LSC Use Only No:	LSC Action-Date:	UWUCC USE Only No.	UWUCC Action-Date:	Senate Action Date:
		08-42e.	App-4/14/09	App-4/28/09

Curriculum Proposal Cover Sheet - University-Wide Undergraduate Curriculum Committee

Contact Person Dr. Chris Janicak	Email Address cjanicak@iup.edu
Proposing Department/Unit Safety Sciences	Phone 7-3274

Check all appropriate lines and complete information as requested. Use a separate cover sheet for each course proposal and for each program proposal.

1. Course Proposals (check all that apply)

_____New Course _____Course Prefix Change _____Course Deletion
XXX Course Revision _____Course Number and/or Title Change XXX Catalog Description Change

***Current* Course prefix, number and full title**	***Proposed* course prefix, number and full title, if changing**
SAFE 345 Systems Safety Analysis	

2. Additional Course Designations: check if appropriate

_____ This course is also proposed as a Liberal Studies Course.
_____ This course is also proposed as an Honors College Course.
_____ Other: (e.g., Women's Studies, Pan-African)

3. Program Proposals

_____Catalog Description Change _____Program Revision
_____New Degree Program _____Program Title Change _____Other
_____New Minor Program _____New Track

***Current* program name**	***Proposed* program name, if changing**

4. Approvals		**Date**
Department Curriculum Committee Chair(s)	Jan Wachter Jan Wachter	3/20/2009
Department Chair(s)	La Lapuso	3/20/09
College Curriculum Committee Chair	Andrew Miller	3-31-09
College Dean	Barbara A. Zoni	4-6-09
Director of Liberal Studies *		
Director of Honors College *		
Provost *		
Additional signatures as appropriate: (include title)		
UWUCC Co-Chairs	Gail S Sechrist	4/14/09

Received
APR 10 2009
Liberal Studies

Course Revision: SAFE 345 Systems Safety Analysis

Part II. Description of the Curriculum Change

1. A new Syllabus of Record appears in Appendix A.

2. A summary of the proposed revisions:

   - ***Class hours composition description*** – Revise the class hours composition description; see below:

   New Description:

   3 class hours
   0 lab hours
   3 credit hours
   (3c-0l-3cr)

   Old Description:

   2 class hours
   3 lab hours
   3 credit hours
   (2c-3l-3cr)

   - ***Course description*** – Revise the course description; see below:

   New Description:

   Focuses on the evaluation of system designs using detailed system analysis techniques. Topics include system definition, economics of systems safety, systems safety methodology, mathematics of systems analysis including statistical methods, Boolean algebra, and reliability. Skills gained include the ability to perform system hazard analyses and operating and support hazard analyses. Techniques include failure mode and effect analysis, fault tree analysis and technique for human error rate prediction. Practical analysis work is accomplished **through in-class discussion and demonstration sessions and homework assignments.**

   Old Description:

   Focuses on the evaluation of system designs using detailed system analysis techniques. Topics include system definition, economics of systems safety, systems safety methodology, mathematics of systems analysis including statistical methods, Boolean algebra, and reliability. Skills gained include the ability to perform system hazard analyses and operating and support hazard analyses. Techniques include failure mode and effect analysis, fault tree analysis and technique for human error rate prediction. Practical analysis work is accomplished in laboratory sessions.

- ***Course content*** – Incorporate laboratory exercises as additional lecture topics and lectures hours into the course content (see Appendix A).

- ***Laboratory exercises*** – Remove the laboratory exercises from this course.

- ***Course evaluation***

  New Course Evaluation Method:

~40% Exams	There will be three (3) exams consisting of combinations of multiple choice, true/false and matching questions.
~60% Assignments	Periodic in-class assignments and out-of-class assignments will be given. These will consist of problems, systems analyses, etc. to be solved by the student.

