

## Course Syllabus

- 1) **Course title:** Advanced Modeling and Simulation for Test & Evaluation
- 2) **Course coordinator / point of contact:** Dr. Mikel D. Petty, UAHuntsville, Center for Modeling, Simulation & Analysis, 256-824-4368, pettym@uah.edu
- 3) **Course description:** This course addresses advanced issues in the application of modeling and simulation as a complement to physical testing in support of systems evaluation. This course has a pre-requisite Introduction to Modeling and Simulation for Test and Evaluation. The general relationships among simulation, test, and evaluation are investigated in context of systems acquisition life-cycle management. Forms of use of simulation in support of test planning, test execution, and systems analysis are described, characterized, and illustrated with real-world examples. Issues and opportunities relevant to the integrated use of simulation and testing will be identified; and strategies to optimize the use of scarce resources in executing test and evaluation programs will be provided.
- 4) **Course learning objectives:**
  - a) Identify and apply DoD policies and regulations related to M&S for T&E [ESR T1]
  - b) Identify types of M&S, uses and benefits, and limitations and risks for T&E [ESR T1, ESR T2]
  - c) Identify the uses of M&S during Developmental T&E (DT&E), Operational T&E (OT&E), and Live Fire T&E [ESR T3]
  - d) Identify the uses of M&S for testing in a joint environment [ESR T3]
  - e) Describe the process and importance of M&S Validation, Verification, & Accreditation [ESR T2]
  - f) Describe the M&S program contractual process [ESR T4]
  - g) Match existing M&S T&E facilities used within the DoD to a given program need, as appropriate [ESR T5]
- 5) **Educational Skill Requirements (ESR) and level of mastery:**
  - a) ESR T-1 Application and Mastery
  - b) ESR T-2 Application and Mastery
  - c) ESR T-3 Application and Mastery
  - d) ESR T-4 Application and Mastery
  - e) ESR T-5 Application and Mastery
- 6) **Prerequisites:** Baccalaureate degree and the course Introduction to Modeling and Simulation for Test & Evaluation

- 7) **Course format and delivery:** Resident class lecture for a 16 week semester with 3 hours of lecture per week
- 8) **Recommended texts:**
1. Systems Engineering Principles and Practice, by Alexander Kossiakoff and William N. Sweet, NY: Wiley, 2003
  2. Systems Analysis, Design, and Development, by Charles Wasson, NY: Wiley, 2006
  3. Department of the Army Pamphlet 73–1: Test and Evaluation in Support of Systems Acquisition, Headquarters, Department of the Army, Washington, DC, 30 May 2003.
  4. National Research Council, Modeling and Simulation in Manufacturing and Defense Acquisition: Pathways to Success. 2002. Accessed at <http://www.nap.edu/catalog/10425.html>
  5. Systems Engineering Plan Preparation Guide, Department of Defense, Washington DC, 2008
  6. Defense Acquisition Guidebook, Chapters 4 and 9, Defense Acquisition University
- 9) **Course assessments:** Three exams, course exercises and case studies

10) **Suggested Schedule of Lecture Topics, Exercises & Exams by Class Meeting**

1. Course Introduction
2. Planning Modeling & Simulation for Test & Evaluation
3. Acquisition and Test & Evaluation Overview
4. Simulation and Modeling for Acquisition, Requirements & Training (SMART)
5. Exercise 1 Test Evaluation Strategy (TES) and M&S Planning
6. Executing Modeling & Simulation for Test & Evaluation
7. Integrating M&S with T&E
8. Comparative Testing and M&S
9. Test Ranges, Facilities & Resource Management Center
10. Joint Test & Evaluation
11. Exercise 2 Modeling & Simulation and TEMP Planning
12. Exam 1
13. Course Review
14. Modeling Applications

15. Modeling History
16. Lower Level Modeling Concepts
17. Exercise 3 Case Study: Orbit Simulation
18. Case study summary
19. Physics Based Modeling
20. Exercise 4 Pendulum with drag
21. Exercise 5 Transient Diffusion
22. Digital Storage of Information
23. Pseudo Random Numbers
24. Simulation Implementation
25. Exercise 6 Simulation & the Courant Condition
26. Finite Differencing Methods
27. Exercise 7 Cooling Fin Simulation
28. Finite Elements Analysis
29. Case Study: String Vibrations
30. Case Study: String Vibrations continued
31. Exam 2
32. Advance Verification, Validation & Accreditation
33. Statistical Validation Techniques
34. Design of Experiments
35. Design of Experiments and Test Planning
36. Case Study: Pendulum Clock VV&A
37. Risk Management
38. Technology Maturity
39. Exercise 8 Risk and Monte Carlo Models
40. Advanced Technology & Rapid Acquisitions
41. Analysis of Alternatives.
42. Case Study: Roadway Stimulator
43. Distributed Simulation
44. High Level Architecture
45. Test & Training Enabling Architecture

46. Test & Simulation Infrastructure

47. Case Study: Extend Simulation of Net-Centric Warfare

48. Exam 3