UNIVERSITY OF KENTUCKY

New Course Report

10/5/2015 7:25:35 AM

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OFFICE OF THE SENATE COUNCIL

Revised

1. General Information

1a. Submitted by the College of: ENGINEERING

Date Submitted: 9/17/2015

1b. Department/Division: Mechanical Engineering

1c. Contact Person

Name: Dr. Tingwen Wu

Email: timwu@uky.edu

Phone: 218-0644

Responsible Faculty ID (if different from Contact)

Name:

Email:

Phone:

1d. Requested Effective Date: Semester following approval

1e. Should this course be a UK Core Course? No

2. Designation and Description of Proposed Course

2a. Will this course also be offered through Distance Learning?: Yes [4]

2b. Prefix and Number: ME 516

2c. Full Title: SYSTEMS ENGINEERING

2d. Transcript Title:

2e. Cross-listing:

2f. Meeting Patterns

LECTURE: 3

2g. Grading System: Letter (A, B, C, etc.)

2h. Number of credit hours: 3

2i. Is this course repeatable for additional credit? No

If Yes: Maximum number of credit hours:

If Yes: Will this course allow multiple registrations during the same semester?

2j. Course Description for Bulletin: Systems Engineering is a discipline necessary for cost-effective development of complex multi-disciplinary systems. Optimal design of modern systems for defense, transportation, telecommunications and energy, among other industries, requires a different perspective than the design of subsystems operating within them. This course presents principles and the practice of Systems Engineering, along with its origins in the aerospace and software industries, historical perspective and case studies of current interest. Topics include system life-cycle, requirements definition, modeling, personality, trade studies, design optimization (with minimal information), risk management, proposal writing and others. Guest lecturers and case studies provide a realistic setting for understanding the application of course materials. Prerequisite: Engineering Standing or consent of instructor.

2k. Prerequisites, if any: Engineering Standing

2l. Supplementary Teaching Component:

3. Will this course taught off campus? No

If YES, enter the off campus address:

4. Frequency of Course Offering: Spring,

Will the course be offered every year?: Yes

If No, explain:

5. Are facilities and personnel necessary for the proposed new course available?: Yes

If No, explain:

6. What enrollment (per section per semester) may reasonably be expected?: 20

7. Anticipated Student Demand

Will this course serve students primarily within the degree program?: Yes

Will it be of interest to a significant number of students outside the degree pgm?: Yes

If Yes, explain: Is relevant to students in other College of Engineering majors.

8. Check the category most applicable to this course: Traditional – Offered in Corresponding Departments at Universities Elsewhere,

If No, explain:

9. Course Relationship to Program(s).

a. Is this course part of a proposed new program?: No

If YES, name the proposed new program:

b. Will this course be a new requirement for ANY program?: No

If YES, list affected programs:

10. Information to be Placed on Syllabus.

a. Is the course 400G or 500?: Yes

b. The syllabus, including course description, student learning outcomes, and grading policies (and 400G-/500-level grading differentiation if applicable, from **10.a** above) are attached: Yes

Distance Learning Form

Instructor Name: TBD

Instructor Email: TBD

Internet/Web-based: No

Interactive Video: Yes

Hybrid: No

1.How does this course provide for timely and appropriate interaction between students and faculty and among students? Does the course syllabus conform to University Senate Syllabus Guidelines, specifically the Distance Learning Considerations? Use of Blackboard, email, and web-conferencing provides interaction.

2.How do you ensure that the experience for a DL student is comparable to that of a classroom-based student's experience? Aspects to explore: textbooks, course goals, assessment of student learning outcomes, etc. Student learning outcomes are assessed for all sections of the course, along with the usual TCE evaluations.

3.How is the integrity of student work ensured? Please speak to aspects such as password-protected course portals, proctors for exams at interactive video sites; academic offense policy; etc. Standard university policy will be followed in all academic aspects, all quizzes and exams will be proctored.

4.Will offering this course via DL result in at least 25% or at least 50% (based on total credit hours required for completion) of a degree program being offered via any form of DL, as defined above? No

If yes, which percentage, and which program(s)? No

5.How are students taking the course via DL assured of equivalent access to student services, similar to that of a student taking the class in a traditional classroom setting? Since course will be offered at/to a site located on a UK campus remote site, students will have equivalent access to service.

6.How do course requirements ensure that students make appropriate use of learning resources? Students will be required to access resources through online or similar venues.

7.Please explain specifically how access is provided to laboratories, facilities, and equipment appropriate to the course or program. Any required laboratories will be located at the remote site. If specialized equipment is needed then the students will comE to central campus or access through online instrumentation approaches.

8.How are students informed of procedures for resolving technical complaints? Does the syllabus list the entities available to offer technical help with the delivery and/or receipt of the course, such as the Information Technology Customer Service Center (http://www.uky.edu/UKIT/)? Syllabus provides the access information.

9.Will the course be delivered via services available through the Distance Learning Program (DLP) and the Academic Technology Group (ATL)? YES

If no, explain how student enrolled in DL courses are able to use the technology employed, as well as how students will be provided with assistance in using said technology. No answer necessary.

10.Does the syllabus contain all the required components? YES

11.I, the instructor of record, have read and understood all of the university-level statements regarding DL.

