraw Hill, 1993.
3. Hatch, M. R. , "Vibration Simulation using Matlab and Ansys", CRC Press, 2001.
4. Foreman, J. E. K. , "Sound Analysis and Noise Control", New York: Van NostrandReinhold, 1990.
5. Documentos auxiliares de referência: Sebenta de Hernâni Lopes – "Vibrações e Ruído – Teoria", 2007 Sebenta de Hernâni Lopes – "Vibrações e Ruído – Prática e Laboratorial", 2007.

Teaching and learning methods

The theory classes (30 hours): Presenting methodologies of vibration systems analysis along with problems resolution. Laboratory classes: Measurement of vibration and noise. The experimental tests will be made with the signal analyzer equipment. Building the experimental set-up. Modal analysis using MeScope software. One problem set assignment will be given to the students (99. 5 hours).

Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final)
   - Practical Work - 100%
2. Alternative 2 - (Regular, Student Worker) (Final, Supplementary, Special)
   - Final Written Exam - 100%

Language of instruction

Portuguese

Electronic validation

Manuel Teixeira Brás César	Debora Rodrigues de Sousa Macanjo Ferreira	Paulo Alexandre Gonçalves Piloto	José Carlos Rufino Amaro
29-09-2023	04-10-2023	04-10-2023	20-10-2023