Course guide
330453 - CVM - Components and Machine Vibrations

Last modified: 25/04/2024

Unit in charge: Manresa School of Engineering
Teaching unit: 712 - EM - Department of Mechanical Engineering.

Degree: BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2016). (Compulsory subject).
BACHELOR'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2017). (Optional subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: Peña Pitarch, Esteban

Others: Ortuño Martin, Jose
Vallejo Serrano, Joan
Martinez Cano, Ferran
Al Omar Mesnaoui, Anas
Alcelay Larrión, José Ignacio

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Knowledge and skills for the calculation, design and testing of components and vibrations in machines.

Transversal:
03 TLG. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

TEACHING METHODOLOGY

- Expository class of theory and problems: in this class it is not intended to make an exhaustive demonstration of the subject, but rather the student will be given a global vision of it insisting on the key concepts for a better understanding, doubts will be discussed and resolved standard problems and questions that guarantee understanding of the subject. Problem solving in face-to-face class aims for the student to learn to analyze them and identify the key elements for their approach and resolution. For each face-to-face session, the student will be provided, with sufficient anticipation in the virtual classroom, the notes on the subject dealt with in the session, and a series of problems. The reading of the theoretical content before the face-to-face session is mandatory and will be controlled by formulating questions during the class.
- Carrying out laboratory practices in small groups. Preparation and delivery of internship reports.
- Resolution and delivery of proposed problems.
- Tutoring, study and individual and team work.
- Exams and evaluation tests.

LEARNING OBJECTIVES OF THE SUBJECT

Upon completion of this course, the student should be able to:
- Acquire basic theoretical knowledge about components and vibrations in machines.
- Apply the main tools and methodology that facilitate, in each of the phases of the design process and product development, meeting objectives in order to meet customer needs.
- Model mechanical systems.
- Plan and analyze vibration behavior tests in machines.

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours large group	30,0	20.00
Hours small group	30,0	20.00

Total learning time: 150 h

CONTENTS

Content Title 1: Spring Design

Description:
Helical spring design, bending and bending effect. Extension and compression springs. Belleville Springs. Crossbows. Spring fatigue load.

Related activities:
A1, A7, A9.

Full-or-part-time: 20h
Theory classes: 2h
Laboratory classes: 6h
Self study : 12h

Content Title 2: Mechanical Transmissions and Gears

Description:
Straps type. Voltage and power. Movement and dimensioning. Lewis equation in gears. AGMA stress equations and gear analysis.

Related activities:
A2, A7, A9.

Full-or-part-time: 40h
Theory classes: 4h
Laboratory classes: 12h
Self study : 24h

Content Title 3: One-degree-of-freedom systems

Description:
Free response and with harmonic excitation. Base excitation and rotational imbalance. Response to an impulse and a force.

Related activities:
A3, A7, A9.

Full-or-part-time: 20h
Theory classes: 2h
Laboratory classes: 6h
Self study : 12h

Content title 4: Systems with multiple degrees of freedom

Description:
Systems with two degrees of freedom. Systems with multiple degrees of freedom.

Related activities:
A4, A8, A9.

Full-or-part-time: 20h
Theory classes: 2h
Laboratory classes: 6h
Self study : 12h

Content Title 5: Design for Vibration Suppression

Description:
Acceptable levels of vibration. Vibration isolation. Vibration absorbing elements. Viscoelastic damping addiction.

Related activities:
A5, A8, A9.

Full-or-part-time: 26h
Theory classes: 4h
Laboratory classes: 6h
Self study : 16h

Title of content 6: Vibrations in continuous systems.

Description:
Vibration in bars. Torsional vibration. Transverse vibration in beams. Damping models. Forced response.

Related activities:
A6, A8, A9.

Full-or-part-time: 24h
Theory classes: 4h
Laboratory classes: 6h
Self study : 14h

ACTIVITIES

TITLE OF ACTIVITY 1: RESOLUTION OF SPRING DESIGN PROBLEMS

Description:
Different exercises involving springs were analyzed and will be solved.

Specific objectives:
Once the activity is finished, the student must know how to interpret, dimension and calculate springs and leaf springs.

Material:
Practice guide (available on the digital Campus) and teacher's notes.

Delivery:
Students must prepare a report of the practice carried out, according to the instructions indicated and deliver to the teacher in the set time.
The evaluation of this activity together with the other activities will form part of the evaluation as specified in the corresponding section of the qualification system.

