July 2008

ODU – RII Professional Certificate in Systems Engineering Program Detailed Course Outlines

SE 101: Systems Engineering Introduction & Fundamentals

Module 1: What is Systems Engineering?

- **Definitions**
- **Lifecycles and Processes**
- **SE Process and Project Lifecycle**
- **Origins**
- **INCOSE**
- **Benefits**
- **System Life Cycle Stages**

Module 2: Processes & SE Activities

- **Planning/SEP**
- **Requirements**
- **Functional Analysis & System Architecture**
- **Interfaces**
- **Integration/Verification/Validation**

Module 3: SE Process Controls

- **Risk Management**
- **Configuration Management**
- **Technical Performance Measures (TPMs)**
- **Design/Technical Reviews**
- **System of Systems Approach**

Description: This course provides an in-depth introduction to systems engineering: What is it? Why is it needed? Who uses it? The systems engineering process is described from requirements capture/definition and Systems Engineering Plan (SEP) development through compliance verification planning and implementation, risk management, trade studies, configuration management, and system integration. A practical overview of project processes and responsible parties is linked to systems engineering practices and methods with special emphasis on additional project pieces (politics, corporate reputation, resources) and project activities (safety, reliability (RAM), operations, quality, human factors). An introduction to the "system of systems" mentality and current viewpoints surrounding the terminology are included.

SE 102: Requirements Management for System Integration

Module 1: Introduction

- Basics
- Importance/Role of Requirements
- Requirement Structure
- Overall Process

Module 2: Requirements Process Details

- Capture
- Definition/Development
- Analysis
- Allocation
- Management (including electronic methods)
- Traceability
- Reviews and Baselining
- Special Considerations
    - Derived Requirements
    - Design Goals/Scientific Goals
    - Orphans
    - Interface Requirements
- Intro to Compliance Verification/Validation and Planning

Module 3: Project

Application of Knowledge

Description: The Requirements Management for System Integration Course demonstrates how important a solid set of system requirements at the initiation of a project is to the successful integration of that system. Learn how to capture, develop, analyze, and review system requirements. Structure requirement wording to ensure verifiability (compliance) and learn how to translate scientific "wish lists" into actual requirements. Gain insight into informal and formal requirements review processes including the baselining process and understand the importance of clear requirements allocation to each level of a project or system. Understand the difference between requirements and design goals. Learn options for electronic management of requirements and allocation processes. Understand the important connection between baseline requirement changes and project cost increases.

SE 104: Concept and Architecture Development

Module 1: Introduction

- Definitions of Concepts and Architecture
- Concept Formulation
- Preliminary Architecture Development
- System Breakdown Structure (SBS)/System Hierarchy
- Introduction to System Analysis

Module 2: Concept and Architecture Development Process

- Process Details/Iterative Approaches
- Functional Analysis and Allocation
- Evolution of Design/Operations Concepts/Architectural Synthesis
- System Optimization
    - Alternate Design Studies
    - Performance Evaluation
    - Risk Reduction
- Architecture Selection
- Baselining Processes
- System Analysis
    - Design Analysis
    - Operations Analysis
    - Life Cycle Cost Analysis
    - Deployment Analysis
    - Reliability, Availability, Maintainability (RAM) Analyses
    - Safety Analysis
- Technical Performance Measures (TPMs)

Module 3: Project

Application of Knowledge

Description: Concept and Architecture Development is key to the successful implementation of a system. Students will learn how appropriate concepts are generated from existing requirements, preliminary concepts, and other date and preliminary system architectures and how associated hierarchies are generated. Students will understand that through careful system analysis, systems engineers determine the optimum system for their application. TPMs are introduced to ensure measurement of key system parameters throughout the development and optimization cycles.

SE 103: Integration, Verification & Validation

Module 1: Introduction

- Overview of the Compliance Verification Process
- Clarification of Terms (Verification, Validation, Integration)
- Verification Methods and Applicability
- Verification Analysis
- Verification Phases and the System Development Cycle
- Verification Planning/Program Master Verification Plan (PMVP) Development

Module 2: Verification, Validation, Integration Details

- Implementation of the PMVP
- System Functional Validation
- Facility Considerations
- Interface Verification and Validation
- System Build
- Integrated System Verification/System Integration
- Verification Closure/Rollup
- Verification-Related Risks

Module 3: Project

Application of Knowledge

Description: The Integration, Verification and Validation Course starts with an introduction to the verification process and clarification of terminology. Verification methods including Test, Analysis, Demonstration, and Inspection are defined and selection of the appropriate method for each system requirement is explained. Planning is covered in detail including customizing the verification process for your project needs to avoid costly design and schedule impacts late in the project lifecycle. Understand how to integrate the verification process into overall project management and systems engineering activities. Gain detailed knowledge on validation of system functions and learn why testing is not the only option for showing compliance with performance requirements. Learn the importance of focusing on interface verification to ensure successful system integration and study the methods for verification closure and rollup.

SE 301: Systems Engineering Plan (SEP) and Final Project

Module 1: Introduction

- Overview/Refresher of the Systems Engineering Process/Methods
- Introduction of Final Project

Module 2: SEP/Final Project

- Development of SEP
- Application of SE Methods as Assigned -- including but not limited to
    - Implementation of SEP
    - Requirements Definition/Review
    - Concept and Architecture Development
    - Verification Planning and Implementation
    - System Integration

Module 3: Final Presentation

Demonstration of Knowledge/Completion of Certificate Program

Description: Students apply knowledge gained in throughout the program and present results based on in-class assignment.

Elective:

SE 204: Modeling & Simulation

Module 1: Introduction & Basic Concepts

- Concepts & Definitions
- Modeling Methods
- Discrete Event Simulation
- Hands-on Discrete Event Simulation
- Statistics for M&S

Module 2: Architectures & Applications

- Modeling & Simulation Categories
- Distributed Simulation & HLA
- Major DoD Simulation Systems
- Live-Virtual-Constructive Integration
- Combat Modeling

Module 3: Special Topics

- Verification, Validation & Accreditation
- Simulation-C4ISR Interoperability
- Human Computer Interaction
- Special M&S Case Studies
- Simulation Project Management

Description: This course provides participants with an essential overview of the basic terms, concepts, methods, and applications of M&S. The material is structured to emphasize the overarching concept of modeling and how models are designed, implemented, and used in the context of simulation. Special attention is given to military M&S systems and applications because of the extensive applications and demanding requirements for M&S in military use. Upon completion of the course, participants will have the necessary background to be effective and productive in simulation projects and to recognize possible ways to use simulation.