LSC Use Only No:	LSC Action-Date:	UWUCC USE Only No.	UWUCC Action-Date:	Senate Action Date:
		02-39d	App 2/4/03	App 2/25/03

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)	Lon H. Ferguson	10/19/02
Department Chair(s)	Lon H. Ferguson	10/19/02
College Curriculum Committee Chair		11-22-02
College Dean	Kathleen S. Zoni	25 Nov 02
Director of Liberal Studies *		
Director of Honors College *		
Provost *		
Additional signatures as appropriate: (include title)		
UWUCC Co-Chairs	Gail S. Sechrist	2/4/03

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DEC 2 2002
LITERAL STUDIES

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JAN 30 2003
LITERAL 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:

   - Course description – Revise the course description, see below:

     New Description:

     Focuses on the evaluation of system designs using detailed system analysis techniques. Topics covered 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.

     Old Description:

     Focuses on the evaluation of system designs using detailed system analysis techniques. Topics covered 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 preliminary hazard analysis, failure mode and effect analysis, fault tree analysis, and exercises in the application of fault tree analysis to hardware and man/machine systems. Practical analysis work is accomplished in laboratory sessions.

   - Course objectives – Update course objectives to include systems safety programming

   - Course content - Remove the Ergonomics content from this course. The Ergonomics material is now covered in the required Ergonomics course.

   - Laboratory exercises - Expand laboratory activities to include the application of a variety of analysis techniques

3. Justification/rationale for the revision:

At one time students were required to take either SAFE 345 Systems Safety Analysis or SAFE 347 Ergonomics. Department Faculty felt it was important for students to have an introduction to both of these topics so content in Ergonomics was added to Systems and vice versa. In 1998, Department Faculty realized the current coverage of systems was not adequate so we changed our program and the student are now required to take systems. Therefore, the overlap that existed between these courses was no longer necessary and we needed to change the syllabus to remove this overlap in content.

The other changes in laboratories and course objectives were the result of recommendations and discussions from our Advisory Committee and from a department wide curriculum meeting in the Spring of 2002.

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

Prerequisites: SAFE 211 and MATH 217

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

Focuses on the evaluation of system designs using detailed system analysis techniques. Topics covered 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 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
G	Boolean Algebra/FTA	G & H
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

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

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

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.

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.

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

Syllabus of Record

I. Catalog Description

SA 345 Systems Safety Analysis
Prerequisites: SA 211, MA 217

3 credits
2 lecture hours
3 lab hours
(2c-31-3cr)

Focuses on the evaluation of system designs using detailed system analysis techniques. Topics covered 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 preliminary hazard analysis, failure mode and effect analysis, fault tree analysis, and exercises in the application of fault tree analysis to hardware and man/machine systems. Practical analysis work is accomplished in laboratory sessions.

II. Course Objectives

A. Students will be able to explain the general concept of a system, system design processes and the system life cycle. They will be able to construct organizational policies for preparing system safety program plans and for conducting system safety analyses.

B. Students will be able to describe the various theories of accident causation, including newer models such as the Universal Model. They will demonstrate an understanding of concepts such as accident causes, most likely and worst credible effects, and the relationship of these with risk.

C. Students will be able to construct a definition of any specific system so that a system safety analysis of that system could be performed.

D. Students will demonstrate that they can perform the various analyses methods below and be able to cite the limitations and areas of application of each analyses:

1. Preliminary Hazard Analysis
2. Failure Mode and Effects Analysis
3. Hazard and Operability Studies
4. Fault Tree Analysis

E. Students will be able to utilize each of the techniques above to assess the risks associated with any technological system.

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

G. Students will be able to explain the methodologies associated with the following hazard analysis techniques:

1. Job Safety Analysis
2. Sneak Circuit Analysis
3. Energy Trace and Barrier Analysis
4. What If Analysis

H. Students will be able to recognize the role of the Software Systems and be able to identify analysis techniques that can be applied to these unique systems.

I. Students will demonstrate an understanding of reliability concepts and will be able to solve mathematical reliability problems relevant to system safety.