Full-or-part-time: 8h
Laboratory classes: 3h
Self study: 5h

TITLE OF ACTIVITY 2: TROUBLESHOOTING OF TRANSMISSIONS AND GEARS

Description:
Belt and gear systems will be dimensioned.

Specific objectives:
Once the activity is finished, the student must be able to size, design and calculate mechanical transmissions.

Material:
Collection of problems (available in the digital Campus) and notes of the teacher.

Delivery:
Delivery of solved problems.
The evaluation of this activity together with the other activities will form part of the evaluation as specified in the corresponding section of the qualification system.

Full-or-part-time: 16h
Laboratory classes: 6h
Self study: 10h

TITLE OF ACTIVITY 3: RESOLUTION OF VIBRATION PROBLEMS WITH A DEGREE OF FREEDOM

Description:
Machine vibrations with one degree of freedom will be dimensioned and calculated.

Specific objectives:
Once the activity is finished, the student must be able to design and interpret vibrations in a system with one degree of freedom.

Material:
Collection of problems (available in the digital Campus) and notes of the teacher.

Delivery:
Delivery of solved problems.
The evaluation of this activity together with the other activities will form part of the evaluation as specified in the corresponding section of the qualification system.

Full-or-part-time: 16h
Laboratory classes: 6h
Self study: 10h

TITLE OF ACTIVITY 4: RESOLUTION OF VIBRATION PROBLEMS WITH MULTIPLE DEGREES OF FREEDOM

Description:
Systems with multiple degrees of freedom will be dimensioned and calculated.

Specific objectives:
Once the activity is finished, the student must be able to design and interpret vibrations in a system with multiple degrees of freedom.

Material:
Collection of problems (available in the digital Campus) and notes of the teacher.

Delivery:
Delivery of solved problems.
The evaluation of this activity together with the other activities will form part of the evaluation as specified in the corresponding section of the qualification system.

Full-or-part-time: 16h
Laboratory classes: 6h
Self study: 10h

TITLE OF ACTIVITY 5: DESIGN FOR THE SUPPRESSION OF VIBRATIONS

Description:
Calculation, design and dimensioning of the suppression of vibrations in machines.

Specific objectives:
Once the activity is finished, the student must be able to design all kinds of systems for the suppression of vibrations in machines.

Material:
Practice guide (available on the digital Campus) and teacher's notes.

Delivery:
Students must prepare a report of the practice carried out, according to the instructions indicated and deliver to the teacher in the set time.
The evaluation of this activity together with the other activities will form part of the evaluation as specified in the corresponding section of the qualification system.

Full-or-part-time: 8h
Laboratory classes: 3h
Self study: 5h

TITLE OF ACTIVITY 6: SOLVING PROBLEMS OF VIBRATIONS IN CONTINUOUS SYSTEMS

Description:
Vibrations in continuous systems will be dimensioned and studied.

Specific objectives:
Once the activity is finished, the student must be able to size and identify vibrations in continuous systems.

Material:
Practice guide (available on the digital Campus) and teacher's notes.

Delivery:
Students must prepare a report of the practice carried out, according to the instructions indicated and deliver to the teacher in the set time.
The evaluation of this activity together with the other activities will form part of the evaluation as specified in the corresponding section of the qualification system.

Full-or-part-time: 8h
Laboratory classes: 3h
Self study: 5h

TITLE OF ACTIVITY 7: FIRST PARTIAL TEST OF CONTINUOUS ASSESSMENT

Description:
Individual test in the classroom with a part of the theoretical concepts studied, and Solving exercises and problems related to the learning objectives.

Specific objectives:
At the end of this activity the student should be able to:
Know, understand and apply the concepts studied in the theoretical sessions taught so far.

Material:
Statement and Calculator.

Delivery:
Resolution of the Test.
The evaluation of this activity together with that of other activities will form part of the evaluation as specified in the corresponding section of the teaching guide.

Full-or-part-time: 12h
Theory classes: 2h
Self study: 10h

TITLE OF ACTIVITY 8: SECOND PARTIAL TEST OF CONTINUOUS ASSESSMENT

Description:
Individual test in the classroom with a part of the theoretical concepts studied, and Solving exercises and problems related to the learning objectives.

Specific objectives:
At the end of this activity the student should be able to:
Know, understand and apply the concepts studied in the theoretical sessions taught so far.

Material:
Statement and Calculator.

Delivery:
Resolution of the Test.
The evaluation of this activity together with that of other activities will form part of the evaluation as specified in the corresponding section of the teaching guide.