Instructor Name: Dr. Suzanne Weaver Smith

SIGNATURE|STEPHEN|L S Stephens|ME 516 NEW Dept Review|20140207

SIGNATURE|CHE202|Kimberly W Anderson|ME 516 NEW College Review|20140213

SIGNATURE|STEPHEN|L S Stephens|ME 516 ZCOURSE_NEW Approval Returned to Dept|20140218

SIGNATURE|BJSTOK0|Barbara J Brandenburg|ME 516 NEW College Review|20140304

SIGNATURE|STEPHEN|L S Stephens|ME 516 ZCOURSE_NEW Approval Returned to Dept|20140313

SIGNATURE|BJSTOK0|Barbara J Brandenburg|ME 516 NEW College Review|20140910

SIGNATURE|JMETT2|Joanie Ett-Mims|ME 516 NEW Undergrad Council Review|20150415

SIGNATURE|ZNNIKO0|Roshan Nikou|ME 516 NEW Graduate Council Review|20150508

SIGNATURE|JEL224|Janie S Ellis|ME 516 NEW Senate Council Review|20150630

SIGNATURE|TIMWU|Tingwen Wu|ME 516 NEW Approval Returned to Dept|20150702

SIGNATURE|JEL224|Janie S Ellis|ME 516 NEW Senate Council Review|20150917

SIGNATURE|BJSTOK0|Barbara J Brandenburg|ME 516 NEW Approval Returned to Dept|20151002

SIGNATURE|STEPHEN|L S Stephens|ME 516 NEW Dept Review|20140307

j. * Course Description for Bulletin:

Systems Engineering is a discipline necessary for cost-effective development of complex multi-disciplinary systems. Optimal design of modern systems for defense, transportation, telecommunications and energy, among other industries, requires a different perspective than the design of subsystems operating within them. This course presents principles and the practice of Systems Engineering, along with its origins in the aerospace and software industries, historical perspective and case studies of current interest. Topics include system life-cycle, requirements definition, modeling, personality, trade studies, design optimization (with minimal information), risk management, proposal writing and others. Guest lecturers and case studies provide a realistic setting for understanding the application of course materials. Prerequisite: Engineering Standing or consent of instructor.

k. Prerequisites, if any:

Engineering Standing

l. Supplementary teaching component, if any: ○ Community-Based Experience ○ Service Learning ○ Both

3. * Will this course be taught off campus? ○ Yes ◉ No

If YES, enter the off campus address:

4. Frequency of Course Offering.

a. * Course will be offered (check all that apply): ☑ Fall ☑ Spring ☐ Summer ☐ Winter

b. * Will the course be offered every year? ◉ Yes ○ No

If No, explain:

5. * Are facilities and personnel necessary for the proposed new course available? ◉ Yes ○ No

If No, explain:

6. * What enrollment (per section per semester) may reasonably be expected? 20

7. Anticipated Student Demand.

a. * Will this course serve students primarily within the degree program? ◉ Yes ○ No

b. * Will it be of interest to a significant number of students outside the degree pgm? ◉ Yes ○ No

If YES, explain:

Is relevant to students in other College of Engineering majors.

8. * Check the category most applicable to this course:

☑ Traditional – Offered in Corresponding Departments at Universities Elsewhere
☐ Relatively New – Now Being Widely Established
☐ Not Yet Found in Many (or Any) Other Universities

9. Course Relationship to Program(s).

a. * Is this course part of a proposed new program? ○ Yes ◉ No

If YES, name the proposed new program:

b. * Will this course be a new requirement for ANY program? ○ Yes ◉ No

If YES, list affected programs::

10. Information to be Placed on Syllabus.

a. * Is the course 400G or 500? ◉ Yes ○ No
If YES, the *differentiation for undergraduate and graduate students must be included* in the information required in **10.b.** You must include: (i) identification of add assignments by the graduate students; and/or (ii) establishment of different grading criteria in the course for graduate students. (See SR 3.1.4.)

b. ☑ * The syllabus, including course description, student learning outcomes, and grading policies (and 400G-/500-level grading differentiation if applicable, from **10** attached.

Distance Learning Form

This form must accompany every submission of a new/change course form that requests distance learning delivery. This form may be required when changing a course already approved for DL
fields are required!

Introduction/Definition: For the purposes of the Commission on Colleges Southern Association of Colleges and Schools accreditation review, ***distance learning*** is defined as a fo educational process in which the majority of the instruction (interaction between students and instructors and among students) in a course occurs when students and instructors the same place. Instruction may be synchronous or asynchronous. A distance learning (DL) course may employ correspondence study, or audio, video, or computer technologies

A number of specific requirements are listed for DL courses. **The *department* proposing the change in delivery method is responsible for ensuring that the requiremer are satisfied at the individual course level.** It is the responsibility of the instructor to have read and understood the university-level assurances regarding an equivalent expe students utilizing DL (available at http://www.uky.edu/USC/New/forms.htm).

Course Number and Prefix:	ME 516	Date:	1/27/2014
Instructor Name:	TBD	Instructor Email:	TBD

Check the method below that best reflects how the majority of the course content will be delivered.

Internet/Web-based ☐ Interactive Video ☑ Hybrid ☐

Curriculum and Instruction

1. How does this course provide for timely and appropriate interaction between students and faculty and among students? Does the course syllabus conform to University Syllabus Guidelines, specifically the Distance Learning Considerations?

   Use of Blackboard, email, and web-conferencing provides interaction.

