Course Change Request

Date Submitted: 03/08/18 1:56 pm

Viewing: ISEN 440: Systems Thinking

Last edit: 03/08/18 3:21 pm

Changes proposed by: savannah.darbonne

Catalog Pages referencing this course
Department of Industrial and Systems Engineering
ISEN - Indust & Systems Engr (ISEN)

Programs referencing this course
CERT-CU12: Data Center Operations Engineering - Certificate

Faculty Senate Number

Contact(s)

<table>
<thead>
<tr>
<th>Name</th>
<th>E-mail</th>
<th>Phone</th>
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<tbody>
<tr>
<td>Savannah Darbonne</td>
<td><a href="mailto:savannah.darbonne@tamu.edu">savannah.darbonne@tamu.edu</a></td>
<td>979-862-9115</td>
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Rationale for Course

The proposed changes are part of a routine curriculum review.

Course prefix ISEN  Course number 440

Department Industrial & Systems Eng
College/School College of Engineering
Academic Level Undergraduate
Undergraduate course level justification (Select One)

Academic Level Graduate

(Alternate)

Effective term 2018-2019

Complete Course Title Systems Thinking
Abbreviated Course Title SYSTEMS THINKING

Catalog course description
Systems thinking process, systems of systems and the fundamental considerations associated with the engineering of large-scale systems, or systems engineering including systems modeling, design and the system development process.

Prerequisites and Restrictions
MATH 304 or approval of instructor; junior or senior classification.

Concurrent Enrollment No

Should catalog prerequisites / concurrent enrollment be enforced? Yes

Enforced Prerequisites / Concurrent Enrollment

In Workflow
1. ISEN Department Head
2. Curricular Services Review
3. EN Committee Preparer UG
4. EN Committee Chair UG
5. EN College Dean UG
6. UCC Preparer
7. UCC Chair
8. Faculty Senate Preparer
9. Faculty Senate
10. Provost II
11. President
12. Curricular Services
13. Banner

Approval Path
1. 03/08/18 2:50 pm Natarajan Gautam (gautam): Approved for ISEN Department Head
2. 03/08/18 3:21 pm Sandra Williams (sandra-williams): Approved for Curricular Services Review
3. 03/08/18 3:53 pm Eileen Hoy (ehoy): Approved for EN Committee Preparer UG
4. 03/08/18 5:04 pm Prasad Enjeti (enjeti): Approved for EN Committee Chair UG
5. 03/08/18 5:04 pm Prasad Enjeti (enjeti): Approved for EN College Dean UG
6. 03/08/18 6:12 pm Sandra Williams (sandra-williams): Approved for UCC Preparer
7. 03/09/18 3:33 pm Sandra Williams (sandra-williams): Approved for UCC Chair
<table>
<thead>
<tr>
<th>And/Or</th>
<th>(</th>
<th>Course Prefix/Number</th>
<th>Min Grade/Score</th>
<th>Academic Level</th>
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<th>Concurrency?</th>
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<tr>
<td></td>
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<td>MATH 304</td>
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Crosslistings: No  Crosslisted With
Stacked: No  Stacked with

Semester: 3  Credit Hour(s): 3
Contact Hour(s) (per week):
Lecture: 3  Lab: 0  Other: 0  Total: 3

Repeatable for credit?: No
Three-peat?: No
CIP/Fund Code: 1515010006
Default Grade Mode: Letter Grade(G)
Alternate Grade Modes: Satisfactory/Unsatisfactory
Method of instruction: Lecture
Will sections of this course be taught as non-traditional? (i.e., parts of term, distance education): Yes

Learning Outcomes

Meets traditional face-to-face learning outcomes.

Describe how learning outcomes are met or provide justification why they are not met.

Learning outcomes will be met by through lectures and in-class and homework assignments (Section I syllabus topics). They will also be met with the use of system developer software, and in-class and homework assignments (Section II & III syllabus topics).

Hours

Meets traditional face-to-face hours.

Describe how hours are met or provide justification why they are not met.

The hours are met by attending in-class lectures and take-home lecture videos.

Will this course be taught as a distance education course?: No

Is 100% of this course going to be taught in Texas?: Yes

Will classroom space be needed for this course?: Yes

This will be a required course or an elective course for the following programs:

Required (select program)

Elective (select program)

Has/Will this course be (en) submitted for core curriculum consideration?: No
Course Syllabus

Syllabus: Upload syllabus

Upload syllabus
SYLLABUS_ISEN440 (Systems Thinking- Existing Course).pdf
ISEN 440-SystemsThinking-Syllabus.pdf

Letters of support or other documentation
No

Additional information

Reviewer Comments
Sandra Williams (sandra-williams) (03/09/18 3:33 pm): UCC approved March 9 via e-vote.

Reported to state?
No
Course title and number: Systems Thinking, ISEN 440
Term: TBD
Meeting times and location: TBD
Hours: 3 credits

Course Description and Prerequisites

Introduction to the systems thinking process, systems of systems, and the fundamental considerations associated with the engineering of large-scale systems, or systems engineering. These include systems modeling and design, the system development process (needs analysis, concept exploration, concept definition, engineering design, integration and evaluation) and systems engineering management.