Full-or-part-time: 12h
Theory classes: 2h
Self study: 10h

TITLE OF ACTIVITY 9: FINAL TEST

Description:
Individual test in the classroom with a part of the theoretical concepts studied, and Solving exercises and problems related to the learning objectives.

Specific objectives:
At the end of this activity the student should be able to:
Know, understand and apply all the concepts studied in the theoretical sessions.

Material:
Statement and Calculator.

Delivery:
Resolution of the Test.
The evaluation of this activity together with that of other activities will form part of the evaluation as specified in the corresponding section of the teaching guide.

Full-or-part-time: 18h
Theory classes: 3h
Self study: 15h

GRADING SYSTEM

- Delivery of the Proposed Problems: 10% of the grade for the course.
- First Partial Continuous Assessment Test: 35% of the grade for the subject.
- Second Partial Continuous Assessment Test: 35% of the grade for the subject.
- Attendance to the practices (5%) and the preparation of reports (15%) related to the results obtained in said practices: 20% of the grade for the subject.

Therefore, the Note for Partial Tests (NPP) = 35% * (First Written Test Note) + 35% * (Second Written Test Note) + 20% * (Practice Note) + 10% * (Delivery Note of the proposed Problems).

It is important to note that the partial written tests are liberating, in such a way that, if the student obtains an NPP> 4.95, he will be exempted from passing the final test. Students who fail to pass the course by partial exams or those who want to improve their grade will have a second chance with a new final test.

The Final Test Score (NPF) = 100% * (Final Written Test Score). Thus, the final grade of the Subject = MAX (NPP: NPF).

EXAMINATION RULES.

- Es obligatorio para aprobar la asignatura asistir y realizar todas las actividades, entregando todos los informes de las prácticas de laboratorios, y la resolución de todos los problemas propuestos en los plazos indicados. Las actividades no realizadas puntúan 0.
- En la resolución de los problemas propuestos, los alumnos utilizarán los contenidos estudiados en la parte expositiva de la sesión presencial y podrán aclarar las dudas y las dificultades con las que se pueden encontrar con el profesor. La fecha límite de entrega de la resolución de los problemas propuestos y los informes de las prácticas de laboratorio será especificada, y no se aceptará ninguna entrega una vez pasada la fecha límite.
- Los informes de las prácticas serán originales, con lo que la copia de las prácticas (total o parcial) será sancion a con el suspenso de la actividad. Se tendrá en cuenta que la responsabilidad de la práctica de laboratorio está compartida por todos los miembros del grupo, por lo tanto, en el caso de detectar alguna copia la norma se aplicará a todos los miembros de todos los grupos involucrados en la copia.
- En la entrega de la resolución de los problemas propuestos, cualquier copia total o parcial de soluciones supondrá el suspenso a la actividad. El alumno debe velar por la privacidad y seguridad de sus datos.
- En ningún caso se podrá disponer de ningún tipo de formulario o apuntes tanto en las pruebas parciales como en la final.

BIBLIOGRAPHY

Basic:

- Mott, Robert L. Machine elements in mechanical design [on line]. 3rd ed. Upper Saddle River: Prentice Hall, 1999 [Consultation: 17/01/2023]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=5510299. ISBN 0138414467.
- Norton, Robert L. Diseño de maquinaria: síntesis y análisis de máquinas y mecanismos [on line]. 6a ed. México: McGraw-Hill, 2020 [Consultation: 07/06/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=5701. ISBN 9788448620998.
- Gans, Roger F. Mechanical systems: a unified approach to vibrations and controls [on line]. Cham: Springer International Publishing, 2015 [Consultation: 13/11/2020]. Available on: http://dx.doi.org/10.1007/978-3-319-08371-1. ISBN 9783319083711.
- Budynas, Richard G; Nisbett, J. Keith. Diseño en ingeniería mecánica de Shigley [on line]. 10a ed. Ciudad de México: McGraw-Hill, 2019 [Consultation: 27/05/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?docID=5485813. ISBN 9781456267568.

Complementary:

- Spotts, M. F-; Shoup, T. E. Elementos de máquinas [on line]. México: Pearson Educación, 1999 [Consultation: 18/06/2024]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=12527. ISBN 9701702522.
- Hamrock, Bernard J; Jacobson, Bo O.; Schmid, Steven R. Elementos de máquinas. México: McGraw-Hill, 2000. ISBN 970102799X.