  Old Course Evaluation Method:

62% Exams	There will be three (3) written exams consisting of combinations of multiple choice, true/false and matching questions. (3 exams @ 100 points each = 300 points).
4% Homework	Periodic out-of-class assignments will be given. These will consist of problems to be solved by the student. (5 homework assignments @ 4 points each = 20 points)
34% Lab Reports	Each student will a prepare lab report on each analysis performed. (14 labs @ 12 points each = 168 points).

3. Justification/rationale for the revision:

It was determined that the topics covered in the laboratory sessions could be covered as effectively in a lecture setting, where instructor-led discussions of the topics would be conducted supported by group student discussions and homework assignments. In fact, lectures may be the more effective route of communicating much of the safety systems information currently covered in the laboratory setting, since the instructor could now use the advanced audiovisual and Internet setups contained in the lecture rooms to present information (such as risk assessment charts, fault tree analyses, failure modes and effects analyses, and demonstration of software programs), rather than presenting the information

verbally, through handouts, or using the blackboard as it is currently being conducted (since safety sciences laboratories are not currently equipped with advanced audiovisual capabilities).

The Chairman of the Department of Safety Sciences and the Chair of the Department of Safety Sciences Undergraduate Curriculum Committee also performed an analysis of other university programs that offer undergraduate systems safety analysis courses. It appears that no other university or college teaching systems safety analysis uses a laboratory approach.

It is anticipated that the information currently being covered in the laboratory sessions will now be covered by an additional 1 hour instructor-led group exercise or demonstration lecture each week (e.g., during a Friday lecture).

Lastly, by consolidating the multiple three-hour laboratory sessions into an additional one-hour lecture, time and cost savings could be realized for the Department of Safety Sciences.

4. The old syllabus of record appears in Appendix B.
5. Liberal Studies course approval form and checklist (if appropriate).

These changes do not affect the Liberal Studies requirements.

Part III. Letters of Support or Acknowledgement

These course changes will not affect other departments; therefore letters of support from other departments were not obtained.

APPENDIX A: NEW SYLLABUS OF RECORD

I. Catalog Description

SAFE 345 Systems Safety Analysis	3 class hours 0 lab hours
Prerequisites: SAFE 211 and MATH 217	3 credit hours (3c-0l-3cr)

Focuses on the evaluation of system designs using detailed system analysis techniques. Topics include system definition, economics of systems safety, systems safety methodology, mathematics of systems analysis including statistical methods, Boolean algebra, and reliability. Skills gained include the ability to perform system hazard analyses and operating and support hazard analyses. Techniques include failure mode and effect analysis, fault tree analysis and technique for human error rate prediction. Practical analysis work is accomplished through in-class discussion and demonstration sessions and homework assignments.

II. Course Outcomes

Students will be able to:

A. Explain the general concept of a system, system design processes and the system life cycle.

B. Construct organizational policies for preparing system safety program plans and for conducting system safety analyses.

C. Develop a system safety program plan that can be used to evaluate a system using a variety of system safety techniques.

D. Demonstrate they can perform various system safety analyses methods.

E. Utilize appropriate system safety techniques on any technological system to complete a risk assessment.

F. Diagram Event Trees and Cause Consequence Charts and explain how these can be used to provide useful information about system risk.

G. Recognize the role of the Software Systems and be able to identify analysis techniques that can be applied to these unique systems.

H. Demonstrate an understanding of reliability concepts and be able to solve mathematical reliability problems relevant to system safety.

I. Demonstrate an understanding of how to use system safety applications to control an organization's exposure to accidents and losses due to product liability.