Prerequisites
MATH 304 or approval of instructor.

Semester Team Project
Students will form semester teams comprising 3-5 students and each team will work on an interesting real-life problem of their choice, and apply the systems engineering approach to model, analyze and design a system model to address the problem. Each team will learn to use IBM Systems Developer software (or equivalent software) to develop the systems engineering documents for the project, write a project report, and give a presentation of their results at the end of the semester.

Learning Outcomes or Course Objectives
Students should be able to 1) understand the anatomy of engineered systems and their complex interactions; 2) formulate, analyze, and interpret issues associated with engineered systems; use systems thinking techniques and software tools necessary for systems engineering practice; and 3) model and analyze engineered systems using systems engineering tools.

Instructor Information

Name: Lewis Ntaimo, Ph.D.
Telephone number: 979-458-2360
Email address: ntaimo@tamu.edu
Office hours: TBD, open-door policy
Office location: ETB 4008

Textbook and/or Resource Material

Recommended Text:
References:

Grading Policies

The grade for the course will be based on homework and in-class quizzes, exams, semester project, and on the level and quality of your participation during class. No late assignments will be accepted. There will be three exams based on the material covered in class, homework and reading assignments. The three exams will constitute 60% of the grade while the other 40% will come from the homework and in-class assignments (20%) and team project (20%). Grades will be assigned as follows:

A (90-100%), B (80-89.9%), C (70-79.9%), D (60 – 69.9%), F (< 60%).

Course Topics, Calendar of Activities, Major Assignment Dates

Tentative important dates:

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<tbody>
<tr>
<td>Week 1</td>
<td>Topic</td>
<td>Reading</td>
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<tr>
<td>Module 1: Course Overview</td>
<td>Kossiakoff, Ch. 1, 2; Buede, Ch. 1</td>
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<tr>
<td>Module 1: Introduction to Systems Engineering</td>
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<td>Module 2: Structure of Complex Systems</td>
<td>Kossiakoff, Ch. 3</td>
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<tr>
<td>Module 3: Systems Thinking Concepts and Tools</td>
<td>Hitchins, Ch. 1,8,9, Gharajedaghi, Ch. 2</td>
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<td>Module 4: Set Theory</td>
<td>Lecture slides, Buede, Ch. 4</td>
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<td>Module 5: Systems Modeling</td>
<td>Buede, Ch. 4; Wymore, Ch. 2, Zeigler, et al., ch. 1, 2,4</td>
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<tr>
<td>Module 6: Theory of Systems Design</td>
<td>Buede, Ch. 6; Wymore, Ch. 1</td>
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<tr>
<td>Module 7: Systems engineering tools, UML Rational systems developer software, SysML, IDEF</td>
<td>Lecture slides</td>
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<td>Module 8: The system development process</td>
<td>Lecture slides, Kossiakoff, Ch. 4-10</td>
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<tr>
<td>Final review, students finalize their project reports</td>
<td>Lecture slides</td>
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Other Pertinent Course Information

Detailed Course Structure

Module 1 – Introduction
SE definitions, origins, complex systems, SE viewpoint, profession, power
Refs: Kossiakoff, Ch. 1-2

Module 2 – Structure of Complex System
Systems development process
SE technical knowledge
Hierarchy of complex systems
System building blocks,
System environment, interfaces & interactions
Refs: Kossiakoff, Ch. 3-4

Module 3 – Systems Thinking
Basic models and constructs
Systems thinking principles
Classification
CLMs
N² Charts
Refs: Hitchins, Ch. 1, 9; Gharajedaghi, Ch. 2

Module 4 – Set Theory
Sets
Partitions and power sets
Cartesian products of sets
Relations
Functions
Refs: Course notes; Buede, Ch. 4

Module 5 – Systems Modeling
Dynamical systems concept
Discrete time system models
Theoretical properties of systems models
System coupling
Refs: Course notes; Wymore, Ch. 1

Module 6 – Systems Design Theory
Theory of system design: FSD,
BSD, ISD, system testing
Writing system requirements
Refs: Course notes; Buede, Ch. 6; Wymore, Ch. 1

Module 7 – SE Tools
Overview of SE tools
Unified Modeling Language (UML)
IBM Rational Systems Developer Software
Refs: Course notes

Module 8 – SE Process
System engineering management plan
The system development process
Advanced development
Real life case study: Project 28
Refs: Kossiakoff, Ch. 5-10
Americans with Disabilities Act (ADA)

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, in Cain Hall, Room B118, or call 845-1637. For additional information visit http://disability.tamu.edu

Academic Integrity

For additional information please visit: http://aggiehonor.tamu.edu

“An Aggie does not lie, cheat, or steal, or tolerate those who do.”
Course title and number: Systems Thinking, ISEN 440
Term: Summer 2018
Meeting times and location: TBA TBA
Hours: 3 credits

**Course Description and Prerequisites**

Introduction to the systems thinking process, systems of systems, and the fundamental considerations associated with the engineering of large-scale systems, or systems engineering. These include systems modeling and design, the system development process (needs analysis, concept exploration, concept definition, engineering design, integration and evaluation) and systems engineering management.

