Course guide
205090 - 205090 - Practical Use of Fem for Structural Analysis with Nastran

Last modified: 26/09/2024

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 748 - FIS - Department of Physics.

Degree: MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2013). (Optional subject).
MASTER'S DEGREE IN AERONAUTICAL ENGINEERING (Syllabus 2014). (Optional subject).
MASTER'S DEGREE IN SPACE AND AERONAUTICAL ENGINEERING (Syllabus 2016). (Optional subject).

Academic year: 2024 **ECTS Credits:** 3.0 **Languages:** English

LECTURER

Coordinating lecturer: Miguel Angel Tomas Beltran
Juan Carlos Cante Teran

Others: Miguel Angel Tomas Beltran
Juan Carlos Cante Teran

PRIOR SKILLS

knowledge about structural analysis and numerical methods

TEACHING METHODOLOGY

Lessons are based on learning by doing methodology, being then the practical assignments the core of the subject. Some theory will be introduced in each session in order to link the subject with previous student knowledge, such as linear systems analysis, structural analysis or numerical methods. During the sessions different assignments will be performed according to industry standard procedures for FEM development.

LEARNING OBJECTIVES OF THE SUBJECT

In this course students will learn state of the art FEM modelling techniques for structural analysis in the aircraft industry. This is accomplished by using the industry standard code for linear analysis (NASTRAN) and getting familiar with typical procedures for FEM modelling used in recent aircraft developments such as A380, A350 or A220.

Specific learning objectives are listed next:
Linear elastic analysis
Linear buckling analysis
Normal modes analysis
Nastran Input File Format
Nastran results file format
Basic Nastran cards: CORD2R, GRID,CELAS/CBUSH, CROD, CBAR/CBEAM, CQUAD, PCOMP, MAT1, MAT8
FEM Linearity
FEM equations (F=K u)
FEM basic steps
Static Equilibrium
DoFs
Units system
Problems with NASTRAN syntax (ej Floating point / 8 char cols)
Numerical problems (unconstrained DoF, Max Ratio, K6Rot)
Local Stiffness derivation (Ej junction stiffness)
Typical industry GFEM introduction
Composite idealization
SPCDs
Load introduction
Interpolation elements vs Rigid elements
Quality checks
Mesh size (GFEM vs DFEM)
Mesh generation
Results interpretation
EXCEL applied to FEM generation
EXCEL applied to results processing

STUDY LOAD

Type	Hours	Percentage
Hours large group	27,0	36.00
Self study	48,0	64.00

Total learning time: 75 h

CONTENTS

Introduction to FEM use in Aerospace industry for structural analysis

Description:
1.- Linear Models for Static and fatigue strength justification
2.- Buckling Analysis
3.- Normal Modes

Full-or-part-time: 6h
Theory classes: 4h
Self study : 2h

Mathematical Formulation Basics

Description:
1.- Statics Solution
2.- Eigenvalues Solutions (stability)
3.- Linear Models in aerospace structural analysis
4.- Guyan reduction for superelement analysis

Full-or-part-time: 6h
Theory classes: 4h
Self study : 2h

Introduction to NASTRAN code

Description:
1.- FEM comertial codes / Why NASTRAN
2.- NASTRAN file structure
3.- NASTRAN Cards
4.- Load Introduction Cards
5.- Boundary Condition Cards
6.- Case Control Cards
7.- PARAM cards
8.- F06 results file

Full-or-part-time: 12h
Theory classes: 8h
Self study : 4h

Modelling techniques in Aerospace industry

Description:
1.- Typical Aero structures GFEM topology.
2.- Load Introduction techniques
3.- Fastener Idealization techniques in DFEM models.
4.- Composite Materials analysis.
5.- Superelements application.
6.- Pre-Post Use in aerospace industry
7.- Excel use applied to FEM models

Full-or-part-time: 17h
Theory classes: 11h
Self study : 6h

Assignment

Description:
FEM model to put in practice the different course contents

Full-or-part-time: 34h
Self study : 34h

GRADING SYSTEM

25 % Lesson Assignments
25 % Test Exam
50% FEM Project

In case of partial unsatisfactory marks, following procedures are provided to overcome the subject:
- Test exam exam could be repeated in an exam to be carried out during the period of the final exams. Students with grades lower than 5 points (unsatisfactory) can retake the exam. If the new grade is equal or higher than 5 points, It will substitute the original one with a grade of 5.
- A Report about practical sessions contents can be presented before the final exams period in order to compensate for the sessions the student did not assist
- Individual report about an FEM project (including all NASTRAN files used) can be presented before the final exams if the student could not present the project during the regular period.

BIBLIOGRAPHY

Basic:
- MSC software. Getting started with MSC Nastran [on line]. [Consultation: 12/04/2022]. Available on: https://simcompanion.hexagon.com/customers/s/article/getting-started-with-msc-nastran-user-s-guide-doc9176.
- MSC Nastran 2012: quick reference guide [on line]. Santa Ana, CA: MSC Software, 2011 [Consultation: 19/04/2022]. Available on: https://simcompanion.mscsoftware.com/infocenter/index?page=content&id=DOC9106.