TECHNICAL SHEET OF THE SUBJECT

Data of the subject	
Subject name	Structural Analysis
Subject code	DIM-GITI-433
Mainprogram	Bachelor's Degree in Engineering for Industrial Technologies
Involved programs	Máster Universitario en Ingeniería Industrial + Máster en Medioambien. y Gest. Intel. de la Energía [First year] Máster Universitario en Ingeniería Industrial [First year] Grado en Ingeniería en Tecnologías Industriales [Fourth year]
Level	Reglada Grado Europeo
Quarter	Semestral
Credits	4,5 ECTS
Type	Optativa (Grado)
Department	Department of Mechanical Engineering
Coordinator	Jesús R. Jiménez Octavio

Teacher Information	
Teacher	
Name	Jesús Ramón Jiménez Octavio
Department	Department of Mechanical Engineering
Office	Alberto Aguilera 25 [D-514]
EMail	Jesus.Jimenez@iit.comillas.edu
Teacher	
Name	Alberto Carnicero López
Department	Department of Mechanical Engineering
Office	Alberto Aguilera 25 [D-319]
EMail	carnicero@iit.comillas.edu
Teacher	
Name	Carlos González Bravo
Department	Department of Mechanical Engineering
EMail	cgbravo@icai.comillas.edu

SPECIFIC DATA OF THE SUBJECT

Contextualization of the subject
Contribution to the professional profile of the degree

This subject provides the basic principles of structural analysis and its application to solve problems in the field of engineering.

Upon completion of the subject, students will learn the calculation methods for trusses and rigid node structures, also becoming familiar with general rules for designing steel structures and certain rules for buildings. The concepts acquired here are the basis of some topics of the subject Industrial Constructions and even can be a brief introduction to the Finite Element Method.

In addition, this subject covers theoretical and practical aspects of structural analysis. A practical approach is added to the theoretical part, therefore, the conceptual problems are enriched with more realistic ones according to the validation against the specific mandatory standards.

Prerequisites

There are no formal prerequisites for this subject. However, it is recommended to have basic knowledge of previous courses in engineering such as:

- Diferential calculus
- Linear algebra
- Material mechanics

Competencies - Objectives

Competences

GENERALES

CG03	Conocimiento en materias básicas y tecnológicas, que les capacite para el aprendizaje de nuevos métodos y teorías, y les dote de versatilidad para adaptarse a nuevas situaciones.
CG04	Capacidad de resolver problemas con iniciativa, toma de decisiones, creatividad, razonamiento crítico y de comunicar y transmitir conocimientos, habilidades y destrezas en el campo de la Ingeniería Industrial.
CG05	Conocimientos para la realización de mediciones, cálculos, valoraciones, tasaciones, peritaciones, estudios, informes, planes de labores y otros trabajos análogos.
CG06	Capacidad para el manejo de especificaciones, reglamentos y normas de obligado cumplimiento.

Learning outcomes

RA1	Conocer y aplicar el Principio de los Trabajos Virtuales (PTV), tanto en estructuras articuladas como en pórticos de nudos rígidos
RA2	Conocer métodos de flexibilidad y aplicar el PTV a la resolución de problemas hiperestáticos
RA3	Resolver de forma sistemática estructuras articuladas y de nudos rígidos empleando el método directo de la rigidez y/o el método. Identificar las situaciones en las que la aplicación de uno u otro método es idónea
RA4	Manejar el Código técnico de la Edificación. Identificar tipos de cargas y combinar acciones para el dimensionamiento de piezas a compresión, a tracción y a flexión

THEMATIC BLOCKS AND CONTENTS

Contents - Thematic Blocks

UNIT 1: Structural typologies

- Structural members
- Types of structures

UNIT 2: Principle of Virtual Work

- Principle of Virtual Work for trusses
- Generalization of the method

UNIT 3: Flexibility methods

- Principle of Virtual Work application to the resolution of indeterminate structures

UNIT 4: Direct stiffness method

- Concept of stiffness
- Shape functions
- System of equations for stiffness methods
- Calculation of internal efforts

UNIT 5: Matrix stiffness method

- Generalization of the direct stiffness method
- Assembly of the global system of equations
- Application of boundary conditions
- Calculation of external reactions

UNIT 6: Building codes for steel structures

- Combination of loads
- Desing of structrural members
- Buckling resistance

TEACHING METHODOLOGY

General methodological aspects of the subject

In-class Methodology: Activities

This subject is oriented to the student's activity and their learning process in order to achieve the learning objectives. This implies that in-class and non-presential activities will promote a proactive role of the student in the learning process.

- **Lectures:** Desciption of concepts and methods through the teacher's explanations. Theoretical discussions, practical examples and a small formal or spontaneous participation of the students will be

CG06, CG05, CG03, CG04

included.

- **Resolution of proposed problems:** The problems proposed by the lecturer and worked on by the students will be explained, analyzed and resolved.
- **Resolution of doubts in-class:** The lecturer will solve the doubts raised by the students after having tried to solve the problems in groups or individually.

Non-Presential Methodology: Activities	
The main objective of the in-class activities is to understand the theoretical concepts of the subject and to be able to use them when solving different types of basic problems. Therefore, homework should focus on addressing advanced problems that will be explained and/or evaluated at the end of each unit.	CG05, CG06, CG04, CG03

SUMMARY STUDENT WORKING HOURS

CLASSROOM HOURS	
Clase magistral y presentaciones generales	Resolución de problemas de carácter práctico o aplicado
25.00	20.00
NON-PRESENTIAL HOURS	
Estudio de conceptos teóricos fuera del horario de clase por parte del alumno	Resolución de problemas de carácter práctico o aplicado
25.00	65.00
ECTS CREDITS: 4,5 (135,00 hours)	

EVALUATION AND CRITERIA

Evaluation activities	Evaluation criteria	Weight
Final exam	• Comprehension of theoretical concepts • Application of theoretical concepts to the resolution of problems • Analysis and interpretation of results in numerical applications	70
Continuous assessment	• Application of theoretical concepts to the resolution of problems • Analysis and interpretation of results in numerical applications • Development of technical writing and reporting skills	30

Ratings

Convocatoria Ordinaria

- Final Exam - 70% getting a minimum mark of 4.0
- Continuous Assessment - 30%

Exceeding 15% absences may result in the loss of the call for the final exam.

Convocatoria Extraordinaria

- Final Exam - 85% getting a minimum mark of 4.0
- Continuous Assessment - 15%

BIBLIOGRAPHY AND RESOURCES

Basic Bibliography

- Structural Analysis, 8th Ed., R.C. Hibbeler. Prentice Hall, 2012

Complementary Bibliography

- Fundamentals of Structural Analysis, 4th Ed., K.M. Leet, C. Uang and A.M. Gilbert. McGraw-Hill, 2011
- Design of Steel Structures, L. Simoes da Silva, R. Simoes and H. Gervasio. Ernst & Son, 2010
- The Behaviour and Design of Steel Structures to EC3, 4th Ed., N.S. Trahair, M.A. Bradford, D.A. Nethercot and L. Gardner. Taylor & Francis, 1977