Last update: 02-06-2016

820448 - EESD - Earthquake Engineering and Structural Dynamics

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering

Teaching unit: 737 - RMEE - Department of Strength of Materials and Structural Engineering

Academic year: 2016

Degree: BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
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BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)

ECTS credits: 6 Teaching languages: English

Teaching staff

Coordinator: J. Ramón González-Drigo

Others: J. Ramón González-Drigo

Requirements

The students must have completed successfully ERM2 (Elasticity and Strength of Materials 2) code 820424.

Degree competences to which the subject contributes

Transversal:

1. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

Teaching methodology

Lectures are held in general classrooms where theoretical lessons are taught. The practical applications are performed using different numerical methods that are implemented with appropriate software in computer rooms.
This course uses narrative method by 40%, individual work 35% and cooperative learning by 25%.

Learning objectives of the subject

The course presents the theoretical basis and practical application of several conventional methods used in earthquake engineering and structural dynamics. One goal of the course is to establish criteria and develop competence and skills enabling to calculate and therefore analyze the dynamic behavior of conventional structures. Another objective is to introduce the design of structures according to the requirements of a specific seismic code.

Last update: 02-06-2016

820448 - EESD - Earthquake Engineering and Structural Dynamics

Technically, the program starts with a module devoted to seismology and to basic geophysical concepts. This first lesson aims to introduce the earthquake as the main dynamic action on structures. The following lessons describe and expose the scientific basis and the numerical techniques required to calculate the dynamic response of single degree of freedom systems with and without damping. The study of single degree of freedom systems is a first and crucial step in the dynamic analysis, since here the definitions of characteristic parameters are introduced. The program continues with the analysis of n-degree of freedom systems. Thus, the theory is applied to shear buildings. Finally earthquake resistant construction standards are introduced and several examples of its application are presented.

The overall aims of this course are:
1. Acquire, maintain or improve skills in English.
2. Introduction to basic and specific concepts and vocabulary related to seismology and dynamics.
3. Acquire ability and competence to write and manage computer calculation codes.
4. Approach and knowledge of the techniques and procedures used in the linear and nonlinear dynamic analysis of single degree and n-degrees of freedom structures with and without damping.
5. Comprehension of the mechanisms of dynamic response of structures (for single degree of freedom and n-degrees of freedom structures with and without damping).
6. Ability to communicate clearly and efficiently in oral and written presentations.
7. Ability to read and understand texts, figures and tables included in the scientific and technical literature related to basic seismology and dynamic analysis of structures
8. Acquire knowledge about bibliography and information sources of public or private administrations related to seismology and structural engineering.
9. Acquire skills for autonomous learning.

Study load

Total learning time: 150h	Hours large group:	45h	30.00%
	Hours medium group:	0h	0.00%
	Hours small group:	15h	10.00%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

Last update: 02-06-2016

820448 - EESD - Earthquake Engineering and Structural Dynamics

Content

(ENG) Tema 1	Learning time: 10h Theory classes: 2h Laboratory classes: 1h Guided activities: 1h Self study : 6h
(ENG) Tema 2	Learning time: 10h Theory classes: 2h Laboratory classes: 1h Guided activities: 1h Self study : 6h
(ENG) Tema 3	Learning time: 10h Theory classes: 2h Laboratory classes: 1h Guided activities: 1h Self study : 6h
(ENG) Tema 4	Learning time: 10h Theory classes: 2h Laboratory classes: 1h Guided activities: 1h Self study : 6h
(ENG) Tema 5	Learning time: 10h Theory classes: 2h Laboratory classes: 1h Guided activities: 1h Self study : 6h

820448 - EESD - Earthquake Engineering and Structural Dynamics

(ENG) Tema 6	Learning time: 10h Theory classes: 2h Laboratory classes: 1h Guided activities: 1h Self study : 6h
(ENG) Tema 7	Learning time: 10h Theory classes: 2h Laboratory classes: 1h Guided activities: 1h Self study : 6h
(ENG) Tema 8	Learning time: 10h Theory classes: 2h Laboratory classes: 1h Guided activities: 1h Self study : 6h
(ENG) Tema 9	Learning time: 10h Theory classes: 2h Laboratory classes: 1h Guided activities: 1h Self study : 6h
(ENG) Tema 10	Learning time: 10h Theory classes: 2h Laboratory classes: 1h Guided activities: 1h Self study : 6h

Description:
(ENG) Estructures modelades com a edificis simples. L'edifici simple. Equacions de rigidesa.

