

SPIM MM 905 – Non linear dynamics, High speed processes

Master Degree : Mechanical Engineering and Material sciences

Reference number: SPIM MM 905

Title of the subject : Non linear dynamics, High speed processes

Department : *Applied Mechanics and Mechanical engineering*

Coordinating lecturer : E.M Daya, el-mostafa.data@univ-lorraine.fr

Course is given each year (optional courses, open only if the number of students is over 10)

Semester : *Autumn*

Total hours of classes : 60 h ECTS Credits : 6

Teaching language : French

The course is proposed in English for exchange students : No

Course composition	Coef.	Number of hours				
		Lectures	Tutorials	Practicals	Others	
Non linear dynamics		15	15			
High speed processes		15	15			

Aim :

The goal of the first part of this course is to discuss the analysis in nonlinear structural dynamics. Currently, the nonlinear vibration study is an important task to design structures in many industrial domains such as aerospace, automobile,..This part will give a comprehensive discussion of the nonlinear vibration phenomena focusing on basic techniques to solve the nonlinear vibration problems.

In the second part, we will focus on the phenomena involving rapid deformation, which have considerable importance in industry and in many applications like for example for structure integrity under dynamic loading. High speed process development is closely related to the competitiveness of the industry (manufacturing processes at high speed velocity, crashworthiness ...). Modeling tools will be developed and illustrations will be given.

Prerequisites

Courses of continuum mechanics, structural mechanics and a preliminary course in structural dynamics are requested as prerequisites

Course syllabus

Non linear vibrations:

Effects of the nonlinearities in structural dynamics
 Study of Duffing oscillator, Amplitude equation and backbone curves.
 Nonlinear vibrations of beams
 Methods and modal analysis in nonlinear structural dynamics

High speed processes :

Overview of the mechanical behaviour of solids under high strain rate loading
 Experimental approaches and corresponding constitutive law

Impact and dynamic damage

Fracture at very large strain rate

High speed machining is considered as a industrial process where mechanisms like the thermomechanical coupling under high strain rate govern the formation of the chip.

The course will also give some insight in the development of instabilities which may develop in such processes (shear banding, dynamic necking, fragmentation ...).

Assessment system :

Continuous evaluation is generalized in this Master Degree. Students will obtain information concerning the evaluation at the beginning of each semester.

When not passed, a second exam is planned after the end of the semester so the student has a second opportunity to obtain the ECTS credit

Mark is a composite between evaluation elements, which are listed below. The relative percentage of each item is provided on due time.

Homework

Project

Mid Exam

Final Exam

Practicals

The course syllabus, the academic weekly planning and the assessment system may be subject to variation. Modifications are dully announced in advance.