**Ogden College of Science and Engineering**

**Office of the Dean**

**745-4449**

**REPORT TO THE UNIVERSITY CURRICULUM COMMITTEE**

Date: October 15, 2013

The Ogden College of Science and Engineering submits the following action items for consideration at the October 2013, UCC meeting:

1. New Business

|  |  |
| --- | --- |
| **Type of item** | **Description of Item & Contact Information** |
| Action | **Create a New Course**  ENGR 400, Principles of Systems Engineering  Contact: Stacy Wilson, [stacy.wilson@wku.edu](mailto:stacy.wilson@wku.edu), x55848 |
| Action | **Create a New Minor Program**  Systems Engineering  Contact: Robert Choate, [robert.choate@wku.edu](mailto:robert.choate@wku.edu), x58852 |

Proposal Date: April 9, 2013

**Ogden College of Science and Engineering**

**Department of Engineering**

**Proposal to Create a New Course**

**(Action Item)**

Contact Person: Stacy Wilson; [stacy.wilson@wku.edu](mailto:stacy.wilson@wku.edu); 745-5848

**1. Identification of proposed course:**

* 1. Course prefix (subject area) and number: ENGR 400
  2. Course title: Principles of Systems Engineering
  3. Abbreviated course title: Systems Engineering
  4. Credit hours and contact hours: 3 credit hours, 3 contact hours
  5. Type of course: A – Applied Learning
  6. Prerequisites: Junior standing in an engineering discipline; and EE 210 or EM 221, or EM 222 and STAT 301
  7. Course catalog listing: An overview of the field and relevant principles of systems engineering. Topics will prepare students to apply systems engineering theory to the solution of complex system-based engineering problems.

**2. Rationale:**

* 1. Reason for developing the proposed course:

Systems engineering is an iterative approach to problem solving that examines all stages of a system’s life cycle: design/development, production/construction, operation/maintenance, and retirement/disposal. Systems engineers develop high-quality, cost-effective solutions that meet the needs of their customers. NASA has identified systems engineering as “a critical core competency in enabling current and future mission success” (<http://www.nasa.gov/offices/oce/appel/seldp/index.html>).

The importance of understanding systems engineering principles and practices is becoming widely known in the engineering community. This course is the foundation course for the systems engineering minor.

* 1. Projected enrollment in the proposed course: 10-15 students per offering.

The primary constituents of this program initially will be majors in civil, electrical and mechanical engineering. It is projected that approximately 25 students will participate in the systems engineering minor per year. This estimate is determined by anticipating that 40% of a cohort of students will enroll in the minor each year. The percentage used in this estimation was determined by examining the number of students who enrolled in the initial offering of the principles of systems engineering course in the fall 2012 and summer 2013. Each student participating in the minor will be required to enroll in this course.

* 1. Relationship of the proposed course to courses now offered by the department: There are no similar courses currently offered in the department. However, this course will complement the design courses offered in each program.
  2. Relationship of the proposed course to courses offered in other departments:

**There are no other similar courses offered in other departments.**

* 1. Relationship of the proposed course to courses offered in other institutions:

Data available from INCOSE (International Council on Systems Engineering) indicates growth in systems engineering programs, with the number of masters programs in systems engineering growing faster in comparison to the number of undergraduate and doctoral programs. For example, within the USA there are currently 13 Bachelor of Science, 41 Master of Science, and 14 PhD programs that include the words “systems engineering” in their title. However, an infusion of systems thinking and limited exposure to systems engineering principles is beginning to appear in many undergraduate engineering curricula. Within the WKU engineering programs, the use of scenario- or project-based education and team projects has been its cornerstone since inception. These experiences provide the opportunity for students to apply “systems engineering” to real-world problems.

**3. Discussion of proposed course:**

* 1. Course objectives: The objective of this course provides the student with an introduction to systems engineering principles. The course is also intended to prepare the student for their capstone design course. Additional learning objectives include:
     + - to develop a systems engineering perspective of how complex systems are conceived;
       - to establish and increase the knowledge and comprehension of the value and purpose of systems engineering;
       - to establish a working knowledge of methods and tools systems engineers use; and
       - to understand the roles of systems engineers and gain the ability to contribute to the development of complex systems.
  2. Content outline:
* The systems engineering process
* Requirements
* Design fundamentals
* Subsystem fundamentals
* Trade studies
* Integration
* Technical reviews
* Case studies and ethics
  1. Student expectations and requirements:

Student performance will be assessed using examinations, papers, and presentations.

* 1. Tentative texts and course materials:

Systems Engineering and Analysis, Benjamin S. Blanchard and Wolter J. Fabrycky, Prentice Hall, 5th Edition, 2011.