III. Course Outline

A. Overview of Systems Concepts (2.5 hours)
   1. Definitions
   2. Systems
   3. Subsystems
   4. Components
   5. System Safety Lifecycle

B. Military Standard-882D System Safety Program Requirements (2.5 hours)
   1. Background
   2. Task Descriptions
   3. Evaluation Criteria

C. Systems Safety Program Planning (3.5 hours)
   1. Program Organization
   2. System Safety Program Plans
   3. Management Planning
   4. Milestone Charts
   5. System Safety Workgroups

D. Overview of Analysis Techniques (5.5 hours)
   1. Quantitative Techniques
   2. Qualitative Techniques
   3. Preliminary Hazard Lists
   4. Preliminary Hazard Analysis
   5. Event Diagrams
   6. System and Subsystem Hazard Analysis
   7. Operator and Support Hazard Analysis
   8. Health Hazard Analysis

Examination #1 (1 hour)

E. Statistical Techniques (2.5 hours)
   1. Component Reliability
   2. System Reliability
   3. Probability of Failure
   4. Systems in Series
   5. Systems in Parallel

F. Risk (2.5 hours)
   1. Definition of Risk
   2. Quantifying Risk
   3. Developing Risk Assessment Codes
   4. Risk Assessment Charts

G. Boolean Algebra (2 hours)
   1. Boolean Postulates
   2. Developing Boolean Equations

H. Fault Tree Analysis (FTA) (5.5 hours)
   1. Fault Trees Versus Reliability Trees
   2. Establishing Fault Trees
   3. Forming Boolean Equations from Fault Trees
   4. Analyzing Systems using FTA

Examination #2 (1 hour)

I. Failure Modes and Effects Analysis (FMEA) (3 hours)
   1. Assumptions of FMEA
   2. Analyzing Systems Using FMEA

J. Hazard Analysis Techniques (4.5 hours)
   1. HAZOP
   2. Cause-Consequence
   3. Flow Analysis
   4. What if
   5. Energy Trace Barrier Analysis

K. Operator and Support Hazard Analyses (4 hours)
   1. Procedure (Task) Analysis
   2. Human Reliability Analysis
   3. Technique for Human Error Rate Prediction
   4. Critical Incident Technique
   5. Link Analysis
   6. Management Oversight Risk Tree
   7. Technique for Operational Review

L. Product Liability (2 hours)
   1. Developing a Product Liability Loss Control Program
   2. Using Systems Safety to Reduce Product Liability

Final Exam – during final exam week

IV. Evaluation Methods

The faculty person assigned to teach this course could be one of several faculty members within the Department of Safety Sciences. Following is an example of the evaluation methods and weighting used by one of those faculty members.

~40% Exams	There will be three (3) exams consisting of combinations of multiple choice, true/false and matching questions.

~60% Assignments	Periodic in-class assignments and out-of-class assignments will be given. These will consist of problems, systems analyses, etc. to be solved by the student.

V. Example Grading Scale

The grading scale will be based on the following:

A = 90-100%
B = 80-89%
C = 70-79%
D = 60-69%
F < 60%

A grading curve that results in an appropriate distribution of grades may be used as needed.

VI. Course Attendance Policy

Although there is no formal attendance policy for this class, student learning is enhanced by regular attendance and participation in class discussions and the university expects all students to attend class.

VII. Required Textbooks

Stephans, Richard A. (2004). System Safety for the 21st Century. New York: John A. Wiley and Sons, Inc. ISBN 0-471-44454-5

VIII. Special Resource Requirements

None

IX. Bibliography

Davies, John Booth, et al. (2003). Safety Management: A Qualitative System Approach. London, England: Taylor and Francis Publishing Company.

Yang, Guangbin (2007). Life Cycle Reliability Engineering. Hoboken, NJ: John Wiley & Sons, Inc.

Historic Titles

Apostalakis, G.E., et al. (1988). Accident Sequence Modeling. London: Elsevier Applied Sciences.

Barlow, R.E., et al. (1975). Reliability and Fault Tree Analysis. Philadelphia, PA: Society for Industrial and Applied Mathematics.

Browning, R.L. (1980). The Loss Rate Concept in Safety Engineering. New York, NY: Marcel-Deskker Inc.

Copi, Irving M. (1986). Introduction to Logic, 7th Edition. New York, NY: MacMillan Publishing.

Department of Defense. (1993). Military Standard 882D: System Safety Requirements. Washington, D.C.: United States Department of Defense.

