

Code:**Credits: 9****Matter:** Applied Mechanics II**Main language of instruction:** Italian**Other language of instruction:** English

Teaching Staff

Head instructor

Prof. Marco Cirelli - marco.cirelli@unicusano.it

Introduction

1. Objective of the course :

The course "Applied Mechanics II" aims for students to learn theoretical knowledge and application tools for the design of mechanical systems and structural analysis. The course has been organized into two main parts.

In the first part, the student will learn basic knowledge of 3D virtual modelling. Therefore, the issues inherent in computer-aided design and virtual assembly of mechanisms will be discussed.

The second part studies the concept of structural analysis using finite element methodology.

Projects will be carried out in both parts to put into practice the concepts learned.

Objectives

2. Course Structure:

The course has been organized into five subjects. The first subject deals with Computer Aided Engineering (CAE). An overview of the advantages of the CAE use in engineering design is presented. A description of the main CAEs software and how they usually work is shown. The second subject contains knowledge about parametric tridimensional modelling. Sketch concepts, 2-D and 3-D entities, geometrical constraints, and basic and advanced 3D features are treated. The third subject is about virtual assembly. Concepts of joints, static and dynamic assemblies, and top-down and bottom-up assemblies are discussed. The fourth and fifth subjects describe, respectively, theoretical and practical aspects of structural analysis by using Finite Element Method (FEM). The concepts of discretization, shape and typologies of elements, assembly of elements, constraints and load, and material properties are

addressed. The course focuses on teaching essential knowledge about novel methodologies to design mechanical systems. The students will learn both theoretical and practical aspects of virtual prototyping.

The course contains a practical part consisting in:

- Create several 3D components
- Generate different assemblies to realize mechanisms
- Structural analysis of several mechanisms

The practical part (projects) must be carried out using the commercial software *Autodesk Inventor*. The practical part has to be realized by the students **in an autonomous way**.

Competencies:

- To learn essential knowledge about Computer Aided Engineering.
- To understand how a Computer Aided Design software works.
- To be able to design components in a virtual environment.
- To acquire the abilities to design parametric parts.
- To be able to design mechanical assemblies.
- To know essential knowledge about mathematical joints for the assemblies generation.
- To be able to design mechanisms both in bottom-up and top-down approach.
- To acquire experience in modeling, assembling and motion functionality evaluation of mechanisms.
- To know and understand the Finite Element Method.
- To be able to realize a tridimensional model and evaluate its structural integrity by using FEM.
- To acquire problem-solving skills in structural analysis based on quantitative and qualitative information.
- To be able to search for, interpret and convey information.
- To acquire the abilities to solve problems and make decisions using relevant information, applying the appropriate methods for structural analysis perform.
- To be able to organize the results and to write a complete report of the analysis.
- To be able to work with academic papers.
- To acquire skills for independent learning.
- To be able to create models, analyze it and assumes critical conclusions.
- To acquire the ability to put knowledge into practice.

Syllabus

3. Programme of the course:

Subject 1. Computer Aided Engineering

Subject 2. Virtual prototyping – Design of components

Subject 3. Virtual prototyping – Design of assemblies

Subject 4. Finite Element Method – Theoretical aspects

Subject 5. Finite Element Method – Practical aspects

Evaluation system and criteria

The exam consists of a written test aimed at ascertaining the ability to analyze and rework the concepts acquired and a series of project activities (Projects) carried out during the course in virtual classes. The Projects, being interactive teaching activities, are mandatory and preparatory to booking the exam.

I) **Project evaluation:** The evaluation of each project ranges from 0 (not sufficient) to 5 points and is carried out in progress during the course. It is necessary to obtain sufficient skills for each project to access the final exam.

II) **Final exam:**

The final exam can be taken in written form both at the Rome campus and at the teaching centres upon reservation by the student. The written test includes one/two exercises and the answer to a series of theoretical questions.

Notice: all projects have to be completed and sent to the Professor according to the guidelines reported on the course web page.

Bibliography and resources

4. *Materials to consult: lecture notes by the Professor.*

5. *Recommended bibliography: --*