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Name: Lewis Ntaimo, Ph.D.
Telephone number: TBA
Email address: ntaimo@tamu.edu
Office hours: TBA, open-door policy
Office location: TBA

**Textbook and/or Resource Material**

Recommended Text:
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Course Topics, Calendar of Activities, Major Assignment Dates

Tentative important dates:

**Exam 1**: July, TBA  
**Exam 2**: August, TBA  
**Exam 3**: August, TBA

**Team Project Report**: August, TBA

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<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Required Reading</th>
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<tbody>
<tr>
<td>Week 1</td>
<td>Introduction to Systems Engineering</td>
<td>Kossiakoff, Ch. 1</td>
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<tr>
<td>Week 1</td>
<td>Functional and Information Modeling</td>
<td>Kossiakoff, Ch. 2</td>
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<tr>
<td>Week 2</td>
<td>Systems Thinking Concepts</td>
<td>Hitchins, Ch. 1, Gharajedaghi, Ch. 2</td>
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<td>Week 2</td>
<td>Systems Thinking Tools</td>
<td>Hitchins, Ch. 8, 9</td>
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<tr>
<td>Week 3</td>
<td>Set Theoretic Concepts</td>
<td>Buede, Ch. 4</td>
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<tr>
<td>Week 3</td>
<td>Systems Modeling</td>
<td>Course notes, Wymore, Ch. 2</td>
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<td>Course notes, Wymore, Ch. 2</td>
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<tr>
<td>Week 4</td>
<td>Theory of Systems Design</td>
<td>Course notes, Wymore, Ch. 1</td>
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<td>Week 4</td>
<td>The System Development Process</td>
<td>Course notes, Wymore, Ch. 1</td>
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<td>Week 5</td>
<td>Formulation of Issues and Constraints</td>
<td>Kossiakoff, Ch. 3, 5, 6</td>
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<td>Week 5</td>
<td>Systems Engineering Tools, IDEF, UML, Rational Systems Developer</td>
<td>Kossiakoff, Ch. 7,8</td>
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Detailed Topical Outline

Section I – Basic Concepts (Weeks 1-2)

1. Introduction to Systems Engineering (Kossiakoff, Ch. 1)
   1.1 What is Systems Engineering?
   1.2 Identifying and classifying a system
   1.3 Systems Engineering tools (modeling, simulation, trade-off analysis)
   1.4 The system development process
2. Functional and Information Modeling (Kossiakoff, Ch. 2)
   2.1 Structure of complex systems
   2.2 Model of a complex system
   2.3 System building blocks
   2.4 The system environment
   2.5 Interfaces and interactions
3. Systems Thinking
   Part I: Concepts (Hitchins, Ch. 1, Gharajedaghi, Ch. 2)
   3.1 System models
   3.2 System constructs
   3.3 System principles

   Part II: Systems Thinking Tools (Hitchins, Ch. 8,9)
   3.4 Causal loop/influence modeling
   3.5 N² charts
   3.6 Case studies (Reading)

Section II – Systems Modeling, simulation and Design (Weeks 3-4)

4. Set Theoretic Concepts (Buede, Ch. 4)
   6.1 Sets
   6.2 Partitions and power sets
   6.3 Cartesian product of sets
   6.4 Relations
   6.5 Functions
5. Systems Modeling (Wymore, Ch. 1, 2)
   4.1 Discrete (open) systems
   4.2 State transition diagrams
   4.3 System experiments (simulations)
   4.4 Input, output and state trajectories
   4.5 System performance
   4.6 Theoretical properties of system models
6. Theory of Systems Design (Wymore, Ch. 1, 2)
   5.1 Input/output requirements
   5.2 Technology requirements
   5.3 Performance requirements
   5.4 Cost requirements cost
   5.5 Trade-off requirements
   5.6 System test requirements
### Section III – Systems Engineering Processes (Weeks 4-5)

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<th>7. Systems Engineering Tools</th>
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<td>7.1 Introduction to object oriented analysis</td>
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<tr>
<td>7.2 Unified Modeling Language (UML)</td>
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<tr>
<td>7.3 IBM Rational Software Modeler</td>
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<thead>
<tr>
<th>8. The System Development Process (Kossiakoff, Ch. 3, 4)</th>
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<tr>
<td>8.1 System life cycle models (DoD, ISO/IEC, NSPE)</td>
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<tr>
<td>8.2 Concept development phases</td>
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<tr>
<td>8.3 Engineering development phases</td>
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<td>8.4 Systems engineering documents</td>
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<tr>
<th>9. Formulation of Issues and Constraints (Kossiakoff, Ch. 5, 6, 7, 8)</th>
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<tr>
<td>9.1 Needs analysis</td>
</tr>
<tr>
<td>9.2 Concept exploration</td>
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<tr>
<td>9.3 Concept definition</td>
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<tr>
<td>9.4 Advanced development</td>
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