2. How do you ensure that the experience for a DL student is comparable to that of a classroom-based student's experience? Aspects to explore: textbooks, course goals, of student learning outcomes, etc.

   Student learning outcomes are assessed for all sections of the course, along with the usual TCE evaluations.

3. How is the integrity of student work ensured? Please speak to aspects such as password-protected course portals, proctors for exams at interactive video sites; academ policy; etc.

   Standard university policy will be followed in all academic aspects, all quizzes and exams will be proctored.

4. Will offering this course via DL result in at least 25% or at least 50%* (based on total credit hours required for completion) of a degree program being offered via any f as defined above?

   No

   Which percentage, and which program(s)?

   No

   *As a general rule, if approval of a course for DL delivery results in 50% or more of a program being delivered through DL, the effective date of the course's DL delivery months from the date of approval.

5. How are students taking the course via DL assured of equivalent access to student services, similar to that of a student taking the class in a traditional classroom setting

   Since course will be offered at/to a site located on a UK campus remote site, students will have equivalent access to service.

Library and Learning Resources

6. How do course requirements ensure that students make appropriate use of learning resources?

   Students will be required to access resources through online or similar venues.

7. Please explain specifically how access is provided to laboratories, facilities, and equipment appropriate to the course or program.

   Any required laboratories will be located at the remote site. If specialized equipment is needed then the students will comE to central campus or access through online instrumentation approaches.

Student Services

8. How are students informed of procedures for resolving technical complaints? Does the syllabus list the entities available to offer technical help with the delivery and/or r the course, such as the Information Technology Customer Service Center (http://www.uky.edu/UKIT/)?

   Syllabus provides the access information.

9. Will the course be delivered via services available through the Distance Learning Program (DLP) and the Academic Technology Group (ATL)?

   ◉ Yes
   ○ No

   If no, explain how students enrolled in DL courses are able to use the technology employed, as well as how students will be provided with assistance in using said techn

   No answer necessary.

10. Does the syllabus contain all the required components, below? ☑ Yes

    - Instructor's ***virtual*** office hours, if any.
    - The technological requirements for the course.
    - Contact information for Distance Learning programs (http://www.uky.edu/DistanceLearning) and Information Technology Customer Service Center (http://www.uky.edu/UKIT/Help/; 859-218-HELP).
    - Procedure for resolving technical complaints.
    - Preferred method for reaching instructor, e.g. email, phone, text message.
    - Maximum timeframe for responding to student communications.
    - Language pertaining academic accommodations:

- "If you have a documented disability that requires academic accommodations in this course, please make your request to the University Disability Resour The Center will require current disability documentation. When accommodations are approved, the Center will provide me with a Letter of Accommodatior details the recommended accommodations. Contact the Disability Resource Center, Jake Karnes, Director at 859-257-2754 or jkarnes@email.uky.edu."

- Specific dates of face-to-face or synchronous class meetings, if any.
- Information on Distance Learning Library Services (http://www.uky.edu/Libraries/DLLS)
  - Carla Cantagallo, DL Librarian
  - Local phone number: 859 257-0500, ext. 2171; long-distance phone number: (800) 828-0439 (option #6)
  - Email: dlservice@email.uky.edu
  - DL Interlibrary Loan Service: http://www.uky.edu/Libraries/libpage.php?lweb_id=253&llib_id=16

11. I, the instructor of record, have read and understood all of the university-level statements regarding DL.

Instructor Name:
Dr. Suzanne Weaver Smith

Abbreviations: DLP = Distance Learning Programs ATG = Academic Technology Group Customer Service Center = 859-218-HELP (http://www.uky.edu/UKIT/Help)

~~Revised 8/09~~

[1] Courses are typically made effective for the semester following approval. No course will be made effective until all approvals are received.

[2] The chair of the cross-listing department must sign off on the Signature Routing Log.

[3] In general, undergraduate courses are developed on the principle that one semester hour of credit represents one hour of classroom meeting per week for a semester, exclusive of any laboratory meeting. La meeting, generally, represents at least two hours per week for a semester for one credit hour. (from SR 5.2.1)

[4] You must also submit the Distance Learning Form in order for the proposed course to be considered for DL delivery.

[5] In order to change a program, a program change form must also be submitted.

Rev 8/09

Proposed ME 516 (Currently ME 599) SYSTEMS ENGINEERING
Face-to-Face Syllabus

Instructor: Dr. Suzanne Weaver Smith, suzanne.smith@uky.edu
Office: 112 Robotics (NASA Kentucky offices), 323-4545

Office Hours: MTWThF in the office when available (specific times to be set for the term in consultation with the students), but best is via email almost anytime. The instructor will normally respond to e-mail (or phone calls received between 8 am and 4 pm) within four hours of receipt.

Course Description:

Systems Engineering is a discipline necessary for cost-effective development of complex multi-disciplinary systems. Optimal design of modern systems for defense, transportation, telecommunications and energy, among other industries, requires a different perspective than the design of subsystems operating within them. This course presents principles and the practice of Systems Engineering, along with its origins in the aerospace and software industries, historical perspective and case studies of current interest. Topics include system life-cycle, requirements definition, modeling, personality, trade studies, design optimization (with minimal information), risk management, proposal writing and others. Guest lecturers and case studies provide a realistic setting for understanding the application of course materials. Prerequisite: Engineering Standing or consent of instructor.