III. Course Outline

A. Introduction (2 hours)
1. System Concepts
2. Examples of Systems
3. Relationship of System Design/Development and Study

B. Accident Causation Models (2 hours)
1. Clarification of Terminology
2. Historical Models
3. Contemporary Models

C. Fundamentals of System Safety Analysis (2 hours)
1. Defining Systems for Analysis
2. Types of Analyses
3. Characteristics of Analyses
4. Resources Needed to Perform Analyses
5. Information Produced by Analyses

D. Preliminary Type of Analyses (2 hours)
   1. Areas of Application
   2. Capabilities and Limitations
   3. Organizing Analysis Results

E. Reliability and Failure Mode Type of Analyses (3 hours)
   1. Reliability Concepts and Problems
   2. Functional Block Diagrams
   3. Capabilities and Limitations of the FMEA
   4. Organizing Analysis Results

F. Software Safety Analysis (2 hours)
   1. Software Systems
   2. Analysis Techniques
   3. Organizing Analysis Results

G. Human Control Functions in a Human-Machine System (2 hours)
   1. Human Functioning in System Operation
   2. Human Limitations
   3. Human Error Identification
   4. Human Error Rates

H. Hazard Analyses Techniques (2 hours)
   1. Distinguishing Characteristics
   2. Specific Techniques
   3. Areas of Application

I. Problem Solving Techniques (2 hours)
   1. Event Trees
   2. Cause-Consequence Charts

J. Introduction to Fault Tree Analysis (4 hours)
   1. Characteristics of Analysis
   2. Deductive Logic
   3. Symbology
   4. Fault tree Construction
   5. Qualitative Interpretation

K. Quantitative Computations for Fault tree Analysis (3 hours)
   1. Fundamental Propositions of Boolean Algebra
   2. Rationalizing the Tree
   3. Computing Probabilities

L. Concepts of Risk, Risk Assessment and Risk Management (2 hours)
   1. Review of Risk Concepts
   2. Risk Assessment
   3. Risk Management

Laboratory Exercises (Fourteen 3-hour Sessions)

Laboratory Session	Title of Exercise	Lecture Units Covered
A	Defining a System for Analysis	C
B	Introduction to Preliminary Hazard Analysis	D
C	Conclusion of Preliminary Hazard Analysis	D
D	Introduction to Failure Mode and Effects Analysis	E
E	Performing the Failure Mode and Effects Analysis	E
F	Conclusion of the Failure Mode and Effects Analysis	E
G	Introduction to Process Hazard Analysis	H
H	Conclusion to Process Hazard Analysis	H
I	Introduction to Fault Tree Analysis	J
J	Fault Tree Construction	J
K	Qualitative Interpretation of the Fault Tree	J
L	Quantitative Interpretation of the Fault Tree	K
M	Quantitative Techniques in Fault Tree Utilization	K
N	Use of Fault Trees in Risk Assessment	L

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.

60% Exams	There will be three (3) written exams consisting of combinations of multiple choice, true/false and matching questions.
15% Quizzes	Periodic quizzes (3 or 4) will be given. Quizzes are announced and consist of several essay questions.
15% Homework	Periodic out-of-class assignments will be given. These usually consist of problems to be solved by the student.
10% Lab Reports	Each student will prepare lab reports on each analysis performed.

The grading scale will be based on the following:

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

or a grading curve that results in a normal distribution of grades.

V. Required Textbooks

Readings in System Safety Analysis. IUP, 6th edition, 1990.

VI. Special Resource Requirements

None

VII. Bibliography

a. Current Titles

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

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

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

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

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

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

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

b. Historic Titles (Some of the most important work was done in this area in the 1970's and early 1980's.)

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

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

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

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

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

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

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

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

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

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

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

Appendix C: Catalog Description

SAFE 345 Systems Safety Analysis (2c-3l- 3cr)

Prerequisites: SAFE 211and MATH 217

Focuses on the evaluation of system designs using detailed system analysis techniques. Topics covered 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.