



Title : Model Based System Engineering

Pre-requisite: Nil

Objectives: The objective of this course is to focus on the systems thinking throughout the engineering process — from customer needs and requirements gathering to systems modeling to integrated design and delivery

Outcomes: This course develops the critical capability in digital engineering, MBSE integrates iterative, comprehensive design with insights into the implications of choices, changes, and system behaviors

Course Code: SYSE-819

Credit Hours: 3-0

Course Contents with proposed contact Hours (Weekly plan):

1. **Fundamentals of MBSE:** Definition and key concepts of MBSE, Advantages and benefits of using MBSE. Model-based systems engineering versus document-centric design (3 hours)
2. **Modeling Languages and Notations:** Introduction to modelling languages, SysML (Systems Modeling Language) and UML (Unified Modelling Language), Understanding the basic constructs and symbols used in MBSE, creating diagrams and models to represent system structure, behavior, and requirements. (6 hours)
3. **MBSE Methodologies and Processes:** Overview of MBSE methodologies and their application in system development. Understanding the process of developing and managing models throughout the system lifecycle. Integration of MBSE with other engineering disciplines. (6 hours)
4. **System Modeling and Analysis:** Creating system architecture models using SysML or other modeling languages. Analyzing and validating system models using simulation, verification, and validation techniques. Model-based trade-off analysis and decision-making. (6 hours)
5. **Requirements Engineering in MBSE:** Capturing and managing system requirements using modeling techniques. Tracing requirements from stakeholders to system components. Managing requirements changes and configuration management in MBSE. (6 hours)
6. **Model Integration and Interoperability:** Techniques for integrating models from different domains and disciplines. Model interoperability standards and tools. Managing interfaces and interactions between models. (6 hours)
7. **Tools and Technology for MBSE:** Introduction to MBSE tools and software platforms. Evaluation and selection of MBSE tools based on project requirements. Hands-on exercises and demonstrations using MBSE tools. (6 hours)
8. **Case Studies and Applications:** Real-world case studies demonstrating the application of MBSE in different industries. Examples of successful MBSE implementations and lessons learned. Discussion on challenges and best practices in MBSE adoption. (6 hours)
9. **Future Trends and Emerging Topics:** Overview of current trends and developments in MBSE. Emerging topics such as digital twins, cyber-physical systems, and agile MBSE. (3 hours)

Details of lab work/workshop practice, if applicable:

Access to a computer capable of running a no-install bundle of a SysML authoring tool such as NoMagic MagicDraw™ or Cameo Systems Modeler™ or Capella

Recommended reading, including textbooks, reference books with dates

1. *A Practical Guide to SysML The Systems Modeling Language: A Volume in the MK/OMG Press Book 3rd Edition 2015*
2. *Guide to the Systems Engineering Body of Knowledge (SEBoK), Version 2.7 Oct. 2022*
Editor: Robert J. Cloutier

Nature of Assessments

Assessment will be carried out as per NUST statutes