Prerequisites: Engineering Standing

Student Learning Outcomes:

1. To demonstrate an understanding of the discipline of systems engineering, focusing on aerospace systems but including comparison of various industry perspectives. Assessment is via individual homework.

2. To demonstrate an understanding of the concepts and processes of systems engineering, including system life-cycles, requirements definition, modeling, trade studies, concept definition, measures of effectiveness, and risk management, along with the roles of personality, decision-making and proposal writing in complex multi-disciplinary system development. Assessment is via individual homework and group projects.

3. To demonstrate an understanding of current or historical case studies and/or failure analyses. Assessment is via individual homework.

4. To demonstrate an understanding of classical design optimization and its extensions to statistical and heuristic methods for systems architecting. Assessment is via individual homework.

5. To demonstrate key aspects of the practice of Systems Engineering using a topic of current interest (often related to autonomous aircraft systems or autonomous automobile systems) via a semester-long concept design project.

Required Textbook:
None, handouts will be provided via Blackboard (or current UK system). References are listed at the end of this syllabus.

Course Assignments: See course schedule below.

Graded material will include the following:
Class attendance and participation (individual, 10%), homework (individual, typically 5-7 multi-part assignments weighted approximately equally, 50%), midterm project (small group, typically culmination presentation of 2-3 written assignments to that point, 15%), and final project (***varies with current theme of the term but one the following is defined in the first-day syllabus***: 1) may be an individual accident report case study of the student's choice from a list of available accidents of historic or current significance or 2) may be a group project concept design continuing the midterm project, resulting in final written report and presentation, 25%).

For graduate students enrolled in the course, homework assignments will include additional problems and individual final projects will have an additional component.

Project groups are chosen by the students in the class. Groups may be combined into larger teams during the term depending on the nature of the course theme which is often an autonomous aircraft or autonomous ground vehicle system design for a specific objective of current interest. Detailed instructions/expectations for projects are provided with the assignments.

Grades:
Grades will be assigned as follows (cutoffs may be adjusted lower if warranted):
Undergraduate: 90-100, A; 80-89, B; 70-79, C; 60-69, D; below 60, E
Graduate: 90-100, A; 80-89, B; 70-79, C; below 70, E
Grades for graduate students and undergraduate students will be compiled and assigned separately.

Mid-term grades will be posted in myUK by the deadline established in the Academic Calendar (http://www.uky.edu/Registrar/AcademicCalendar.htm)

Attendance Policy: In accordance with the Senate Policy on excused absences (see below).

Excused Absences:
Students need to notify the professor of absences prior to class when possible. S.R. 5.2.4.2 defines the following as acceptable reasons for excused absences: (a) serious illness, (b) illness or death of family member, (c) University-related trips, (d) major religious holidays, and (e) other circumstances found to fit "reasonable cause for nonattendance" by the professor.

Students anticipating an absence for a major religious holiday are responsible for notifying the instructor in writing of anticipated absences due to their observance of such holidays no later than the last day in the semester to add a class. Information regarding dates of major religious holidays may be obtained through the religious liaison, Mr. Jake Karnes (859-257-2754).

Students are expected to withdraw from the class if more than 20% of the classes scheduled for the semester are missed (excused or unexcused) per university policy.

Verification of Absences:
Students may be asked to verify their absences in order for them to be considered excused. Senate Rule 5.2.4.2 states that faculty have the right to request "appropriate verification" when students claim an excused absence because of illness or death in the family. Appropriate notification of absences due to university-related trips is required prior to the absence.

Academic Integrity:
Per university policy, students shall not plagiarize, cheat, or falsify or misuse academic records. Students are expected to adhere to University policy on cheating and plagiarism in all courses. The minimum penalty for a first offense is a zero on the assignment on which the offense occurred. If the offense is considered severe or the student has other academic offenses on their record, more serious penalties, up to suspension from the university may be imposed.

Plagiarism and cheating are serious breaches of academic conduct. Each student is advised to become familiar with the various forms of academic dishonesty as explained in the Code of Student Rights and Responsibilities. Complete information can be found at the following website: http://www.uky.edu/Ombud. A plea of ignorance is not acceptable as a defense against the charge of academic dishonesty. It is important that you review this information as all ideas borrowed from others need to be properly credited.

Part II of *Student Rights and Responsibilities* (www.uky.edu/StudentAffairs/Code/part2.html) states that all academic work, written or otherwise, submitted by students to their instructors or other academic supervisors, is expected to be the result of their own thought, research, or self-expression. In cases where students feel unsure about the question of plagiarism involving their own work, they are obliged to consult their instructors on the matter before submission. When students submit work purporting to be their own, but which in any way borrows ideas, organization, wording or anything else from another source without appropriate acknowledgement of the fact, the students are guilty of plagiarism. Plagiarism includes reproducing someone else's work, whether it be a published article, chapter of a book, a paper from a friend or some file, or something similar to this. Plagiarism also includes the practice of employing or allowing another person to alter or revise the work which a student submits as his/her own, whoever that other person may be.

Students may discuss assignments among themselves or with an instructor or tutor, but when the actual work is done, it must be done by the student, and the student alone. When a student's assignment involves research in outside sources of information, the student must carefully acknowledge exactly what, where and how he/she employed them. If the words of someone else are used, the student must put quotation marks around the passage in question and add an appropriate indication of its origin. Making simple changes while leaving the organization, content and phraseology intact is plagiaristic. However, nothing in these Rules shall apply to those ideas which are so generally and freely circulated as to be a part of the public domain (Section 6.3.1).

