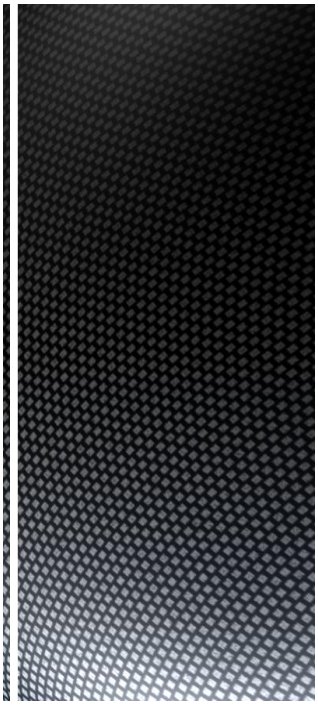


CAD/CAM (21-342)

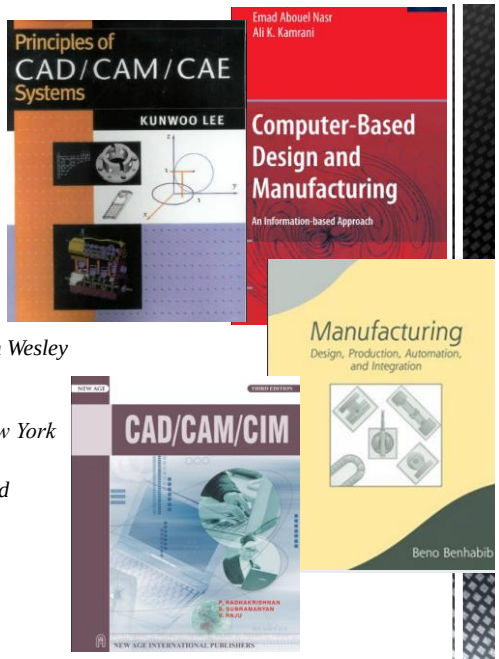
Advanced Manufacturing Laboratory
Department of Industrial Engineering
Sharif University of Technology

Session # 15

Course Description

- *Instructor*
  - *Omid Fatahi Valilai, Ph.D. Industrial Engineering Department, Sharif University of Technology*
  - *Email: FValilai@sharif.edu , Tel: 6616-5706*
  - *Website: Sharif.edu/~fvalilai*
- *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:*
  - *Lee, Kunwoo; "Principles of CAD/CAM/CAE systems", 1999, Addsion Wesley*
  - *Abouel Nasr, Emad; Kamrani, Ali K.; "Computer-Based Design and Manufacturing: An Information-Based Approach", 2007, Springer, New York*
  - *Benhabib, Beno; "Manufacturing: Design, Production, CAD/CAM, and Integration", 2003, Marcel Dekker Inc, New York*
  - *Radhakrishnan, P.; Subramanian, S.; Raju, V.; "CAD/CAM/CIM", 3rd edition, 2005, New age international (P) limited publishers, New York*

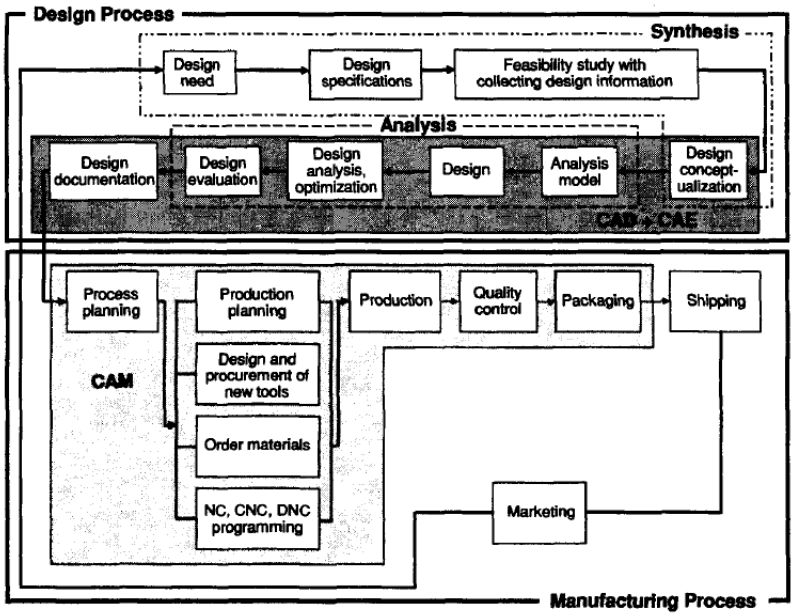
Course Description *(Continued..)*

- *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

- *Introduction*
  - *Today's manufacturing environment should:*
    - *Increased product variety*
    - *Reduced product life cycle*
    - *Changed cost structures*
    - *Hardly estimate the costs and benefits of computer integrated manufacturing (CIM) technology.*

