ISE 562: Simulation Modeling

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17. Grad Final Review (george_hodge@ncsu.edu; lian_lynch@ncsu.edu; mlnosbis@ncsu.edu)
18. PeopleSoft (none)

Approval Path
   Yahya Fathi (fathi): Approved for 14IE GR Director of Curriculum
   Negash Medhin (ngmedhin): Approved for 14OR Grad Head
3. Fri, 13 Nov 2015 00:34:21 GMT
   Xiangwu Zhang (xiangwu_zhang): Approved for 18TEC GR Director of Curriculum
4. Wed, 10 Feb 2016 14:14:37 GMT
   Xiangwu Zhang (xiangwu_zhang): Approved for 18TEC Grad Head
5. Thu, 11 Feb 2016 20:19:11 GMT
   Robyn Fillinger (rfillin): Approved for COE CC Coordinator GR
6. Thu, 18 Feb 2016 18:24:12 GMT
   Mihail Devetsikiotis (mdevets): Approved for COE CC Chair GR
7. Thu, 18 Feb 2016 18:59:15 GMT
   Robyn Fillinger (rfillin): Approved for COE Final Review GR
8. Thu, 18 Feb 2016 20:29:25 GMT
   Douglas Reeves (reeves): Approved for COE Dean GR
   Renzo Shamey (rshamey): Approved for TEX CC Coordinator GR
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    Renzo Shamey (rshamey): Approved for TEX CC Chair GR
    Teresa Langley (teresa_langley): Approved for TEX Final Review GR
13. Fri, 26 Aug 2016 18:09:02 GMT
    Nancy Cassill (nicassil): Approved for TEX Dean GR
    George Hodge (george_hodge): Approved for ABGS Coordinator
New Course Proposal

Date Submitted: Wed, 11 Nov 2015 18:17:30 GMT

Viewing: ISE 562/OR 562/TE 562 : Simulation Modeling

Changes proposed by: roberts

Change Type
Major

Course Prefix
ISE (Industrial and Systems Engineering)

Course Number
562

Dual-Level Course
No

Cross-listed Course
Yes

Cross-listed with Subject Code(s)

Course Prefix:
TE
OR

Title
Simulation Modeling

Abbreviated Title
Simulation Modeling

College
College of Engineering

Academic Org Code
Fitts Department Industrial & Systems Engineering (14IE)

CIP Discipline Specialty Number
14.3501

CIP Discipline Specialty Title
Industrial Engineering.

Term Offering
Spring Only

Year Offering
Offered Every Year

Effective Date
Spring 2017

Previously taught as Special Topics?
Yes

Number of Offerings within the past 5 years
5

<table>
<thead>
<tr>
<th>Course Prefix/Number</th>
<th>Semester/Term Offered</th>
<th>Enrollment</th>
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</thead>
<tbody>
<tr>
<td>ISE589/TE589/OR591</td>
<td>Spring 2011</td>
<td>31</td>
</tr>
<tr>
<td>ISE589/TE589/OR591</td>
<td>Spring 2012</td>
<td>29</td>
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<tr>
<td>ISE589/TE589/OR591</td>
<td>Spring 2013</td>
<td>22</td>
</tr>
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<td>ISE589/TE589/OR591</td>
<td>Spring 2014</td>
<td>19</td>
</tr>
<tr>
<td>ISE589/TE589/OR591</td>
<td>Spring 2015 - DE Only</td>
<td>14</td>
</tr>
<tr>
<td>ISE589/TE589/OR591</td>
<td>Spring 2016</td>
<td>30</td>
</tr>
</tbody>
</table>

Course Delivery

Face-to-Face (On Campus)
Distance Education (DELTA)
Online (Internet)

Grading Method
Graded/Audit

Credit Hours
3

Course Length
16 weeks

Contact Hours (Per Week)

Component Type | Contact Hours
---------------|----------------|
Lecture         | 3

Course Is Repeatable for Credit
No

Instructor Name
Stephen Roberts

Instructor Title
Professor

Grad Faculty Status
Full

Anticipated On-Campus Enrollment

Open when course_delivery = campus OR course_delivery = blended OR course_delivery = flip
Enrollment Component

<table>
<thead>
<tr>
<th>Per Semester</th>
<th>Per Section</th>
<th>Multiple Sections?</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>30</td>
<td>30</td>
<td>No</td>
</tr>
</tbody>
</table>

DELTA/Online Enrollment:
Open when course_delivery = distance OR course_delivery = online OR course_delivery = remote

<table>
<thead>
<tr>
<th>Delivery Format</th>
<th>Per Semester</th>
<th>Per Section</th>
<th>Multiple Sections?</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEC</td>
<td>10</td>
<td>10</td>
<td>No</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Course Prerequisites, Corequisites, and Restrictive Statement

Probability and statistics, computer programming

Is the course required or an elective for a Curriculum?
No

Catalog Description

This course concentrates on design, construction, and use of discrete/continuous simulation object-based models employing the SIMIO software, with application to manufacturing, service, and healthcare. The focus is on methods for modeling and analyzing complex problems using simulation objects. Analysis includes data-based modeling, process design, input modeling, output analysis, and the use of 3D animation with other graphical displays. Object-oriented modeling is used to extend models and enhance re-usability.