Please note: Any assignment you turn in may be submitted to an electronic database to check for plagiarism.

Accommodations due to disability:
If you have a documented disability that requires academic accommodations, please see me as soon as possible during scheduled office hours. In order to receive accommodations in this course, you must provide me with a Letter of Accommodation from the Disability Resource Center (Room 2, Alumni Gym, 257-2754, email address: jkarnes@email.uky.edu) for coordination of campus disability services available to students with disabilities.

STUDENT INTERACTION
Students are expected to maintain communication with the instructor through various means:

Personal Meetings (by arrangement or during scheduled office hours)
E-mail or Phone

These interactions are expected to be conducted in a professional manner. It is essential that students check e-mail on a daily basis. The UK e-mail address will be used by default, so students must activate e-mail forwarding if they prefer another primary e-mail address. In any communications with the instructor or other students, be sure to follow e-mail etiquette, for example: http://office.microsoft.com/en-us/outlook/HA012054101033.aspx.

The best way to contact the instructor is via email almost anytime. The instructor will normally respond to e-mail (or phone calls received between 8 am and 4 pm) within four hours of receipt.

Students are expected to be familiar with, and have internet access, along with access to software for document creation and editing, and for preparation of presentations. Some of the homework assignments require the use of Excel or MATLAB software, or equivalent, for computations. This access is provided at a number of on-campus locations.

Overview of the Course Schedule:

Week	Topic
2	**Introduction, SE Definitions and Characteristics**
3	**SE Principles and Practice: Part I, Industry Sector Trending**
4	**Systems Engineering Experience**
5	**Practical Systems Engineering**
6	**Requirements Allocation, Measures of Effectiveness**
7	**Trade Studies**
8	**Case Study, Personality**
9	**Term Project Presentations**
10	**Procurement, Evaluating and Mitigating Risk**
11	**Classical Optimization**
12	**Trending, Genetic Algorithms and Monte Carlo Methods**
13	**Design Heuristics, Proposal Writing**
14	**Term Project – Final Presentations**
15	**Closing**

Typical Course Schedule (Twice Weekly Schedule – Guest Speaker dates not confirmed)

Week	*Day*	*Topic*	*Notes/Handouts/Readings*	*HW*
1	Th	1 – Introduction	Syllabus	HW1 – SE definitions and courses, due Th, Wk 2
2	T	2 – SE Definition	INCOSE Chapt 3 Life Cycle; Life cycle readings: DARPA Vulture, Toyota Volta, Boeing Dreamliner, Shuttle	
	Th	3 – SE Environment, Qualities and Characteristics	Vulture Industry Day, DARPA Vulture Budget Justification	HW2 – Technical Orientation, Context Diagram, due Th, Wk 3
3	T	4 – Bourne Practical SE Principles, Part 1	Tennekes *Simple Science of Flight* Intro/Chapt; AIAA 2013 UAV RoundUp	TP1 – RoundUp Rotorcraft Data, Requirements, Operational timeline, due Th, Wk 4
	Th	5 - UAV History; Low-Re UAVs	flight design spaces: birds and aircraft	
4	T	*Guest Speaker –*		HW3 – Specific energy consumption for cars, due Th, Wk 5
	Th	4 - Muratore Art of Systems Engineering	NASA SE Handbook 4.1/4.2/4.3 AppC Requirements; AppF Logical Decomposition; DoDAF 4.1-4.2.2 Operational Views	
5	T	6 – Bourne Practical SE Principles, Part 2		TP2 –Operational Environment, Operational View, Reqts Reprise, due Th Wk 6
	Th	6 – Bourne Practical SE Principles, Part 2 (cont)		
6	T	***Case Study No. 1***		
	Th	7 – Trade Studies		HW4 – Trade Studies, due Th, Wk 7

Week	*Day*	*Topic*	*Notes/Handouts/Readings*	*HW*
7	T	In-class work on Trade Studies		
	Th	7 – Trade Studies (cont)		
8	T	8 – Personality Typing		TP3 – Midterm Group Presentation, due Wk 9
	Th	In-class Work on Term Project		
9	T	Midterm Presentations		
	Th	***Case Study No. 2***	Boeing Dreamliner AIAA Daily Launch compilation	
		Spring Break – no class		
10	T	9 – Procurement Approaches and Design Processes	NASA/UTexas Lecture	
	Th	10 – Managing Risk I	NASA/UTexas Lecture	TP4 – Risk Analysis, due Th, Wk 11
11	T	11 – Classical Optimization		
	Th	11 – Classical Optimization (cont)		HW5 – Applied Optimization, due Th, Wk 12
12	T	12 – Trending, Genetic and Monte Carlo Methods		
	Th	12 – Trending, Genetic and Monte Carlo Methods (cont)		TP5 – Final Term Project, due Wk 14
13	T	13 – Heuristic Optimization		HW6 – Heuristic Optimization, due Th Wk 13
	Th	In-class Work on Term Project		
14	T	14 – Proposal Writing		
	Th	Final Project Presentations		
15	T	***Case Study No. 3***		
	Th	Final Wrap-Up		Teaching evaluations

Other Information:

