Lawrence Technological University
EME 7203: Manufacturing Systems Simulation
Spring 2012

Course Information:
Course No.: EME 7203
Course Title: Manufacturing Systems Simulation
Lecture: Thursday, 5:45 – 8:25 pm
Classroom: E30
Office hours: Tuesday, and Friday, 3:30 – 5:30pm or by appointment
Blackboard: my.ltu.edu

Text:

Software Site: http://highered.mcgraw-hill.com/sites/0073376280/

Faculty:
Ahad Ali, Ph.D., Assistant Professor and Director of MSIE
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Email: aali@ltu.edu; Web page: http://vfacstaff.ltu.edu/aali/

Catalog Description:
This course introduces Discrete-Event Simulation as a design and analysis tool for manufacturing systems. Students will learn how to conduct a simulation project using manufacturing oriented software such as Arena. Topics in simulation methodology include: building valid models, selecting input probability distribution, statistical analysis of output, design of simulation experiments, and variance reduction techniques in simulation. Competence is demonstrated by each student conducting a simulation project of a manufacturing system.

Educational Objectives:
• Expose the students to Discrete-Event Simulation as a design and analysis tool, problem solving tool, risk analysis tool, and decision-making tool in manufacturing environment.
• Know how to conduct a successful project using manufacturing-oriented software such as Arena.

Objectives:
After completing the course you should be able to:
• Understand the nature of discrete-event simulation and the types of simulation models
• Understand the broad applicability of discrete-event simulation to solve complex manufacturing systems problems
• Learn the essential steps of the simulation methodology
• Learn analytical techniques for interpreting input data and output results pertinent to simulation models
• Learn to use the Arena Simulation Software Tool to build credible valid simulation models, design and run simulation experiments, and critically evaluate decision-support simulation results
• Gain insight into system behavior by measuring the performance characteristics of proposed new manufacturing system or the impact of proposed changes for existing manufacturing system
Grading Policy:
Homework/Quiz/ Paper Review – 30%, Midterm – 30%, Simulation Project – 40%

A: 91–100; A-: 87–90; B+: 83–86, B: 80–82; B-: 74–79, C+: 67–73, C: 60–66; F < 60

Test:
All tests will be open books and open notes. There will be no make-up tests except in case of
exceptional circumstances. The course instructor must be notified as soon as possible and normally
prior to the exam.

Homework and Class Assignments:
Homework is due at the beginning of class. **Late Homework will not be graded and will receive NO CREDIT.** Extensions to turn in homework due to exceptional circumstances will
require appropriate documentation or prior permission. There will be no makeup class assignments.

Research Paper Review:
Students will have to review research papers and present in the class for the specific topics
assigned in the class. Technical paper review guidelines will be provided.

Course Outlines:

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<tr>
<th>Week</th>
<th>Topics</th>
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<tr>
<td>1</td>
<td>Syllabus, Introduction of Manufacturing Systems Simulation</td>
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<tr>
<td>2</td>
<td>Discrete-Event Modeling and Simulation of Detailed Manufacturing Operations</td>
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<td>3</td>
<td>Input Data Analysis for Modeling and Simulation</td>
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<td>4</td>
<td>Product Mix Modeling</td>
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<td>6</td>
<td>Transporter, and Conveyor Modeling</td>
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<td>7</td>
<td>Statistical Analysis of Simulation Output</td>
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<td><strong>Simulation Project Proposal Presentation</strong></td>
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<td>8</td>
<td>Design of Simulation Experiments and ANOVA</td>
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<td>Verification and Validation</td>
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<td>9</td>
<td>Mid-semester break</td>
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<td>10</td>
<td>Simulation Research Paper Review and Presentation</td>
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<td>11</td>
<td>Response Surface Methodology</td>
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<td>12</td>
<td>Meta Modeling</td>
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<td>13</td>
<td>Simulation Optimization</td>
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<td>14</td>
<td>Agent based Simulation</td>
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<td>15</td>
<td>Distributed Manufacturing Enterprise Simulation</td>
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**Course Project:**
A project is required from all students and should be related on real life applications where the course
materials could be used for the project. However, the project should be beyond class material. The main
purpose of the project is to use simulation for real-life applications. The project will be based on **Systems
Modeling and Simulation** for actual or planned in the applications of manufacturing systems. These
projects have to be more in-depth than regular class project. It must have experimental design, ANOVA
analysis and response surface methodology.

There will be an oral presentation of the project and the written documentation of the study in a
clearly, concisely written report form. This report should follow “normal business practice” e.g. it should
have: abstract, introduction, literature review, problem description, input data analysis, modeling and simulation, design of experiments, results and discussions, conclusions, references and appendix (in any). The report must follow the winter simulation conference paper guidelines without page limit.

**Academic Honor Code:**

Academic integrity and honesty are basic core values of Lawrence Technological University. Lawrence Technological University is committed to creating an academic community that values both individual and collaborative efforts that promote learning and discovery. Such a community expects honesty and integrity in the work of all its members.

