IE420 Simulation of Industrial Systems
Course Syllabus S3_1444 H

<table>
<tr><td>Course title and code</td><td>IE 420 Simulation of Industrial Systems 3(2,1,2)</td></tr>
<tr><td>Catalog Data</td><td>This course introduces students to the concept of simulation, including modeling, simulation languages, and appropriate inputs to a simulation model, and analysis of the output from a simulation model.</td></tr>
<tr><td>Prerequisite</td><td>IE 322</td></tr>
<tr><td>Co-requisites</td><td>N/A</td></tr>
<tr><td>Level</td><td>8</td></tr>
<tr><td>Textbook</td><td>Simulation with Arena, Kelton, W. D., Sadowski, R. P., and Swets, N.B., 4th edition McGraw Hill, 2010.
Simulation Modeling and Analysis, Law, A.M., 4th Ed. McGraw Hill International Editions, 2006.</td></tr>
<tr><td>Reference</td><td>Discrete-Event System Simulation, Jerry Banks; John S. Carson II; Barry L. Nelson; David M. Nicol, 4th edition, 2010.</td></tr>
<tr><td>Course purpose</td><td>To provide the students with the ability to analyze problems by use of a simulation model. The course introduces students to the concept of simulation, including modeling, simulation languages, and appropriate inputs to a simulation model and will cover the generation of random numbers and random variables to simulate stochastic behavior, when to stop a simulation and what confidence to place in the resulting estimators, building and animating an ARENA model, analyzing the results, and comparing alternatives.</td></tr>
<tr><td>Topics to be covered:</td><td>
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<tr><th>List of Topics</th><th>No of Weeks</th><th>Contact hours</th></tr>
<tr><td>1- Introduction: Simulation languages and software, Nature of simulation, Various types of simulation, Simulation and model building, Statistical techniques in simulation.</td><td>1</td><td>3</td></tr>
<tr><td>2- Fundamental simulation concepts: A “manual” example.</td><td>1</td><td>3</td></tr>
<tr><td>3-Guided Tour Through Arena: Introduction to Arena Basic concepts: Entities, stations, resources, transporters, animation, performance measures.</td><td>1</td><td>3</td></tr>
<tr><td>4- MODELING BASIC OPERATIONS AND INPUTS: Resource schedules and failures Animating resources and queues, Dynamic plots, Setting the run conditions,
Run length and stopping rules, Tracing and debugging a model.</td><td>1</td><td>3</td></tr>
<tr><td>5- Review of basic Probability and statistics:</td><td>1</td><td>3</td></tr>
<tr><td>6- Input data modeling: Various probability distributions
Goodness of fit tests, Choosing a distribution in the absence of data.</td><td>2</td><td>6</td></tr>
<tr><td>7- Random numbers, Random variates.</td><td>1</td><td>3</td></tr>
<tr><td>8- Modeling detailed operations: Multiple-way decisions, Sets, variables and non-stationary arrival process</td><td>2</td><td>6</td></tr>
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	9- Statistical analysis of output from terminating simulations: Time frame of simulations, Confidence intervals for terminating systems, Comparing two alternatives, The Output Analyzer Evaluating many alternatives with the Process Analyzer (PAN), Searching for an optimal alternative with OptQuest.	1	3
	10- Variance Reduction Techniques.	1	3
	11- Design of experiments: Factorial designs, Factor screening strategies.	1	3
	12- Conducting Simulation Studies: Model verification and validation Principles of valid simulation modeling.	1	3

Total contact hours per semester

	Lecture	Tutorial	Laboratory	Practical	Other: Design Studio	Total
Contact Hours	**30**	**15**	**30**			**75**

Additional private study/learning hours expected for students per week.

2 hours per week for project

Course Learning Outcomes (CLO)

Outcome Code	Outcome Name	SO
CLO1	Allow students to gain the necessary engineering science and skills in terms of identifying several manufacturing and service problems.	1
CLO2	Formulate simulation models for the manufacturing and service systems using the ARENA software package.	1
CLO3	Enable the students to conduct experiments to analyze the manufacturing systems' functions and to develop functions improvement.	6
CLO4	Enable students to function effectively on a team through a project to meet objectives of formulating real world problems and developing useful solutions.	5

ABET Student Learning Outcomes (SLOs) for the course

SO1 An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

SO5 An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

	SO6 An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
Schedule of Assessment Tasks for Students During the Semester	<table><tr><th>Assessment</th><th>Assessment task (e.g. essay, test, group project, examination etc.)</th><th>Week due</th><th>Proportion of Final Assessment</th></tr><tr><td>1</td><td>Midterm</td><td>Week 7</td><td>25%</td></tr><tr><td>2</td><td>Quiz</td><td>Week 9</td><td>5%</td></tr><tr><td>3</td><td>Lab work</td><td>After each lab activity</td><td>10%</td></tr><tr><td>4</td><td>Project</td><td>Week 10</td><td>20%</td></tr><tr><td>5</td><td>Final Exam</td><td>As scheduled by the registrar</td><td>40%</td></tr></table>
Laboratory and Practical/Field work/Internship	Simulation laboratory for simulation modeling and practice.
Project work	The intent of this project is to have students work as an engineering team to develop a working solution to a real-world case study problem. The actual simulation and proposed solution should be the original work of the student team. All teams have the same assignment.
Computer Usage	Smart Board, Audio Video and MS Excel software, Minitab, Arena, Visual Basic
Estimated Category Content	Engineering Science: 2 credit hours or 66.7% Engineering Design: 1 credit hour or 33.3%
Prepared by	*Dr. Haitham Mahmoud*
Preparation Date	March 2023