References

1. *Practical Systems Engineering Principles,* Bourne, Short Course Notes, 2004-2007.
2. *Systems Architecting, Creating and Building Complex Systems*, Rechtin, Prentice-Hall, 1991
3. *The Art of Systems Architecting, 2nd Ed.*, Maier and Rechtin, CRC Press, Boca Raton, FL, 2002.
4. *Software Architecture: Perspectives on an Emerging Discipline*, Shaw and Garlan, Prentice Hall, Upper Saddle River, NJ, 1996.
5. *Systems Engineering Principles and Practice*, Kossiakoff and Sweet, John Wiley and Sons, Hoboken, NJ, 2003.
6. *Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities,* INCOSE-TP-2003-002-03, version 3, Cecilia Haskins, Ed., International Council on Systems Engineering, June 2006
7. *Introduction to Systems Engineering*, Sage and Armstrong, John Wiley, New York, NY, 2000.
8. *Systems Engineering Fundamentals*, Defense Acquisition University Press, Fort Belvoir, VA, 2001
9. *Systems Engineering – Systems Life Cycle Processes*, International Standard ISO/IEC 15288, 2002.
10. *NASA Systems Engineering Handbook*, NASA/SP-2007-6105, Rev1 Final, 31 Dec 2007.
11. *Unmanned Aviation: A Brief History of Unmanned Aerial Vehicles*, Newcome, American Institute of Aeronautics and Astronautics, Inc., Reston, VA, 2004.
12. *Space Mission Analysis and Design*, Larson and Wertz, Eds., Springer – Verlag, 1999.
13. *Space Systems Engineering, http://spacese.spacegrant.org/*

Proposed ME 516 (Currently ME 599) SYSTEMS ENGINEERING

Distance Learning Syllabus

Instructor: Dr. Suzanne Weaver Smith, suzanne.smith@uky.edu
Office: 112 Robotics (NASA Kentucky offices), 323-4545

Office Hours: MTWThF in the office when available (specific times to be set for the term in consultation with the students), but best is via email almost anytime. The instructor will normally respond to e-mail (or phone calls received between 8 am and 4 pm) within four hours of receipt.

Course Description:

Systems Engineering is a discipline necessary for cost-effective development of complex multi-disciplinary systems. Optimal design of modern systems for defense, transportation, telecommunications and energy, among other industries, requires a different perspective than the design of subsystems operating within them. This course presents principles and the practice of Systems Engineering, along with its origins in the aerospace and software industries, historical perspective and case studies of current interest. Topics include system life-cycle, requirements definition, modeling, personality, trade studies, design optimization (with minimal information), risk management, proposal writing and others. Guest lecturers and case studies provide a realistic setting for understanding the application of course materials. Prerequisite: Engineering Standing or consent of instructor.

Prerequisites: Engineering Standing

Student Learning Outcomes:

1. To demonstrate an understanding of the discipline of systems engineering, focusing on aerospace systems but including comparison of various industry perspectives. Assessment is via individual homework.

2. To demonstrate an understanding of the concepts and processes of systems engineering, including system life-cycles, requirements definition, modeling, trade studies, concept definition, measures of effectiveness, and risk management, along with the roles of personality, decision-making and proposal writing in complex multi-disciplinary system development. Assessment is via individual homework and group projects.

3. To demonstrate an understanding of current or historical case studies and/or failure analyses. Assessment is via individual homework.

4. To demonstrate an understanding of classical design optimization and its extensions to statistical and heuristic methods for systems architecting. Assessment is via individual homework.

5. To demonstrate key aspects of the practice of Systems Engineering using a topic of current interest (often related to autonomous aircraft systems or autonomous automobile systems) via a semester-long concept design project.

Required Textbook:
None, handouts will be provided via Blackboard (or current UK system). References are listed at the end of this syllabus.

Course Assignments: See course schedule below.

Graded material will include the following:
Class attendance and participation (individual, 10%), homework (individual, typically 5-7 multi-part assignments weighted approximately equally, 50%), midterm project (small group, typically culmination presentation of 2-3 written assignments to that point, 15%), and final project (***varies with current theme of the term but one the following is defined in the first-day syllabus***: 1) may be an individual accident report case study of the student's choice from a list of available accidents of historic or current significance or 2) may be a group project concept design continuing the midterm project, resulting in final written report and presentation, 25%).

For graduate students enrolled in the course, homework assignments will include additional problems and individual final projects will have an additional component.

Project groups are chosen by the students in the class. Groups may be combined into larger teams during the term depending on the nature of the course theme which is often an autonomous aircraft or autonomous ground vehicle system design for a specific objective of current interest. Detailed instructions/expectations for projects are provided with the assignments.

Grades:
Grades will be assigned as follows (cutoffs may be adjusted lower if warranted):
Undergraduate: 90-100, A; 80-89, B; 70-79, C; 60-69, D; below 60, E
Graduate: 90-100, A; 80-89, B; 70-79, C; below 70, E
Grades for graduate students and undergraduate students will be compiled and assigned separately.

Mid-term grades will be posted in myUK by the deadline established in the Academic Calendar (http://www.uky.edu/Registrar/AcademicCalendar.htm)

Attendance Policy: In accordance with the Senate Policy on excused absences (see below).