**Cheating will not be tolerated!** LTU’s Academic Honor Code is in effect. Students caught is cheating will receive an F in the course without the chance of recompensation for GPA purposes. A note to this effect will be placed in the student’s file. A second offence will result in expulsion from the university. For details about Academic Honor Code see: [http://www.ltu.edu/currentstudents/honor_code.asp](http://www.ltu.edu/currentstudents/honor_code.asp)

**Recommended Texts:**


**Recommended Articles:**


*Link for full paper access of WSC Papers: http://informs-sim.org/*
Modeling and Simulation Magazines:
- IIE Solution, Institute of Industrial Engineers (IIE).
- Simulation, Society of Computer Simulation (SCS)

Journals:
- ACM Transactions on Modeling and Computer Simulation
- American Journal of Mathematical Management Sciences
- Annals of Operational Research
- European Journal of Operational Research
- IEEE transactions Parallel and Distributed Systems
- Interface
- International Journal of Engineering Systems Modelling and Simulation (IJESMS)
- International Journal of Experimental Design and Process Optimisation
- International Journal of Human Factors Modelling and Simulation
- International Journal of Industrial and Systems Engineering
- International Journal of Modeling, Simulation, and Scientific Computing
- International Journal of Modelling and Simulation
- International Journal of Modelling in Operations Management
- International Journal of Process Systems Engineering
- International Journal of Simulation Modelling
- International Journal on Computer Simulation
- Journal of Defense Modeling & Simulation
- Journal of Simulation
- Management Science
- Modelling and Simulation in Engineering
- Multiscale Modeling and Simulation: A SIAM Interdisciplinary Journal
- Simulation Modelling Practice and Theory. International Journal of the Federation of European Simulation Societies – EUROSIM
- SIMULATION, Transactions of The Society for Modeling and Simulation International
- World Journal of Modelling and Simulation

Conferences:
- ACM SIGMETRICS Conference
- ASME International Computers in Engineering Conference
- European Modelling & Simulation Symposium
- European Simulation Multi-Conference (ESM)
- IASTED International Conference on. Modelling and Simulation
- IIE Annual Conference
- INFORMS Annual Conference
- Michigan Simulation User Group (MSUG) Annual Conference
- Summer Computer Simulation Conference (SCS)
• Winter Simulation Conference (WSC): http://wintersim.org/

Modeling and Simulation Internet Resources:
• AutoMod, Applied Materials, http://www.automod.com/
• SIMUL8, SIMUL8 Corporation, http://www.simul8.com/
• The Association for Computing Machinery has a special interest group in computer simulation, SIGSIM, which maintains a web site at ACM-SIGSIM http://www.sigsim.org/
• The Institute of Industrial Engineers maintains a site at http://www.iienet.org/
• The Michigan Simulation User Group (MSUG) maintains a site at http://www.m-sug.org/
• The Society for Computer Simulation maintains a site at http://www.SCS.org/
• WITNESS Software maintains a site at http://www.Lanner.com/
Sample Report Format for Simulation Project
EME 7203: Manufacturing Systems Simulation

Abstract

1. Introduction
   1.1. Motivation
   1.2. Problem description
   1.3. Objectives of study
   1.4. Scope of the study

2. Literature Review and Critical Analysis [Required]
   2.1. Year-wise / category-wise review (should have minimum 10-15 research papers in the review)
   2.2. Summary of the literate review
   2.3. etc.

3. Input Data Analysis [Required]
   3.1. Source of data
   3.2. Method of collection
   3.3. Assumptions
   3.4. Data Analysis

4. Simulation Model Building [Required]
   4.1. Introduction of the Modeling and Simulation Design System
   4.2. Model Design and Description
   4.3. Design of Experiments / Scenario Analysis / Model Optimization

5. Simulation Results and Discussions [Required]
   5.1. Analysis on Simulation Results
      5.1.1. Comparison of Utilization for Various Resources
      5.1.2. Queuing Analysis
      5.1.3. Bottleneck Identification
      5.1.4. WIP Analysis
      5.1.5. Throughput Analysis
      5.1.6. Line Balancing
   5.2. Model Validation and Verification [Required]
   5.3. Scenario Analysis and Comparisons
   5.4. Design of Experiments and Analysis / ANOVA [Required]
   5.5. Response Surface Methodology
   5.6. Meta Modeling
   5.7. Simulation based Optimization

6. Conclusion and Recommendations

7. References

8. Appendices
   8.1. Process Variables
   8.2. Input Data
   8.3. Arena Simulation Results
   8.4. Statistical Analysis

**Point Distributions**

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<th>Section</th>
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<td>Abstract &amp; Introduction</td>
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<tr>
<td>Literature Review</td>
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<td>Input Analysis</td>
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<td>Model Development</td>
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<td>Results and Discussions</td>
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<td>DOE/RSM/Optimization</td>
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<td>Conclusions</td>
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<td>Presentation (30 min)</td>
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<tr>
<td>Formatting (WSC 2012)</td>
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**Must Follow WSC 2012 Format**

Twelve (12) to Fifteen (15) page requirement