Engineering Design Handbook – Fault Tree Analysis. (1971). Washington, DC: US Army Material Command.

Green, A.E. (1984). Safety Systems Reliability: Chichester, UK: John Wiley and Sons.

Hammer, Willie. (1972). Handbook for System and Product Safety. Englewood Cliffs, CA: Prentice Hall.

Henley, G. and Kumamoto. (1980). Reliability Engineering and Risk Assessment. Englewood Cliffs, CA: Prentice Hall.

Iredon, W. Grant, ed.. (1966). Reliability Handbook. New York, NY: McGraw Hill Book Co..

Layton, Donald M. (1989). System Safety Including DOD Standards. Chesterland: Weber Systems Inc.

Levenson, Nancy G. (1995). Safeware. New York, NY: Addition-Wesley Publishing Co.

Malasky, Sol W. (1984). System Safety Planning/Engineering/Management, 2nd Edition. Princeton, NJ: Hayden Book Co.

O'Conner, Patrick D.T. (1985). Practical Reliability Engineering, 2nd Edition. Chichester, UK: John Wiley and Sons.

Roland, Harold E. (1990). System Safety Engineering and Management. New York, NY: Wiley Interscience.

Stephenson, Joe. (1991). System Safety 2000. New York, NY: Van Nostrand Reinhold.

Swain, A.D. (1975). The Human Element in System Safety – A Guide for Modern Management. London: In Com Tec.

System Safety Society. (1997). System Safety Analysis Handbook. Albuquerque, NM: System Safety Society.

Thompson, J.R. (1987). Engineering Safety Assessment: An Introduction. Essex, UK: Longman Scientific and Technical Publishers.

Vesely, W.E., et al. (1981). Fault Tree Handbook. NUREG-0492. Washington, DC: Nuclear Regulatory Commission.

Vincoli, Jeffrey W. (1993). Basic Guide to System Safety. New York, NY: Van Nostrand Reinhold.

APPENDIX B: OLD SYLLABUS OF RECORD

I. Catalog Description

SAFE 345 Systems Safety Analysis	2 class hours 3 lab hours
Prerequisites: SAFE 211 and MATH 217	3 credit hours (2c-3l-3cr)

Focuses on the evaluation of system designs using detailed system analysis techniques. Topics include system definition, economics of systems safety, systems safety methodology, mathematics of systems analysis including statistical methods, Boolean algebra, and reliability. Skills gained include the ability to perform system hazard analyses and operating and support hazard analyses. Techniques include failure mode and effect analysis, fault tree analysis and technique for human error rate prediction. Practical analysis work is accomplished in laboratory sessions.

II. Course Objectives

Students completing this course will:

A. Explain the general concept of a system, system design processes and the system life cycle.
B. Construct organizational policies for preparing system safety program plans and for conducting system safety analyses.
C. Develop a system safety program plan that can be used to evaluate a system using a variety of system safety techniques.
D. Demonstrate they can perform various system safety analyses methods.
E. Utilize appropriate system safety techniques to assess the risks associated with any technological system.
F. Diagram Event Trees and Cause Consequence Charts and explain how these can be used to provide useful information about system risk.
G. Recognize the role of the Software Systems and be able to identify analysis techniques that can be applied to these unique systems.
H. Demonstrate an understanding of reliability concepts and will be able to solve mathematical reliability problems relevant to system safety.
I. Demonstrate an understanding of how to use system safety applications to control an organization's exposure to accidents and losses due to product liability.