Excused Absences:
Students need to notify the professor of absences prior to class when possible. S.R. 5.2.4.2 defines the following as acceptable reasons for excused absences: (a) serious illness, (b) illness or death of family member, (c) University-related trips, (d) major religious holidays, and (e) other circumstances found to fit "reasonable cause for nonattendance" by the professor.

Students anticipating an absence for a major religious holiday are responsible for notifying the instructor in writing of anticipated absences due to their observance of such holidays no later than the last day in the semester to add a class. Information regarding dates of major religious holidays may be obtained through the religious liaison, Mr. Jake Karnes (859-257-2754).

Students are expected to withdraw from the class if more than 20% of the classes scheduled for the semester are missed (excused or unexcused) per university policy.

Verification of Absences:
Students may be asked to verify their absences in order for them to be considered excused. Senate Rule 5.2.4.2 states that faculty have the right to request "appropriate verification" when students claim an excused absence because of illness or death in the family. Appropriate notification of absences due to university-related trips is required prior to the absence.

Academic Integrity:
Per university policy, students shall not plagiarize, cheat, or falsify or misuse academic records. Students are expected to adhere to University policy on cheating and plagiarism in all courses. The minimum penalty for a first offense is a zero on the assignment on which the offense occurred. If the offense is considered severe or the student has other academic offenses on their record, more serious penalties, up to suspension from the university may be imposed.

Plagiarism and cheating are serious breaches of academic conduct. Each student is advised to become familiar with the various forms of academic dishonesty as explained in the Code of Student Rights and Responsibilities. Complete information can be found at the following website: http://www.uky.edu/Ombud. A plea of ignorance is not acceptable as a defense against the charge of academic dishonesty. It is important that you review this information as all ideas borrowed from others need to be properly credited.

Part II of *Student Rights and Responsibilities* (www.uky.edu/StudentAffairs/Code/part2.html) states that all academic work, written or otherwise, submitted by students to their instructors or other academic supervisors, is expected to be the result of their own thought, research, or self-expression. In cases where students feel unsure about the question of plagiarism involving their own work, they are obliged to consult their instructors on the matter before submission. When students submit work purporting to be their own, but which in any way borrows ideas, organization, wording or anything else from another source without appropriate acknowledgement of the fact, the students are guilty of plagiarism. Plagiarism includes reproducing someone else's work, whether it be a published article, chapter of a book, a paper from a friend or some file, or something similar to this. Plagiarism also includes the practice of employing or allowing another person to alter or revise the work which a student submits as his/her own, whoever that other person may be.

Students may discuss assignments among themselves or with an instructor or tutor, but when the actual work is done, it must be done by the student, and the student alone. When a student's assignment involves research in outside sources of information, the student must carefully acknowledge exactly what, where and how he/she employed them. If the words of someone else are used, the student must put quotation marks around the passage in question and add an appropriate indication of its origin. Making simple changes while leaving the organization, content and phraseology intact is plagiaristic. However, nothing in these Rules shall apply to those ideas which are so generally and freely circulated as to be a part of the public domain (Section 6.3.1).

Please note: Any assignment you turn in may be submitted to an electronic database to check for plagiarism.

Accommodations due to disability:
If you have a documented disability that requires academic accommodations, please see me as soon as possible during scheduled office hours. In order to receive accommodations in this course, you must provide me with a Letter of Accommodation from the Disability Resource Center (Room 2, Alumni Gym, 257-2754, email address: jkarnes@email.uky.edu) for coordination of campus disability services available to students with disabilities.

DISTANCE LEARNING

Students are expected to be familiar with, and have internet access, along with access to software for document creation and editing, and for preparation of presentations. This access is provided at a number of on-campus locations. Students at WKU are provided a room for office hours and Adobe Connect access.

Contact information for Distance Learning programs (http://www.uky.edu/DistanceLearning) and Information Technology Customer Service Center (http://www.uky.edu/UKIT/Help/; 859-218-HELP).

Information on Distance Learning Library Services (http://www.uky.edu/Libraries/DLLS)

- Carla Cantagallo, DL Librarian
- Local phone number: 859 257-0500, ext. 2171; long-distance phone number: (800) 828-0439 (option #6)
- Email: dllservice@email.uky.edu

DL Interlibrary Loan Service:
http://www.uky.edu/Libraries/libpage.php?lweb_id=253&llib_id=16

Specific Dates of Face-to-Face and Synchronous class meetings are indicated on the Daily Course Schedule for the specific term of the course offering (typical daily schedule included below will add specific notes for face-to-face, synchronous and other DL details for the term).

STUDENT INTERACTION
Students are expected to maintain communication with the instructor through various means:

Personal Meetings (by arrangement or during scheduled office hours)
E-mail or Phone

These interactions are expected to be conducted in a professional manner. It is essential that students check e-mail on a daily basis. The UK e-mail address will be used by default, so students must activate e-mail forwarding if they prefer another primary e-mail address. In any communications with the instructor or other students, be sure to follow e-mail etiquette, for example: http://office.microsoft.com/en-us/outlook/HA012054101033.aspx.

The best way to contact the instructor is via email almost anytime. The instructor will normally respond to e-mail (or phone calls received between 8 am and 4 pm) within four hours of receipt.

Students are expected to be familiar with, and have internet access, along with access to software for document creation and editing, and for preparation of presentations. Some of the homework assignments require the use of Excel or MATLAB software, or equivalent, for computations. This access is provided at a number of on-campus locations.

