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:
  * Product Life Cycle Cost Model (2 sessions)
  * Cost Breakdown in Manufacturing Systems
  * Computer-Aided Cost Estimating in Manufacturing

Introduction to CAD/CAM/CAE systems
Product Life Cycle Cost Model

- **Computer-Aided Cost Estimating in Manufacturing**
  - Cost estimating is the mission of determining and evaluating the costs involved in an engineering product or a system using scientific and engineering laws and methods.
  - The area of engineering practice where engineering judgment and experience are utilized in the application of scientific principles and techniques to the problems of cost estimating, cost control and profitability.
  - Classifications for cost estimating:
    - Screening estimate
    - Budget estimate
    - Definitive estimate

- **Objective of Cost Estimating:**
  - Assist in Submitting Bids
  - Revise Quotations
  - Assist in Evaluating Alternatives
  - Control of Manufacturing Expenses
  - Assist in Make or Buy Decisions
  - Establish Ground for a Selling Price
Product Life Cycle Cost Model

- Computer-Aided Cost Estimating in Manufacturing
  - Methods of Cost Estimating
  - The Opinion Estimates Method
  - The Conference Estimating Method
  - The Comparison Method
  - The Unit Estimate Methods
  - The Cost and Time Relationship Method
  - The Power Law and Sizing Model Method
  - Probabilistic Approaches
  - Statistical Methods
  - Simulation
  - The Factor Method
  - The Detailed Computerized Method

\[ C_2 (D_2) \leq C_1 (D_1) \]

\[ C_3 (D_3) \leq C_1 (D_1) \leq C_2 (D_2) \]
Product Life Cycle Cost Model

- Computer-Aided Cost Estimating in Manufacturing
  - Methods of Cost Estimating
    - The Unit Estimate Methods

\[ C_u = \sum C_i / U_i \]

where

- \( C_u \) = average cost per unit of design \( i \)
- \( C_i \) = dollar value of design \( i \)
- \( U_i \) = unit of design \( i \)

Product Life Cycle Cost Model

- Computer-Aided Cost Estimating in Manufacturing
  - Methods of Cost Estimating
    - The Cost and Time Relationship Method
    - The Power Law and Sizing Model Method

\[ C = C_j (Q_j / Q_i)^m \]

where

- \( C \) = cost value for design of size \( Q_i \)
- \( C_j \) = known cost of design with size \( Q_j \)
- \( Q_i, Q_j \) = design sizes
- \( m \) = correlating exponent, \( m \) within \([0, 1]\).
Product Life Cycle Cost Model

- Computer-Aided Cost Estimating in Manufacturing
  - Methods of Cost Estimating
    - Probabilistic Approaches

\[ C(i) = \{ p \cdot x_{ij} \} \]

where

- \( C(i) \) = expected value of the cost of design \( i \)
- \( P \) = probability that \( x \) takes on a value \( x \)
- \( x_{ij} \) = design event

Product Life Cycle Cost Model

- Computer-Aided Cost Estimating in Manufacturing
  - Methods of Cost Estimating
    - Statistical Methods
      - Estimating by confidence intervals
    - Estimating by tolerance intervals
    - Estimating by prediction intervals
Product Life Cycle Cost Model

- Computer-Aided Cost Estimating in Manufacturing
  - Methods of Cost Estimating
    - Simulation
    - The Factor Method

\[
C = \left( C + \sum i f_i \cdot C_e \right) (f_i + 1)
\]

where
- \(C\) = estimated value of project
- \(C_e\) = cost of major equipment
- \(f_i\) = factor for estimating capital (buildings, equipment, etc.)
- \(f_i\) = factor for estimating of indirect cost
- \(i\) = factor index

The factors \(f_i\) and \(f_i\) are determined by historical data, experience, or policy.

Product Life Cycle Cost Model

- Computer-Aided Cost Estimating in Manufacturing
  - Methods of Cost Estimating
    - The Detailed Computerized Method
      - Computerized cost estimating takes advantage of the digital computer to automate the detailed manual cost estimating method.

- It is required that these estimates fall within an acceptable range; the need for accuracy is evident.