**4. Resources:**

* 1. Library resources: See attached library resources form.
  2. Computer resources: The course will use computer resources that are currently available to students in the Department of Engineering.

**5. Budget implications:**

* 1. Proposed method of staffing: Current faculty and staff in the Department of Engineering will be used to staff the course. The civil, electrical and mechanical engineering programs require technical elective courses. It is intended that this course will also be periodically offered as technical elective courses in these programs so that there will be no additional teaching load required during the academic year. It is also anticipated that this course will be offered during the summer term.
  2. Special equipment needed: none
  3. Expendable materials needed: none
  4. Laboratory materials needed: none

**6. Proposed term for implementation:** Spring 2014

**7. Dates of prior committee approvals:**

Engineering Department \_\_\_\_\_4/30/13\_\_\_\_\_\_\_

OSCE Curriculum Committee \_\_\_\_\_10/10/13\_\_\_\_\_\_\_

Undergraduate Curriculum Committee \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

University Senate \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Attachment: Bibliography, Library Resources Form**, **Course Inventory Form**

Proposal Date: April 9, 2013

**Ogden College of Science and Engineering**

**Department of Engineering**

**Proposal to Create a Systems Engineering Minor Program**

**(Action Item)**

Contact Person: Robert E. Choate, [robert.choate@wku.edu](mailto:robert.choate@wku.edu), 745-8852

**1. Identification of program:**

* 1. Program title: Systems Engineering
  2. Required hours in minor program: 21 (CE Majors), 21.5 (EE Majors) or 21 (ME Majors)
  3. Special information: none
  4. Catalog description: Systems engineering is a robust approach to the design, creation, and operation of systems.

**2. Rationale:**

* 1. Reason for developing the proposed minor program:

Several significant trends in the global environment are leading to the emergence of a more widespread and effective application of the systems engineering practice. There is a growing realization that systems engineering is essential to successfully design, develop and sustain the highly complex systems of the 21st century. Therefore, an increasing number of universities are offering programs in systems engineering, while simultaneously a number of corporations in the commercial and defense sectors have articulated needs for systems engineering skills and competencies. The demand in these sectors is strong for trained, experienced systems engineers, especially those who can think holistically about complex problems, are comfortable with the increasing complexity of systems that address those problems, can manage the uncertainty and complexity of the environment in which those systems are being built, and can respond to demands to shorten the time to deliver systems to the field.

* 1. Projected enrollment in the proposed minor program:

The primary constituents of this program initially will be majors in civil, electrical and mechanical engineering. It is projected that approximately 25 students will participate in this minor per year. This estimate is determined by anticipating that 40% of a cohort of engineering students will enroll in the minor each year. The percentage used in this estimation was also supported by the number of students who enrolled in the initial offering of the principles of systems engineering course in the fall 2012 and summer 2013.

* 1. Relationship of the proposed minor program to other programs now offered by the department:

In the proposed structure for engineering at WKU, a core of systems engineering courses will be used to expand the traditional engineering disciplines (e.g. civil engineering, electrical engineering, mechanical engineering) currently offered by the department. Therefore, the groundwork established by the Department of Engineering will be strengthened and diversified by the inclusion of a systems engineering minor curriculum.

* 1. Relationship of the proposed minor program to other university programs:

Numerous elective courses and programs outside of WKU engineering were reviewed (e.g., manufacturing sciences, business, mathematics and statistics) for comparison and possible inclusion in the minor. Of particular interest was the minor in statistics. However, the initial offering is limited to engineering majors with future expansion to an interdisciplinary approached desired. In this manner, education in systems thinking and systems engineering can begin to permeate WKU, and future collaborations, such as with the statistics minor, will be established among departments and colleges. There is likely to be fluidity of curricula and a resulting fluidity of faculty among these departments and programs. The expectation is that systems engineering will remain an area of study of its own; however, there is a potential for the study of systems thinking to become interwoven into our academic fabric.

* 1. Similar minor programs offered elsewhere in Kentucky and in other states (including programs at benchmark institutions): There are currently no systems engineering minors at any Kentucky institution and only one benchmark institution, University of North Carolina – Charlotte, has a Bachelor of Science Program in Systems Engineering (BSSE).
  2. Relationship of the proposed minor program to the university mission and objectives:

The field of systems engineering is emerging as a connector between many of the traditional engineering fields. The proposed minor in systems engineering will offer students the opportunity to expand their understanding of systems and how the effective management of systems influences virtually every aspect of our global societal challenges. Students who complete this minor will be better prepared to successfully solve many of these modern engineering challenges. It is the mission of WKU engineering to prepare students of all backgrounds to be productive, engaged, and socially responsible citizen-leaders of a global society. This minor will only serve to enhance the university mission and objectives.