Overview of the Course Schedule:

Week	Topic
2	**Introduction, SE Definitions and Characteristics**
3	**SE Principles and Practice: Part I, Industry Sector Trending**
4	**Systems Engineering Experience**
5	**Practical Systems Engineering**
6	**Requirements Allocation, Measures of Effectiveness**
7	**Trade Studies**
8	**Case Study, Personality**
9	**Term Project Presentations**
10	**Procurement, Evaluating and Mitigating Risk**
11	**Classical Optimization**
12	**Trending, Genetic Algorithms and Monte Carlo Methods**
13	**Design Heuristics, Proposal Writing**
14	**Term Project – Final Presentations**
15	**Closing**

Typical Course Schedule (Twice Weekly Schedule – Guest Speaker dates not confirmed)

Week	*Day*	*Topic*	*Notes/Handouts/Readings*	*HW*
1	Th	1 – Introduction	Syllabus	HW1 – SE definitions and courses, due Th, Wk 2
2	T	2 – SE Definition	INCOSE Chapt 3 Life Cycle; Life cycle readings: DARPA Vulture, Toyota Volta, Boeing Dreamliner, Shuttle	
	Th	3 – SE Environment, Qualities and Characteristics	Vulture Industry Day, DARPA Vulture Budget Justification	HW2 – Technical Orientation, Context Diagram, due Th, Wk 3
3	T	4 – Bourne Practical SE Principles, Part 1	Tennekes *Simple Science of Flight* Intro/Chapt; AIAA 2013 UAV RoundUp	TP1 – RoundUp Rotorcraft Data, Requirements, Operational timeline, due Th, Wk 4
	Th	5 - UAV History; Low-Re UAVs	flight design spaces: birds and aircraft	
4	T	*Guest Speaker* –		HW3 – Specific energy consumption for cars, due Th, Wk 5
	Th	4 - Muratore Art of Systems Engineering	NASA SE Handbook 4.1/4.2/4.3 AppC Requirements; AppF Logical Decomposition; DoDAF 4.1-4.2.2 Operational Views	
5	T	6 – Bourne Practical SE Principles, Part 2		TP2 –Operational Environment, Operational View, Reqts Reprise, due Th Wk 6
	Th	6 – Bourne Practical SE Principles, Part 2 (cont)		
6	T	***Case Study No. 1***		
	Th	7 – Trade Studies		HW4 – Trade Studies, due Th, Wk 7

Week	*Day*	*Topic*	*Notes/Handouts/Readings*	*HW*
7	T	In-class work on Trade Studies		
	Th	7 – Trade Studies (cont)		
8	T	8 – Personality Typing		TP3 – Midterm Group Presentation, due Wk 9
	Th	In-class Work on Term Project		
9	T	Midterm Presentations		
	Th	***Case Study No. 2***	Boeing Dreamliner AIAA Daily Launch compilation	
		Spring Break – no class		
10	T	9 – Procurement Approaches and Design Processes	NASA/UTexas Lecture	
	Th	10 – Managing Risk I	NASA/UTexas Lecture	TP4 – Risk Analysis, due Th, Wk 11
11	T	11 – Classical Optimization		
	Th	11 – Classical Optimization (cont)		HW5 – Applied Optimization, due Th, Wk 12
12	T	12 – Trending, Genetic and Monte Carlo Methods		
	Th	12 – Trending, Genetic and Monte Carlo Methods (cont)		TP5 – Final Term Project, due Wk 14
13	T	13 – Heuristic Optimization		HW6 – Heuristic Optimization, due Th Wk 13
	Th	In-class Work on Term Project		
14	T	14 – Proposal Writing		
	Th	Final Project Presentations		
15	T	***Case Study No. 3***		
	Th	Final Wrap-Up		Teaching evaluations

Other Information:

References

1. *Practical Systems Engineering Principles,* Bourne, Short Course Notes, 2004-2007.
2. *Systems Architecting, Creating and Building Complex Systems*, Rechtin, Prentice-Hall, 1991
3. *The Art of Systems Architecting, 2nd Ed.*, Maier and Rechtin, CRC Press, Boca Raton, FL, 2002.
4. *Software Architecture: Perspectives on an Emerging Discipline*, Shaw and Garlan, Prentice Hall, Upper Saddle River, NJ, 1996.
5. *Systems Engineering Principles and Practice*, Kossiakoff and Sweet, John Wiley and Sons, Hoboken, NJ, 2003.
6. *Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities,* INCOSE-TP-2003-002-03, version 3, Cecilia Haskins, Ed., International Council on Systems Engineering, June 2006
7. *Introduction to Systems Engineering*, Sage and Armstrong, John Wiley, New York, NY, 2000.
8. *Systems Engineering Fundamentals*, Defense Acquisition University Press, Fort Belvoir, VA, 2001
9. *Systems Engineering – Systems Life Cycle Processes*, International Standard ISO/IEC 15288, 2002.
10. *NASA Systems Engineering Handbook*, NASA/SP-2007-6105, Rev1 Final, 31 Dec 2007.
11. *Unmanned Aviation: A Brief History of Unmanned Aerial Vehicles*, Newcome, American Institute of Aeronautics and Astronautics, Inc., Reston, VA, 2004.
12. *Space Mission Analysis and Design*, Larson and Wertz, Eds., Springer – Verlag, 1999.
13. *Space Systems Engineering, http://spacese.spacegrant.org/*