- Estimating errors can be categorized as controllable and uncontrollable errors.
Product Life Cycle Cost Model

- Computer-Aided Cost Estimating in Manufacturing
  - Methods of Cost Estimating
    - The Detailed Computerized Method
      - Estimating errors can be categorized as controllable and uncontrollable errors.
        - Controllable errors may be caused by:
          - Failure to develop detailed data necessary for the cost estimate
          - Errors in interpreting information
          - Making wrong assumptions
          - Use of poorly documented data
          - Failure to spend the time necessary for accurate estimations
          - Lack of experience
  
- Uncontrollable errors are usually due to:
  - Unpredictable change in equipment
  - Unexpected conditions such as fires, storms, and industrial accidents Labor strike
  - Decline in productivity levels due to employee attitudes and low morale
Product Life Cycle Cost Model

- Computer-Aided Cost Estimating in Manufacturing
  - Methods of Cost Estimating
    - Cost estimate is the summation of various costs involved in the estimation of cost for a product, project, or a system.
    - These costs are classified into two groups:
      - Direct costs
        - Direct material: Materials that are an integral part of the finished product
        - Direct labor: Costs that can be traceable directly to the making of the product
      - Indirect costs
        - Manufacturing overhead: All manufacturing costs except direct material and labor costs
        - Indirect materials
        - Administrative overhead

- Computer-Aided Cost Estimating (CACE) is the use of computers to estimate costs of products, projects, or systems.

- CACE is an important tool to:
  - Develop cost estimates in shorter time.
  - Improve estimate accuracy by minimizing the human interface.
  - Improve cost data availability and security.
  - Evaluate more alternatives.
  - Improve management morale.
Product Life Cycle Cost Model

- Computer-Aided Cost Estimating in Manufacturing
  - Structure of a Computer-Assisted Cost Estimating System
  - Costs beyond the manufacturing stage include the costs of engineering, marketing, and administrative-related activities:
    - Material cost:
      - Material is defined as substance being transformed or used in a manufacturing transformation. Materials are classified as:
        - 1. Raw materials
        - 2. Commercial products
        - 3. Subcontract products
        - 4. Inter-department transfer products
  - Labor Cost:
    - Labor cost estimating constitutes the second part of the direct cost. This cost is important because of the extensive attention it gets from management, government and researchers
      - 1. Identify the operation.
      - 2. Determine the labor time.
      - 3. Identify hourly rates.
      - 4. Determine the labor overhead rate.
      - 5. Determine the cost of fringe benefits.
      - 6. Tabulate the total cost of labors.
Product Life Cycle Cost Model

- Computer-Aided Cost Estimating in Manufacturing
- Structure of a Computer-Assisted Cost Estimating System
- Costs beyond the manufacturing stage include the costs of engineering, marketing, and administrative-related activities:
  - Machinery and Tools Cost:
    - Tools can be classified as hard or soft tools. Hard tools are those that are designed and manufactured specifically for a certain manufacturing operation. On the other hand, soft tools are conventionally used in common manufacturing operations.
    - 1. To determine the investment necessary for tools within a time frame during the planning phase.
    - 2. To evaluate alternative tooling combinations and select the combination incurring the least cost.

Operation Cost:
- An operation involves material, labor, and equipment.
- The estimator must have the necessary cost estimating data in the form of trade books, handbooks, and various data sources about the operations involved in the design.
- 1. Part design
- 2. Production plans
- 3. Material specifications
- 4. Tooling specification
- 5. Standard time sheets
**Product Life Cycle Cost Model**

* Computer-Aided Cost Estimating in Manufacturing
  * Structure of a Computer-Assisted Cost Estimating System
    * Costs beyond the manufacturing stage include the costs of engineering, marketing, and administrative-related activities:
      * Overhead Cost:
        * Overhead cost in present cost accounting practice is the portion of total cost that cannot be directly traced to particular operations, products, or projects.
        * The problem with allocating overhead charges is that these costs often exist even if the product is not produced.
      * Overhead charges may be determined in different ways including:
        1. Overhead as a ratio of direct labor dollars
        2. Overhead as a ratio of direct labor hours
        3. Overhead as a ratio of prime cost