



# Principles of Systems Engineering

This course provides an introduction to systems engineering, including the integration of system life cycle requirements. It is intended to advance understanding of the role of collaborative processes used to manage the development of complex systems, and provide a framework linking customer needs, business strategy, and technology. An enterprise view of systems engineering principles will be discussed, encompassing key philosophies and methods used to achieve customer-valued products that are effective, reliable and of high quality. A key expectation for the student is to acquire the characteristic of approaching any problem or project with a systems perspective.

**Course prerequisites:** Undergraduate degree recommended

## Session 1 - Introduction to Systems Engineering

### Objectives

The main objective of session 1 is to introduce the systems engineering discipline and its basic concepts, resulting in:

- An appreciation for systems engineering thinking, history, and approach;
- A basic understanding of key systems engineering terminology and concepts;
- An understanding of the relevance and role of systems engineering in product development;
- An understanding of the fundamental processes which comprise systems engineering including:
  - Requirements development
  - Concurrent engineering
  - Systematic integration
  - Project management
  - Risk management
  - Total quality management
  - Product and process improvement

### Session Topics

- Introduction and background
- Elements of systems engineering



## **Session 2 - The Systems Engineering Development Process**

### **Objectives**

The main objective of session 2 is to develop an understanding of the nature and relevance of system life cycles and the life-cycle systems-engineering process, resulting in:

- An appreciation of the divergent views of products and life cycles;
- An understanding of systems-acquisition process and various process models;
- An understanding of the relevance of system life cycles and the need to design for life-cycle requirements early in the acquisition process
- A basic understanding of simulation-based systems acquisition, as well as a basic understanding of the modifications of existing systems

### **Session Topics**

- Systems engineering concepts
- Products, projects, and product life cycles
- Systems acquisition process models
- Introduction to requirements management

### **Reading Assignment**

- Blanchard, Chapters 4 and 5 (Read for Session 3)

### **Homework Assignment**

- Blanchard, Chapter 3: Problem 17 (p. 92)
- Blanchard, Chapter 4: Problem 5 – first part only (p.117)
- Blanchard, Chapter 5: Problem 5 (p.140)

## **Session 3 - Introduction to System Design Methodologies**

### **Objectives**

The main objective of session 3 is to continue our discussion of customer requirements, and to explore functional analysis, resulting in:

- An understanding of how customer requirements may be satisfied;
- An appreciation of user requirements versus system requirements;
- Comprehension of the role of functional analysis and allocation in systems development;
- An understanding of system requirements and specifications; and
- Familiarity with functional analysis and system architecture

### **Session Topics**

- Requirement management
- Functional analysis and allocation
- Design criteria and development

### **Reading Assignment**

- Blanchard, Chapters 6, 12, 17, and 19 (Read for Session 4)

### **Homework Assignment**

- Blanchard, Chapter 6: Problem 13 (p. 159)
- Blanchard, Chapter 12: Problem 16 (p.417)
- Blanchard, Chapter 17: Problem 2 (p.649)
- Blanchard, Chapter 19: Problem 17 (p. 714)

## **Session 4 – Methodologies II and System Life Cycle Needs I**

### **Objectives**

The main objective of session 4 is to instruct about the basics of design synthesis and verification and explore the basics of reliability, resulting in:

- An appreciation of the role of component standardization, reuse, and COTS in design practice
- A basic understanding of risk and its management in system development;
- A basic understanding of verification
- An understanding of the importance of life cycle cost and its integration into design strategy
- A basic understanding of reliability and reliability management
- An appreciation of the importance of and approach to designing for reliability

### **Session Topics**

- Risk management
- Design integration and testing
- Verification
- Reliability

### **Reading Assignment**

- Blanchard, Chapters 13, 14, and 16 (Read for Session 5)

### **Homework Assignment**

- Blanchard, Chapter 13: Problem 20 (p. 477)
- Blanchard, Chapter 14: Problem 1 (p. 508)
- Blanchard, Chapter 16: Problem 10 (p. 577)

## **Session 5 –System Life Cycle Needs II**

### **Objectives**

The main objective of session 5 is to instruct about the basics of reliability, maintainability, and supportability for integration into system design, resulting in:

- A basic understanding of designing for maintainability and supportability;
- An appreciation of the interrelationship between reliability and maintainability;
- An appreciation of the need and approach for human factors in system design strategy;
- An understanding of the principles of user-friendly design; and
- An appreciation for environmentally conscious design and manufacturing

### **Session Topics**

- Maintainability
- Usability/ human factors
- Producibility and the environment

### **Reading Assignment**

- None

### **Homework Assignment**

None – Now you are on your own – enjoy!

### **Reading Assignment**

- Blanchard, Chapters 1 and 2; (backfill for today)
- Blanchard, Chapter 3 (for Session 2)

### **Homework Assignment**

- Blanchard, Chapter 2: Problem 18 (p. 52)
- Blanchard, Chapter 3: Problem 1 (p.91)

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