Dynamic Analysis with Patran & MSC Nastran

1. Program overview

Title: Dynamic analysis with Patran & MSC Nastran – online course.

Director: Professor Juan José Benito Muñoz.

Department: Construction & Manufacturing Engineering (UNED University).

2. Eligibility and requirements

A degree is required, although university students in the last year of their course may be admitted with proof of their academic status.

Basic knowledge of linear static structural analysis with Patran & MSC Nastran is required, which may have been acquired through:

- Completion of the *Introductory course to FEM with Patran & MSC Nastran*, also available in ICAEEC.
- Completion of the Expert module of the Mechanical branch of the *International Master's in Theoretical & Practical Application of the Finite Element Method and CAE Simulation* of UNED – Ingeciber.

3. Presentation and objectives

The objective of this course is to introduce attendees to dynamic analysis using *Finite Elements*, allowing them to acquire the basic skills to enable them to use this method in their profession.

This course originated as a collaboration project between UNED and Ingeciber, S.A., a company specializing in Computer-Aided Engineering (CAE).

4. Content

The course consists of two subjects:

a. Dynamic analysis with Patran & MSC Nastran
b. Practical Application Exercises with Patran & MSC Nastran

The documentation for both subjects is in English.

The content of each subject is detailed below:

- **Dynamic analysis with Patran & MSC Nastran**

1. Review of fundamentals
2. Mass modeling
3. Normal modes analysis
4. Normal modes analysis for pre-stiffened structures
5. Model checkout
6. Reduction in dynamic analysis
7. Response method
8. Damping overview
9. Transient response analysis
10. Frequency response analysis / harmonic analysis
11. Residual vector method
12. Enforced motion
13. Random analysis
14. Response / shock spectrum analysis
15. Complex eigenvalue analysis
16. Glued contact in normal modes analysis

This subject consists of various practical exercises that complement the documentation provided:

- 1 Normal modes analysis of a 2 DOF structure
- 2a Normal modes analysis
- 2b Normal modes analysis with coarse mesh
- 2c Normal modes analysis with fine mesh
- 3 Modal analysis of a circuit board
- 4a Modal analysis of a car chassis
- 4b Modal analysis of a car chassis without rigid body modes
- 5a Modal analysis of a tuning fork using fine mesh with Tet 10 elements
- 5b Modal analysis of a tuning fork using coarse mesh with Tet 10 elements
- 5c Modal analysis of a tuning fork using fine mesh with Tet 4 elements
- 5d Modal analysis of a tuning fork using coarse mesh with Tet 4 elements

- 5e Modal analysis of a tuning fork using 1D elements
- 6a Modal analysis of a tower
- 6b Modal analysis of a tower with soft ground connection
- 7a Normal modes analysis for pre-stiffened plate model
- 7b Modal analysis for pre-stiffened turbine blade at different RPM
- 8 Effective mass
- 9 Direct transient analysis
- 10 Direct transient analysis of a car chassis
- 11 Modal transient analysis
- 12 Modal transient analysis of the tower model with seismic input
- 13 Direct frequency response analysis
- 14 Modal frequency response analysis
- 15 Frequency response analysis of a circuit board
- 16 Modal frequency analysis of a car chassis
- 17 Direct transient response with enforced acceleration, matrix partition approach
- 18a Random analysis with single excitation using MSC
- 18b Random analysis with multiple excitation using MSC
- 19 Random vibration analysis of a satellite model using MSC
- 20 Calculate response spectra
- 21 Response spectrum analysis
- 22 Normal modes, glued contact
- 23 Direct transient response with enforced acceleration, large mass method

- **Practical Application Exercises with Patran & MSC Nastran. Examples**

The objective of this subject is to complete the concepts explained previously in the first subject through a number of exercises that must be completed using Patran & MSC Nastran.

The exercises represent a review of the concepts introduced in the subjects taken till now, as well as the orderly use of Patran & MSC Nastran.

These exercises will be delivered to the tutor in order to get feedback and recommendations.

The exercises will be similar to the following ones:

- *Harmonic* / *Frequency* analysis of a bedplate
- Transitory analysis of a bedplate

- Pre-stressed modal analysis of a guitar string
- Modal, harmonic and resonance analyses of an impulse system
- Spectral modal analysis of an instrument panel
- Mechanical analysis of a wheel rim
- Nonlinear transitory analysis of a cylinder system

5. Schedule

35 hours of study. The course lasts from 1 to 6 weeks with full flexibility since no specific delivery date is indicated.

6. Methodology

Distance learning methodology, including pre-prepared study materials and bibliography, tutorials, audiovisual resources and practical application exercises.

7. Teaching materials

Attendees will receive the teaching guide and the corresponding materials for the course.

Furthermore, in order to complete the practical exercises and training, the educational version of Patran & MSC Nastran will be provided by the course.

Additional training material for the course developed by ICAEEC.

The course uses a virtual classroom as a training facility where study tools can be found, and also as the main communication channel with the attendees.

Other tools will also be used including audiovisual resources as well as other complementary documentation.

8. Attendee services

The teaching staff will respond to attendee inquiries via telephone, email, or in person. Phone tutorships will be available within the following hours:

Monday to Friday during office hours and always subject to tutor’s availability.

9. Evaluation and grading criteria

Attendee evaluation will be performed through the practical application exercises.

10. Certification

Certification will consist of a diploma from ICAEEC & Ingeciber indicating successful completion of the subject by the attendee as well as the grade obtained in the practical application exercises.

11. Teaching staff

Professor J. J. Benito (director). Construction & Manufacturing Engineering Department (UNED).

Mr. Ronald Siat (coordinator & tutor). Ingeciber, S.A.

Mr. Rubén Mariño (tutor). Empresarios Agrupados.

12. Fees

Tuition fees are 450,00 €.

Current and former attendees of the UNED *Master's in Theoretical and Practical Application of the Finite Element Method and CAE Simulation* are eligible for a 33% discount.

13. Validation

Attendees who pass this course can request validation of the application and practical course subjects of the mechanical branch of the Dynamic Analysis with Patran & MSC Nastran specialized module from the academic board of UNED *Master's in Theoretical and Practical Application of the Finite Element Method and CAE Simulation*.