MSS - Solids Mechanics and Structures - S6

MÉCANIQUE DES SOLIDES DÉFORMABLES

CONTINUUM MECHANICS OF SOLIDS

Lecturers: Jean-Jacques SINOU, Fabrice THOUVEREZ

| Lecturers : 16.0 | TC : 14.0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Keywords :

Programme

Learning outcomes

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

J. Salençon., *MÉCANIQUE DES MILIEUX CONTINUS – TOME 1.* , Ed. de l'Ecole Polytechnique, 2005
M. Géradin, D. Rixen. *THÉORIE DES VIBRATIONS – APPLICATION À LA DYNAMIQUE DES STRUCTURES*, Elsevier Masson, 1999
G. Dhatt, G. Touzot, E. Lefrançois.. *MÉTHODE DES ÉLÉMENTS FINIS*, Lavoisier Hermès Science Publicatio, 2005

Assessment

MÉCANIQUE DES SOLIDES DÉFORMABLES ASPECTS EXPÉRIMENTAUX

EXPERIMENTAL ANALYSIS IN CONTINUUM AND SOLID MECHANICS

Lecturers: Baptiste CHOMETTE, Francesco FROIIO

| Lecturers : 0.0 | TC : 0.0 | PW : 16.0 | Autonomy : 0.0 | Study : 4.0 | Project : 0.0 | Language : FR

Objectives

(1) become aware of physical phenomena in mechanics,
(2) know different techniques for measuring useful variables in mechanics (extensometry, accelerometry, photoelasticimetry, stroboscopy, etc.),
(3) develop the practical implementation of theoretical concepts and thus promote their assimilation,
(4) knowing how to validate experimental results: critical analysis of the quality and relevance of the measurements carried out, comparing experimental results and results from theoretical or numerical approaches,

Keywords : Deformations, stresses, equilibrium, eigenmodes, resonance, static and dynamic measurements, experimental and numerical methods, finite element method

Programme

- Discovery labs: Study of the resonance phenomena of a flexible structure. Photoelasticimetry: understanding and analysis of the phenomenon of stress-induced birefringence; isocline and isochromatic; comparison with an explicit solution.
- Practical work Measurements and analyses: Determination of the eigenmodes of continuous elastic structures. Measurements by strain gauges with calculation of the tensor, application to the determination of the stress field, comparison and verification of the balance.
- "Finite elements" design office: Calculation of structures using software. Interpretation of static and dynamic cases.

Learning outcomes

- Master the basic notions of deformations and stresses for the deformable solid.
- Understand the link between assumptions, modeling and associated physical phenomena.
- Know how to identify the elements of a measurement chain.
- Know how to write a report of practical work and design office.

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

Assessment

MAQUETTAGE NUMÉRIQUE

DIGITAL MOCK-UP

Lecturers: Didier LACOUR

| Lecturers : 2.0 | TC : 0.0 | PW : 0.0 | Autonomy : 4.0 | Study : 14.0 | Project : 0.0 | Language : FR

Objectives

The aim of this training course is to enable engineers to understand the various aspects of digital modelling (volume and surface modelling, integration with simulation (kinematics, calculation, manufacturing, etc.), which are necessary in particular for other training Two Mechanical and Mechanical Engineering Units of Solids and Structures.

Keywords : Digital Mock-Up, Numerical modelling, Simulation, Finite element calculations, PLM, Bézier surfaces, Modelling curves and surfaces

Programme

- Mathematical modeling of pole surfaces.
- Getting Started with the Catia V5 Software (Part Design).
- Surface modeling with Catia V5.
- Information about the 100% web-based Onshape solution.
- Mini-project: Implementation of modeling, simulation and calculation tools on a concrete problem of design or optimization of a technical system.

Learning outcomes

- Be able to model a technical solution using computer tools
- Know how to manipulate current modelling and simulation tools
- To be able to understand all the scientific and technical aspects of a project
- Knowing the software tools of numerical modelling used in industry.

Independent study

Objectifs : Objectives: Develop and deepen the subject of the mini-project.
Methods: CAD sessions with teacher assistance.