Specific objectives:
(ENG) Conèixer la definició d'edificis de tallant. Capacitat per modelitzar edificis de tallant. Deduir les equacions de rigidesa d'un edifici de tallant. Construcció de les matrius de masses i de rigideses d'un edifici de tallant.

820448 - EESD - Earthquake Engineering and Structural Dynamics

(ENG) Tema 11	Learning time: 10h Theory classes: 2h Laboratory classes: 1h Guided activities: 1h Self study : 6h

Description:
(ENG) Vibració lliure d'un edifici simple. Freqüències naturals i modes normals. Propietat d'ortogonalitat dels modes normals.

Specific objectives:
(ENG) Anàlisi de les vibracions d'un edifici de tallant i càlcul de les corresponent s freqüències naturals i modes normals.

(ENG) Tema 12	Learning time: 10h Theory classes: 2h Laboratory classes: 1h Guided activities: 1h Self study : 6h

Description:
(ENG) Moviment forçat dels edificis simples. Mètode de superposició modal. Resposta al moviment de la base.

Specific objectives:
(ENG) Definició del moviment forçat dels edificis de tallant. Càlcul de la resposta en base a la superposició modal. Càlcul de la resposta al moviment de la base.

(ENG) Tema 13	Learning time: 10h Theory classes: 2h Laboratory classes: 1h Guided activities: 1h Self study : 6h

Description:
(ENG) Moviment amortit dels edificis simples. Equacions per un edifici simple amb amortiment. Equacions desacoblades amb amortiment. Condicions per desacoblar les equacions d'un sistema amb amortiment.

Specific objectives:
(ENG) Descripció i resolució de les equacions d' un edifici de tallant amb esmorteïment.

820448 - EESD - Earthquake Engineering and Structural Dynamics

(ENG) Tema 14	Learning time: 10h Theory classes: 2h Laboratory classes: 1h Guided activities: 1h Self study : 6h

Description:
(ENG) Reducció de matrius dinàmiques. Condensació estàtica. Aplicacions a problemes dinàmics. Condensació dinàmica.

Specific objectives:
(ENG) Formulació de la reducció de matrius dinàmiques. Capacitat per construir la condensació estàtica.

(ENG) Tema 15	Learning time: 10h Theory classes: 2h Laboratory classes: 1h Guided activities: 1h Self study : 6h

Description:
(ENG) El codi sísmic. La perillositat sísmica. El terreny. Acceleració de càlcul. Espectres normalitzats. Càlcul d'espectres a una localització concreta. Exemple de càlcul d'espectres

Specific objectives:
(ENG) Conèixer la Norma de Construcción Sismorresitente Española. Capacitat per aplicar el mètode simplificat de càlcul a una estructura convencional.

Qualification system

Exam 1 corresponding to first period (5 weeks) : 15%
Exam 2 corresponding to second period (10 weeks): 15%
Personal work (exercises and problems. Deliverable): 50%
Cooperative work (algorithms and numerical codes. Deliverable): 20%

Bibliography

Basic:

Barbat, Á. H.; Miquel Canet, J. Estructuras sometidas a acciones sísmicas : cálculo por ordenador. 2ª ed. Barcelona: Centro Internacional de Métodos Numéricos en Ingeniería, cop. 1994. ISBN 8487867103.

Chopra, A. K. Dynamics of structures : theory and applications to earthquake engineering. 3th ed. Upper Saddle River, N.J.: Prentice Hall, cop. 2007. ISBN 013156174X.

Clough, R. W.; Penzien, J. Dynamics of structures. 2nd ed. New Yok [etc.]: McGraw-Hill, 1993. ISBN 0071132414.

Paz, M. Structural dynamics: theory and computation. 4th ed. New York: Chapman & Hall, cop. 1997. ISBN 0412074613.