Justification for new course:

Simulation modeling is not covered as a single course topic, but is incorporated in others which typically include analytic treatments of input, processes, and output. This course aims to fill that need by providing a language-based course for multi-method simulation modeling. The course incorporates traditional symbolic-based simulation modeling within the context of object-oriented structures using methods to employ existing objects and/or to create new objects in discrete and continuous environment. Emphasis is on the creation and development of the simulation model.

Does this course have a fee?
No

Consultation

<table>
<thead>
<tr>
<th>College(s)</th>
<th>Contact Name</th>
<th>Statement Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>College of Sciences</td>
<td>Howard Bondell</td>
<td>I looked at the proposal, and it is not an issue for Statistics. The course is very specific in designing simulations of systems and processes in ISE. They will use basic probability and statistics to analyze these simulated processes, but it is not a course that would overlap our subject matter.</td>
</tr>
</tbody>
</table>

Instructional Resources Statement

Currently Stephen D. Roberts (ISE) and Jeffrey A. Joines (TE) have been co-teaching this class the past 5 years (once per year) as part of their regular teaching and therefore no new resources are required.

Course Objectives/Goals

- Methods for modeling and analyzing problems with simulation.
- Animation of simulation processes
- Modeling with simulation objects
- Creating re-usable models and model components
- Limited continuous/discrete simulation modeling
• Graphical display and output representation
  • Simulation alternative subset selection and ranking and selection
  • Simulation Optimization
  • Case Studies

Student Learning Outcomes
By the end of the semester, the students will be able to:
  • Distinguish and contrast different simulation modeling techniques
  • Design and develop simulation models to solve complex problems
  • Analyze systems (e.g., manufacturing, supply chain, and service) using simulation models
  • Evaluate and choose best alternatives using subset selection, ranking and selection, and optimization
  • Design new simulation objects using object-oriented techniques of composition and inheritance

Student Evaluation Methods

<table>
<thead>
<tr>
<th>Evaluation Method</th>
<th>Weighting/Points for Each</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>15</td>
<td>Roughly due fortnightly (5-6 assignments)</td>
</tr>
<tr>
<td>Multiple exams</td>
<td>45</td>
<td>Three Semester Exams (15%, 15%, 15%)</td>
</tr>
<tr>
<td>Final Exam</td>
<td>20</td>
<td>Comprehensive Exam</td>
</tr>
<tr>
<td>Project</td>
<td>15</td>
<td>Simulation Project of a system is performed via a team of students</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
<td>Inclass lab assignments/pop quizzes are used to keep students engaged and on track.</td>
</tr>
</tbody>
</table>

Topical Outline/Course Schedule

<table>
<thead>
<tr>
<th>Topic</th>
<th>Time Devoted to Each Topic</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>1 period</td>
<td>introduction to simulation and SIMIO</td>
</tr>
<tr>
<td>Elemental Simulation Modeling</td>
<td>2 periods</td>
<td>Simulation Objects, paths, arrivals, variables, properties, branching, work schedules</td>
</tr>
<tr>
<td>Data-Based Modeling</td>
<td>2 periods</td>
<td>Data tables, setting capacities, sequences, processing times, relational tables, statistics assembly, packaging, add-on processes, re-usable processes, tokens, tokenized processes</td>
</tr>
<tr>
<td>Process Simulation</td>
<td>2 periods</td>
<td>Server configuration, resources requirements, failures, parallel servers, condensed waiting, parallel service, appointments, replication length</td>
</tr>
<tr>
<td>Flow and Capacity</td>
<td>2 periods</td>
<td>Sequence-dependent setups, materials management, just-in-time supply, inventory control, supply chains</td>
</tr>
<tr>
<td>Workstations, Inventory, Supply Chains</td>
<td>3 periods</td>
<td>Simulation optimization and Output Analysis</td>
</tr>
<tr>
<td>Simulation Optimization and Output Analysis</td>
<td>2 periods</td>
<td>solution ranking and selection, optimization, terminating systems analysis, steady-state systems and analysis</td>
</tr>
<tr>
<td>Materials Handling and Input Analysis</td>
<td>2 periods</td>
<td>fixed path and free range vehicles, conveyors, input models and input sensitivity analysis</td>
</tr>
</tbody>
</table>
Resource Management and Mobile resources 4 periods
Resource needs, resource decision making, allocation of resources, workers, multiple workers, zero-time events, resource reservations, tasks, task sequences

Service Center Optimization 1 period
balking, reneging, cost optimizations

Object composition 2 periods
anatomy of objects, sub-classing to create new objects

New Object creation 2 periods
inheritance hierarchy, inheritance, new object development, assignments, add-on processes, resources, queuing

Continuous Simulations 1 periods
Continuous Variables, Reneging, Interrupting, flow library

Simulation Application/Project Work 2 periods
More extensive simulation projects requiring new objects and applications

Syllabus
SyllabusSpring2016.pdf

Additional Documentation

Additional Comments
minosbis 8/29/2016: Fully approved by College of Engineering and College of Textiles. No further consultation is required. Possible consultation with Sciences (Jo-Ann Cohen)?

ghodge 8/29/2016 No other consultation needed. Ready for ABGS reviewers.

8/31/2016: Consultation from Sciences noted above.

ABGS Reviewer Comments:
-No concerns

Course Reviewer Comments

xzhang13 (Fri, 13 Nov 2015 00:33:24 GMT): The course has been co-taught successfully by Jeffrey A. Joines (TE) and Stephen D. Roberts (ISE) after the past 5 years. No new resources are required.

Key: 8338