Product Life Cycle Cost Model

- *Introduction*
  - *Today's manufacturing environment should:*
    - *Increased product variety*
    - *Reduced product life cycle*
      - *Design stage.*
      - *Manufacturing stage.*
      - *End-of-life stage*

Product Life Cycle Cost Model

- *Introduction*
  - *Today's manufacturing environment should:*
    - *Increased product variety*
    - *Reduced product life cycle*
    - *Changed cost structures*
      - *Manufacturing costs conventionally have been classified into three items:*
        - *Material*
        - *Labor*
        - *Overhead costs*

Product Life Cycle Cost Model

- *Introduction*
  - *Today's manufacturing environment should:*
    - *Increased product variety*
    - *Reduced product life cycle*
    - *Changed cost structures*
    - *Hardly estimate the costs and benefits of computer integrated manufacturing (CIM) technology.*
      - *The conventional investment appraisal techniques are invalid for a CIM environment.*
      - *CIM equipment is extremely flexible and it is hard to evaluate its capabilities and define its application.*
      - *Economic justifications are proper when a company is involved in replacing old equipment with new equipment.*

Product Life Cycle Cost Model

- *Product Life Cycle Cost Analysis*
  - *Total System Cost (C)*

$$C = (C_r + C_i + C_o)$$

where

C_r = R&D cost
C_i = investment cost
C_o = operations and maintenance cost

Product Life Cycle Cost Model

$$C = (C_r + C_i + C_o)$$

where

C_r = R&D cost
C_i = investment cost
C_o = operations and maintenance cost

- *Product Life Cycle Cost Analysis*
  - *Total System Cost (C)*
    - *Advanced Research and Development (Cr)*

$$C_r = (C_{rm} + C_{rr} + C_{re} + C_{rt} + C_{rd})$$

where

C_{rm} = program management cost
C_{rr} = advanced R&D cost
C_{re} = engineering design cost
C_{rt} = equipment development and test cost
C_{rd} = engineering data cost

Product Life Cycle Cost Model

$$C = (C_r + C_i + C_o)$$

where

C_r = R&D cost
C_i = investment cost
C_o = operations and maintenance cost

- *Product Life Cycle Cost Analysis*
  - *Total System Cost (C)*
    - *Advanced Research and Development (Cr)*
      - *Equipment Development and Test (Crt)*

$$C_r = (C_{rm} + C_{rr} + C_{re} + C_{rt} + C_{rd})$$

$$C_{rt} = [C_{rdl} + C_{rdm} + \Sigma\, C_{rdt}^{i}]$$

C_{rdl} = cost of prototype fabrication and assembly labor
C_{rdm} = cost of prototype material
C_{rdti} = cost of test operations and support associated with specific test *i*
N = number of identifiable tests

where

C_{rm} = program management cost
C_{rr} = advanced R&D cost
C_{re} = engineering design cost
C_{rt} = equipment development and test cost
C_{rd} = engineering data cost

Product Life Cycle Cost Model

$$C = (C_r + C_i + C_o)$$

where

C_r = R&D cost
C_i = investment cost
C_o = operations and maintenance cost

- *Product Life Cycle Cost Analysis*
  - *Total System Cost (C)*
    - *Investment (Ci)*

$$C_i = (C_{im} + C_{ic} + C_{il})$$

where

C_{im} = system/equipment manufacturing cost
C_{ic} = system construction cost
C_{il} = cost of initial support

Product Life Cycle Cost Model

$$C = (C_r + C_i + C_o)$$

where

C_r = R&D cost
C_i = investment cost
C_o = operations and maintenance cost

- *Product Life Cycle Cost Analysis*
  - *Total System Cost (C)*
    - *Investment (Ci)*
      - *Manufacturing (Cim)*

$$C_i = (C_{im} + C_{ic} + C_{il})$$

where

C_{im} = system/equipment manufacturing cost
C_{ic} = system construction cost
C_{il} = cost of initial support

$$C_{im} = (C_{in} + C_{ir})$$

where

C_{in} = nonrecurring manufacturing cos
C_{ir} = recurring manufacturing cost

Product Life Cycle Cost Model

$$C = (C_r + C_i + C_o)$$

where

C_r = R&D cost
C_i = investment cost
C_o = operations and maintenance cost

- *Product Life Cycle Cost Analysis*
  - *Total System Cost (C)*
    - *Investment (Ci)*
      - *Manufacturing (Cim)*