Méhodes :

Core texts

Pierre Bezier, *L'UTILISATION DES COURBES ET SURFACES EN CAO*, Hermes Sciences Publicat, 1988
Jean-Claude Fiorot *COURBES ET SURFACES RATIONNELLES - APPLICATIONS À LA CAO*, Dunod, 1989
Dassault Systemes*MANUEL UTILISATION CATIA V5*, Dassault Systemes, 2020

Assessment

Final mark = 100% Know-how
Know-how mark = 100% continuous assessment

COMPLÉMENTS DE DYNAMIQUE DES STRUCTURES, OPTIMISATION

STRUCTURAL DYNAMICS

Lecturers: Sebastien BESSET

| Lecturers : 4.0 | TC : 4.0 | PW : 4.0 | Autonomy : 0.0 | Study : 8.0 | Project : 0.0 | Language : FR

Objectives

The aim of this course is to deepen the techniques of modal synthesis: truncation effects, structural modifications, and to extend the dynamic models to the situations of structures subjected to large displacements and / or combined loads, to anticipate and control the associated phenomena during the design process: risks of instability and floating. The pedagogical content is based on additional training in the form of courses and TD, a practical session on the effect of a static pre-load on the dynamic behavior of a structure and a project which will serve as a support example.

Keywords : Component mode synthesis, large displacements, prestress loading

Programme

- Modal synthesis: description of the dynamic behavior of a structure based on the eigenmodes. Definition of the number of modes taken into account depending on the domain Frequency of excitation, effects of modal truncation. Prediction of the effect of a localized structural change.
- Large displacements, static pre-stresses: equations on simple cases, qualitative prediction of the expected phenomena, implementation of simulations.
- TP: modifications of the eigenmodes of a structure subjected to a static loading increasing. Buckling phenomenon.
- BE: project to design a structure or to simulate the behavior of a structure.

Learning outcomes

- To be able to propose a model of predictive simulation of dynamic behavior of a structure.
- To be able to gather the necessary information and estimate their degree of importance and reliability.
- To know how to evaluate the validity limits of a model.
- To understand the concepts necessary for the use of a dynamic computation code

Independent study

Objectifs : Students are faced with a modelling problem in a quasi-industrial application.

Méhodes : The teacher presents the problem and intervenes as a resource.

Core texts

T. Gmür, *DYNAMIQUE DES STRUCTURES : ANALYSE MODALE NUMÉRIQUE.*, Presses Polytechniques et Universitaires Romandes, 1997
Michel Géradin, Daniel Rixen *THÉORIE DES VIBRATIONS, APPLICATION À LA DYNAMIQUE DES STRUCTURES.*, Elsevier-Masson, 1999
Olgierd Cecil Zienkiewicz*LA MÉTHODE DES ÉLÉMENTS FINIS*, McGraw Hill, 1979

Assessment

Final mark = 67% Knowledge + 33% Know-how
Knowledge N1 = 100% continuous assessment
Know-how N2 = 100% continuous assessment

PLASTICITÉ, MISE EN FORME

PLASTICITY, FORMING

Lecturers: Christophe JANOLIN, Hélène MAGOARIEC

| Lecturers : 4.0 | TC : 4.0 | PW : 8.0 | Autonomy : 0.0 | Study : 4.0 | Project : 0.0 | Language : FR

Objectives

The aim is to raise awareness of the link between materials forming processes and elastoplastic properties of metallic materials. The first part of the course focuses on the main processes for metal forming: plastic metal stretching, foundry, etc. The second part of the course introduces the classical elastoplastic model. The objective is to understand the limits of the elastic model and the main issues to address in order to introduce plastic behaviour. The model is established following the interpretation of simple homogeneous mechanical tests (tension and tension-torsion) and a phenomenological approach. Practical works allow, among other things, an understanding of the influence of the metal forming process on the elastoplastic properties.

Keywords : Plastic metal forming, foundry, Yield stress, Elastic strains, Plastic strains, Isotropic hardening, Kinematic hardening, Yield criterion, Normality rule.

Programme

2 courses to present the basic concepts + 2 exercises to practice these notions on elastoplastic structures + 3 practical works:
PW1 - Metal forming: sand casting, permanent mould, machining operation with cutting tool
PW2 - Behaviour identification: identification of the elastoplastic properties of the materials formed during PW1 (tension and torsion mechanical tests); Study of the influence of forming process on these mechanical properties.
PW3 - Structural design: finite element analyses of structures made of material identified during PW2.

Learning outcomes

- To know how to perform two foundry processes.
- To understand phenomenological plasticity.
- To know how to manage experiments to identify the elastoplastic behavior of materials.
- To know how to interpret results of an elastoplastic finite elements simulation.

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

R. Hill, *THE MATHEMATICAL THEORY OF PLASTICITY*, Oxford University Press, 1998
P. Suquet *RUPTURE ET PLASTICITÉ*, Ecole Polytechnique, 2006
J.J. Marigo*PLASTICITÉ ET RUPTURE*, Ecole Polytechnique, 2012

Assessment

Final mark = 100% know-how.
Know-how mark = 100% continuous assessment