III. Course Outline

A. Overview of Systems Concepts (2 hours)
   1. Systems
   2. Subsystems
   3. Components
   4. System Safety Lifecycle

B. Military Standard-882D System Safety Program Requirements (2 hours)
   1. Background
   2. Task Descriptions
   3. Evaluation Criteria

C. Systems Safety Program Planning (2 hours)
   1. Management Planning
   2. Milestone Charts
   3. System Safety Workgroups

D. Overview of Analysis Techniques (2 hours)
   1. Preliminary Hazard Lists
   2. Preliminary Hazard Analyses
   3. System and Subsystem Hazard Analyses
   4. Operator and Support Hazard Analyses
   5. Health Hazard Analyses

Examination #1 (1 hour)

E. Statistical Techniques (2 hours)
   1. Component Reliability
   2. System Reliability
   3. Probability of Failure
   4. Systems in Series
   5. Systems in Parallel

F. Risk (2 hours)
   1. Definition of Risk
   2. Quantifying Risk
   3. Developing Risk Assessment Codes

G. Boolean Algebra (2 hours)
   1. Boolean Postulates
   2. Developing Boolean Equations

H. Fault Tree Analysis (FTA) (3 hours)
   1. Fault Trees Versus Reliability Trees
   2. Establishing Fault Trees
   3. Forming Boolean Equations from Fault Trees
   4. Analyzing Systems using FTA

Examination #2 (1 hour)

I. Failure Modes and Effects Analysis (FMEA) (2 hours)
   1. Assumptions of FMEA
   2. Analyzing Systems Using FMEA

J. Hazard Analysis Techniques (3 hours)
   1. HAZOP
   2. Cause-Consequence
   3. Flow Analysis
   4. What if
   5. Energy Trace Barrier Analysis

K. Operator and Support Hazard Analyses (2 hours)
   1. Procedure (Task) Analysis
   2. Technique for Human Error Rate Prediction
   3. Critical Incident Technique
   4. Link Analysis
   5. Management Oversight Risk Tree
   6. Technique for Operational Review

L. Product Liability (2 hours)
   1. Developing a Product Liability Loss Control Program
   2. Using Systems Safety to Reduce Product Liability

M. Culminating Activity (Examination #3) (2 hours)

Laboratory Exercises (14 three-hour laboratories)

The following laboratory exercises are an integral part of the course, giving the students an opportunity to observe and become familiar with many of the ergonomic concepts first-hand, at appropriate times during the course.

Laboratory Session	Title of Exercise	Lecture Units Covered
A	Analyze System and Define for Analysis	A & B
B	Develop System Safety Program Organization/ Determine Tasks	A - C
C	Develop SSPP	A - C
D	Quantitative Analysis Techniques	D - F
E	Risk Assessment Charts, Event Diagrams, PHL's	D
F	Conduct PHA's and SSHA's	D - F
G	Boolean Algebra/FTA	G & H

Laboratory Session	Title of Exercise	Lecture Units Covered
H	FTA Activity	G & H
I	Conduct FMEA's	I
J	Conduct THERP's	J & K
K	Conduct Procedure Analyses	J & K
M	O & SHA's	K
L	Conduct Mini-MORT and TOR Analyses	K
N	Final Lab Activity - System Analysis	A - K

IV. Evaluation Methods

The faculty person assigned to teach this course could be one of several faculty members within the Department of Safety Sciences. Following is an example of the evaluation methods and weighting used by one of those faculty members.

62% Exams	There will be three (3) written exams consisting of combinations of multiple choice, true/false and matching questions. (3 exams @ 100 points each = 300 points).
4% Homework	Periodic out-of-class assignments will be given. These will consist of problems to be solved by the student. (5 homework assignments @ 4 points each = 20 points)
34% Lab Reports	Each student will prepare a lab report on each analysis performed. (14 labs @ 12 points each = 168 points).

V. Example Grading Scale

The grading scale will be based on the following:

A = 90-100%
B = 80-89%
C = 70-79%
D = 60-69%
F < 60%

A grading curve that results in an appropriate distribution of grades may be used as needed.

VI. Course Attendance Policy

Although there is no formal attendance policy for this class, student learning is enhanced by regular attendance and participation in class discussions and the university expects all students to attend class.

VII. Required Textbooks

Stephenson, Joe (1991). System Safety 2000: A Practical Guide for Planning, Managing, and Conducting System Safety Programs. New York: Van Nostrand Reinhold.

VIII. Special Resource Requirements

None

IX. Bibliography

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