$$C_{in} = [C_{inm} + C_{int} + C_{ina} + C_{inp} + \Sigma C_{inq} + \Sigma C_{ins}]$$

where

C_{inm} = manufacturing engineering cost
C_{int} = tools and factory test equipment cost (excluding capital equipment)
C_{ina} = quality assurance cost
C_{inp} = manufacturing management cost
C_{inq} = cost of qualification test i
C_{ina} = cost of production sampling test j
N = number of individual tests

$$C_i = (C_{im} + C_{ic} + C_{il})$$

where

C_{im} = system/equipment manufacturing cost
C_{ic} = system construction cost
C_{il} = cost of initial support

$$C_{im} = (C_{in} + C_{ir})$$

where

C_{in} = nonrecurring manufacturing cost
C_{ir} = recurring manufacturing cost

Product Life Cycle Cost Model

- *Product Life Cycle Cost Analysis*
  - *Total System Cost (C)*
    - *Investment (Ci)*
      - *Manufacturing (Cim)*

$$C_{ir} = [C_{ire} + C_{irl} + C_{irm} + C_{iri} + C_{irt}]$$

where

C_{ire} = recurring manufacturing engineering support cost
C_{irl} = production fabrication and assembly labor cost
C_{irm} = production material and inventory cost
C_{iri} = inspection and test cost
C_{irt} = packing and initial transportation cost

$$C = (C_r + C_i + C_o)$$

where

C_r = R&D cost
C_i = investment cost
C_o = operations and maintenance cost

$$C_i = (C_{im} + C_{ic} + C_{il})$$

where

C_{im} = system/equipment manufacturing cost
C_{ic} = system construction cost
C_{il} = cost of initial support

$$C_{im} = (C_{in} + C_{ir})$$

where

C_{in} = nonrecurring manufacturing cost
C_{ir} = recurring manufacturing cost

Product Life Cycle Cost Model

- *Product Life Cycle Cost Analysis*
  - *Total System Cost (C)*
    - *Investment (Ci)*
      - *Construction Cost (Cic)*

$$C_{ic} = (C_{icp} + C_{ict} + C_{ico} + C_{icm})$$

where

C_{icp} = manufacturing facilities cost
C_{ict} = test facilities cost
C_{ico} = operational facilities acquisition cost
C_{icm} = maintenance facilities acquisition cost

$$C = (C_r + C_i + C_o)$$

where

C_r = R&D cost
C_i = investment cost
C_o = operations and maintenance cost

$$C_i = (C_{im} + C_{ic} + C_{il})$$

where

C_{im} = system/equipment manufacturing cost
C_{ic} = system construction cost
C_{il} = cost of initial support

Product Life Cycle Cost Model

- *Product Life Cycle Cost Analysis*
  - *Total System Cost (C)*
    - *Investment (Ci)*
      - *Initial Logistic Support Cost (CH)*

$$C = (C_r + C_i + C_o)$$

where

C_r = R&D cost
C_i = investment cost
C_o = operations and maintenance cost

$$C_i = (C_{im} + C_{ic} + C_{il})$$

where

C_{im} = system/equipment manufacturing cost
C_{ic} = system construction cost
C_{il} = cost of initial support

$$C_{il} = (C_{ilm} + C_{ilp} + C_{ils} + C_{ili} + C_{ild} + C_{ilt} + C_{ilx} + C_{ily})$$

where

C_{ilm} = logistic program management cost
C_{ilp} = cost of provisioning
C_{ils} = initial spare/repair material cost
C_{ili} = initial inventory management cost
C_{ild} = cost of technical data preparation
C_{ilt} = cost of initial training and training equipment
C_{ilx} = acquisition cost of operational test and support equipment
C_{ily} = initial transportation and handling cost

Product Life Cycle Cost Model

- *Product Life Cycle Cost Analysis*
  - *Total System Cost (C)*
    - *Operator Personnel Cost (Co)*

$$C = (C_r + C_i + C_o)$$

where

C_r = R&D cost
C_i = investment cost
C_o = operations and maintenance cost

$$Co = (C_{oo} + C_{om} + C_{on} + C_{op})$$

where

C_{oo} = cost of system/equipment life cycle operations
C_{om} = cost of system/equipment life cycle maintenance
C_{on} = cost of system/equipment modifications
C_{op} = cost of system/equipment phase-out and disposal