

Academic Year: (2023 / 2024)

Review date: 11-04-2023

Department assigned to the subject: Mechanical Engineering Department

Coordinating teacher: CALVO RAMOS, JOSE ANTONIO

Type: Compulsory ECTS Credits : 3.0

Year : 2 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Functions Derivation
Basic derivation theorems.
Multivariable functions
Introduction to differential equations.
Particle and Rigid Bodies Kinematics.
Particle and Rigid Bodies Dynamics.

OBJECTIVES

By the end of this subject, students will be able to have:

1. Knowledge and understanding of linear differential equations which are applicable in mechanical vibration problems
2. Knowledge and understanding of key aspects of mechanical vibrations fundamentals;
3. The ability to apply their knowledge and understanding to identify, formulate and solve problems of mechanical vibrations using established methods;
4. The ability to combine theory and practice to solve problems of mechanical vibrations;
5. An understanding of applicable techniques and methods in mechanical vibrations, and of their limitations;

DESCRIPTION OF CONTENTS: PROGRAMME

- 1.- Introduction to differential calculus
 - 1.1.- Functions of a Variable
 - 1.2.- Mathematical Models
 - 1.3.- Classification of Differential Equations
 - 1.4.- Linear Ordinary Differential Equations
 - 1.5.- Solution of Differential Equations
 - 1.6.- Solution of Homogeneous First Order Diff Eq.
 - 1.7.- Solution of Nonhomogeneous Linear First Order Diff Eq.
 - 1.8.- Solution of Second Order Diff. Eq.
 - 1.9.- Integration methods
- 2.- Numerical methods for solving differential equations
 - 2.1.- Introduction
 - 2.2.- Euler's method
 - 2.3.- Taylor's method
 - 2.4.- Runge-Kutta methods
- 3.- Introduction to MATLAB
 - 3.1.- Introduction
 - 3.2.- General Rules
 - 3.3.- Basic Operations
 - 3.4.- Output formats
 - 3.5.- Matrices and Vectors
 - 3.6.- Graphics in MATLAB
 - 3.7.- Programming in MATLAB
 - 3.8.- SIMULINK
- 4.- Solution of Differential Equations using MATLAB
 - 4.1.- Introduction
 - 4.2.- ODE function

- 4.3.- Example of a first order equation
- 4.4.- Solution of second order equations
- 4.5.- Solution of equations by SIMULINK
- 5.- Introduction to mechanical vibrations:
 - 5.1.- Introduction
 - 5.2.- Classification of vibrations
 - 5.3.- Components of an oscillatory system
 - 5.4.- Simple Harmonic Motion (SHM)
 - 5.5.- Energy of a Simple Harmonic Movement
 - 5.6.- Nonlinear vibrations
- 6.- Damped mechanical vibrations and forced vibrations
 - 6.1.- Damped harmonic oscillator
 - 6.2.- Differential equation of movement
 - 6.3.- Damping coefficient
 - 6.4.- Solution to the Differential Equation of Motion
 - 6.5.- Logarithmic Decrease
 - 6.6.- Forced vibrations
 - 6.7.- Transmissibility coefficient
 - 6.8.- Resonance
- 7.- Systems of 2 Degrees of Freedom and N Degrees of Freedom
 - 7.1.- Introduction
 - 7.2.- Undamped free vibrations for 2 DOF
 - 7.3.- Forced undamped vibrations for 2 DOF
 - 7.4.- Damped forced vibrations for 2 DOF
 - 7.5.- N DOF Vibrations systems

LEARNING ACTIVITIES AND METHODOLOGY

Master class
 Classroom exercises
 Laboratories exercises
 Personal work.
 Team Work

ASSESSMENT SYSTEM

Laboratory practices 10%
 Weekly exercises 20%
 Partial exam 30%
 Final Exam 40%

It will be necessary to get a 4 out of 10 in the final exam to make an average with the continuous evaluation.

It will not be able to pass the subject in ordinary call if you do not attend the practices.

If the practices are suspended there will be a part of the final extraordinary exam related to them

% end-of-term-examination:	40
% of continuous assessment (assignments, laboratory, practicals...):	60

BASIC BIBLIOGRAPHY

- R. Kent Nagle; E.B Saff Arthur and David Snider Fundamentals of differential equations, Pearson, 2012
- Alonso de Mena, Ana Isabel; Álvarez López, Jorge. ; Calzada Delgado, Juan Antonio. Ecuaciones diferenciales ordinarias, Delta Publicaciones , 2010
- Felipe Lafita Babio, Hilario Mata Cortés Vibraciones mecánicas en ingeniería, INTA, 1964
- José Carlos Bellido Guerrero Alberto Donoso Bello y Sebastián Lajara López Ecuaciones diferenciales ordinarias, Paraninfo , 2014
- SS Rao and Fook Yap Fah Mechanical vibrations, Singapore : Pearson Education South Asia, 2011
- William T. Thomson Teoría de Vibraciones, Prentice / Hall, 1981

BASIC ELECTRONIC RESOURCES

- Jose Antonio Calvo . Course resources in Aula Global: <https://aulaglobal.uc3m.es/course/view.php?id=158351>