Course Description

- **Instructor**
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- **Class time**
  - Saturday-Monday 10:30-12:00

- **Course evaluation**
  - Mid-term (25%)
  - Final exam (40%)
  - Quiz (5%)
  - Exercise (30%)
Course Description (Continued ...)

- Mid-term session:
  - Monday: 8th Ordibehesht 1393, 10:30 ~ 12:30
- Final Exam:
  - Saturday: 24th Khordad 1393, 15:00 ~ 17:30
- Reference:
  - Benhabib, Beno; “Manufacturing: Design, Production, CAD/CAM, and Integration”, 2003, Marcel Dekker Inc, New York

Course Description (Continued...)

- Contents:
  - Introduction to CAD/CAM/CAE systems (5 sessions)
  - Components of CAD/CAM/CAE systems (2 sessions)
  - Geometric modeling systems (3 sessions)
  - Optimization in CAD (5 sessions)
  - Rapid prototyping and manufacturing (3 sessions)
  - Virtual engineering (2 sessions)
  - Product Life Cycle Cost Model (2 sessions)
  - Computer-Based Design and Features/Methodologies of Feature Representations (5 sessions)
  - Feature-Based Process Planning and Techniques (3 sessions)
  - Collaborative Engineering (2 sessions)
Course Description (Continued..)

* Contents:
  * Components of CAD/CAM/CAE systems (2 sessions)
    * Hardware components
    * Hardware configurations
    * Software components
    * CAD/CAM systems

Introduction to CAD/CAM/CAE systems
Components of CAD/CAM/CAE systems

- **3D Modeling in CAD/CAM**
  
  In a CAD/CAM system, the first goal is to create a geometric model of an object.

  Such a model serves as a digital representation, in a computer, that we can use later for a variety of engineering activities such as analysis and manufacturing.

  The representation is well structured in the model database, and the database structured content is stored in the part file of the model.

- **Components of CAD/CAM/CAE systems**

  - **3D Modeling in CAD/CAM**

    - **Solid models** are what CAD/CAM systems use.

    - A solid model is a complete, unique, and unambiguous representation of an object.

    - The model resembles the object. An object, such as a cube, has sides (6), edges (12), and comers (8).

    - Its corresponding solid model has faces, edges, and vertices to represent its sides, edges, and comers, respectively.
Components of CAD/CAM/CAE systems

- **3D Modeling in CAD/CAM**
  - While all CAD/CAM systems create parametric solid models, CAD designers can create the models in different ways.
  
  - We identify three modeling approaches that designers can choose from to create solid models.
    - **Primitives**, 
    - **Features**, and 
    - **Sketching**.

Geometric modeling systems

- **Wireframe modeling systems**
  - This system represents a shape by its characteristics lines and end points.
  
  - The system uses lines and points to display three-dimensional shapes and allow manipulation of the shapes by modifying the lines and points.
Geometric modeling systems

- Surface modeling
  - In this approach, a component is represented by its surfaces which in turn are represented by their vertices and edges.

- Standard surface types available for surface modeling:
  - box,
  - pyramid,
  - wedge,
  - dome,
  - sphere,
  - cone,
  - torus,
  - dish
  - and mesh
Geometric modeling systems

Solid modeling
- There are six common representations in solid modeling.
  - Spatial Enumeration
  - Cell Decomposition
  - Boundary Representation
  - Sweep Methods
  - Primitive Instancing
  - Constructive Solid Geometry (CSG)

In a CSG model, physical objects are created by combining basic elementary shapes known as primitives like blocks, cylinders, cones, pyramids and spheres.

The Boolean operations like union (\(\cup\)), difference (\(-\)) and intersection (\(\cap\)) are used to carry out this task.
Geometric modeling systems

* Solid modeling
  * Constructive Solid Geometry (CSG)
  * In a CSG model, physical objects are created by combining basic elementary shapes known as primitives like blocks, cylinders, cones, pyramids and spheres.

* The Boolean operations like union (∪), difference (−) and intersection ∩ are used to carry out this task.
Geometric modeling systems

- **Solid modeling**
  - Boundary Representation (B-rep)
  - Boundary representation is built on the concept that a physical object is enclosed by a set of faces which themselves are closed and oriented surfaces.

- **Geometric entities -- Topological entities**
  - Point -- Vertex
  - Curve, line -- Edge
  - Surface -- Face