**3. Objectives of the proposed minor:**

A systems engineering minor will provide a pathway for students through an extension of regular engineering courses. This is consistent with the industry attitude that engineering students need a foundational background in one of the traditional engineering disciplines, plus practical, real-world experience to become effective as systems engineers. Unlike systems-centric programs, which treat systems engineering as a separate discipline were most of the courses are taught focusing on systems engineering principles and practice, our domain-centric program offers systems engineering as an option that can be exercised within another major field in engineering. Therefore, the objectives for the graduate in engineering with a systems engineering minor are:

* to attain programmatic or technical leadership roles in an organization identifying, formulating, designing and/or testing practical solutions to engineering problems and guide the engineering development of modern complex and interdisciplinary systems; while,
* employing systems engineering methods and tools in the development of advanced complex and interdisciplinary systems.

**4. Curriculum:**

The Systems Engineering Minor requires a minimum of 21 hours for CE and ME majors and 21.5 hours for EE majors. Students must complete 12 or 12.5 hours of required courses and choose a minimum of 9 hours from elective courses as shown in Tables 1 and 2 below.

Table 1: Systems Engineering Minor Required Courses

|  |  |  |
| --- | --- | --- |
| **Course** | **Description** | **Credit Hours** |
| EE 210 or  EM 221or EM 222 | Circuits and Networks I  or Engineering Statics | 3.5 (EE)  or 3 (CE or ME) |
| STAT 301 | Applied Statistics | 3 |
| ENGR 400 | Principles of Systems Engineering | 3 |
| CE 498 or EE 401 or ME 412 | Capstone Project\* | 3 |
| **TOTAL** |  | **12.5 (EE)**  **or 12 (CE/ME)** |

\* A panel review of the student senior project proposal is required. The proposal must incorporate systems engineering principles outlined in ENGR 400.

Table 2: Systems Engineering Minor Elective Courses **(Minimum Required: 9 Credit Hours)**

|  |  |  |
| --- | --- | --- |
| **Course** | **Description** | **Credit Hours** |
| CE 303/304 | Construction Management/Lab | 3/1 |
| CE 4xx\*\* | CE Technical Electives | 6 |
| EE 460 | Continuous Control Systems | 4 |
| EE 4xx\*\* | EE Technical Electives | 6 |
| EM 313 | Dynamics | 3 |
| ME 49x\*\* | ME Technical Electives | 6 |

\*\* The technical elective must incorporate or expand on systems engineering principles as outlined in ENGR 400 Principles of Systems Engineering. Technical elective courses currently meeting this intent include but are not limited to: CE300 Floodplain Management, CE326 Engineering Law, CE360 Estimating Scheduling Bidding, CE361 Estimating Lab, CE366 Mechanical and Electrical Systems, CE378 Route Surveying, CE379 Route Surveying Lab, CE380 Boundary Surveying, CE381 Boundary Surveying Lab, CE383 Structural Steel Design, CE384 Reinforced Concrete Design, CE426 Advanced Structural Materials, CE436 Design/ Construction Integration, CE440 Masonry Design and Construction, CE441, Masonry Construction Lab, CE451 Water and Wastewater Treatment, CE462 Hydraulic Engineering Systems, CE466 Contracts and Specifications, CE476 Highway Construction, CE486 Steel and Concrete Construction, EE410/411 Computer Design, EE443 Microfabrication and MEMS, EE 431 Introduction to Power Systems, EE432 Power Systems II, EE461 Discrete Control Systems, EE443 Communication Applications, ME49X Reliability Engineering, ME49X Advanced Strength of Materials, ME 49X, Energy Conversion and Sustainability, ME49X Failure Analysis and Prevention, ME 49X Finite Element Analysis and ME49X Kinematics and Dynamics.

**5. Budget implications:** The courses within the new minor will be and have been regularly taught as engineering science elective courses. Students will choose elective courses that fulfill the minor. The teaching load for the engineering faculty will not be increased as a result of implementing the minor.

**6. Proposed term for implementation:** Spring 2014

**7. Dates of prior committee approvals:**

EngineeringDepartment/Division: \_\_\_\_4/30/13\_\_\_\_\_\_\_

Ogden College Curriculum Committee \_\_\_\_10/10/13\_\_\_\_\_\_\_

Professional Education Council (if applicable) \_\_\_\_\_\_n/a\_\_\_\_\_\_\_\_\_

General Education Committee (if applicable) \_\_\_\_\_\_n/a\_\_\_\_\_\_\_\_\_

Undergraduate Curriculum Committee \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

University Senate \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Attachment: Program Inventory Form**