Learning Objectives for EMC001

Segment 1: How Engineers are Made

At the end of this segment, you should be able to…

a. Explain the differences and similarities between scientists and engineers, and provide illustrative examples
b. Describe how engineering is built on scientific developments, and provide illustrative examples
c. Describe why individual engineering disciplines exist
d. Describe the specialties typically associated with 5 most common engineering disciplines, 6 other common disciplines, and 4 less common, highly specialized disciplines (lists to be developed in class)
e. Identify key industries typically associated with the 15 primary disciplines
f. Give examples and explain situations in which a disciplinary approach is appropriate and situations in which a disciplinary approach is not appropriate

Segment 2: The Engineering Method

At the end of this segment, you should be able to…

a. List and explain seven typical steps associated with engineering problem solving
b. Explain the role of models and describe at least three specific examples
c. Explain the difference between mathematical modeling and simulation, and describe the nature and utility of at least three specific examples of simulations
d. Explain the role of physical models and describe at least three specific examples
e. Explain at least three specific roles of failure in engineering design, and describe at least three specific examples (including the scenario, the primary cause(s) of failure, and the lesson(s) learned)
f. Construct a meaningful model and a corresponding simulation that allow analysis of an engineering scenario

Segment 3: Modular Thinking

At the end of this segment, you should be able to…

a. Explain the engineering concept of modularity and provide examples of it in practice today
b. Explain the transition from the craft industry to mass production
c. Describe how the engineering concept of interchangeable parts revolutionized the way products are conceived, fabricated and come to market
d. Provide examples of the key engineering concepts which enabled mass production based product engineering, and why they were so important
e. Describe the transition from *mass production* to *mass customization* and the engineering strategies/capabilities that make it possible
f. Explain the role of engineering and its limitations in exploiting marketing strategies based on modularity and mass customization
g. Define and discuss the concepts of the modular enterprise and enterprise engineering
h. Explain the principles of Structured Decomposition
i. Apply Structured Decomposition to an engineered product

Segment 4: Systems and Constraints

At the end of this segment, you should be able to…

a. Explain why systems of modules are not optimized by optimizing all the modules
b. Explain what is meant by a module itself being a system and the significance of this to engineering systems
c. Describe the concept of a systems constraint
d. Explain how to manage constraints to engineer the systems performance
e. Identify a constraint in a specific engineering scenario, and explain your selection
f. Explain the impact of systems and constraints on ERP systems and what obstacles remain

Segment 5: Case Studies: Engineering in the Real World

At the end of this segment, you should be able to…

a. Describe specific ways in which engineering has had significant effects on society
b. Explain ways in which engineering is influenced by personalities
c. Explain ways in which engineering is influenced by circumstances (society, era, politics, fashions)
d. Describe how outside influences on engineering requires adjustment of the idealized concepts presented in segments 1 and 2

Segment 6: Information

At the end of this segment, you should be able to…

a. Explain how information can be used to enhance resource utilization, citing examples and opportunities
b. Describe Material Requirements Planning (MRP) and when MRP can be used
c. Explain how MRP systems evolved with the availability of enhanced information systems into ERP and its impact on production engineering and product development
d. Identify and explain the current engineering challenges to integrated information systems
e. Explain the current and future trends of information-enhanced and engineered business in terms of the value propositions Information Engineering now makes possible

Segment 7: Innovation

At the end of this segment, you should be able to…

a. List and explain common impediments to creative thinking, then list and explain methods for overcoming these impediments
b. Describe the innovative engineering process in terms of the engineering steps used
c. Explain the difference between traditional engineering and innovative engineering
d. Explain the connection between innovative engineering and teams, cultures, and organizational structure

Course Objectives: Integration of Multiple Segments

At the end of this Course, you should be able to…

a. Select specific engineering items and identify key questions that allow understanding of how the items work, how they were created, and the impact that they have

b. Explain why the shift in emphasis to multi-disciplinary teams is changing the way we think of engineers and the responsibility of engineers in integrating more fully with non engineering professions.
c. Explain why early involvement at the earliest stages of non-engineers on an integrated team is essential to engineering and financial success.
d. Describe the way the engineers often see non-engineers, and why communication gaps frequently exist
e. Identify and explain things you could do to foster better communication and understanding between engineers and non-engineers
f. Articulate what advances in the engineering approach are needed, and the risks of not doing them with respect to 21st century engineering.
e. Present a Term Project that uses concepts from each segment of the course to analyze a specific engineered product, its history, and its characteristics