1. Approval of minutes for the meeting of February 20th, 2018

2. Updates from Undergraduate Studies Committee
   • Undergrad Agenda
   • EMCH 302 Thermodynamics, Heat Conduction, and Principles of Modeling
   • Computer Engineering Program Proposal
   • CMPEN 270 Digital Design – Theory and Practice
   • CMPEN 462 Wireless Communications Systems and Security
   • CMPSC 101 Introduction to Programming
   • CMPSC 447 Software Security

3. Updates from Graduate Studies Committee
   • GSR Activity Summary
   • Proposal Report
   • Master of Engineering in Industrial Engineering Degree
   • Nuclear Security Option – Masters of Science and Masters of Engineering Degrees in Nuclear Engineering
   • CSE 583 – Pattern Recognition and Machine Learning
   • AMD 600 – Thesis Research
   • AMD 596 – Individual Studies

4. Updates from Engineering Technology Committee

5. Updates from Faculty Senate

6. Dean’s Report

7. Other business
Engineering Faculty Council
Meeting Agenda
February 20th, 2018
11:00 a.m.
202 Hammond Building (Stavely conference room)
Present:

1. Approval of minutes for the meeting of January 16, 2018
   Unanimously approved.

2. Dean’s Report:
   
   A. With the support of the EFC, the Dean’s office has reached out to department/unit
   heads to solicit nominations for faculty senate. The election results are as follows:

   Meg Handley, primary (4-year term)
   Jeffrey Laman, primary (4-year term)
   John Messner, primary (4-year term)
   Karl Reichard, primary (3-year term)
   Alok Sinha, primary (4-year term)
   Yanxi Liu, alternate
   Themis Matsoukas, alternate
   Ling Rothrock, alternate
   Justin Watson, alternate
   Siyang Zheng, alternate

3. Undergraduate Studies Committee
   No updates

4. Graduate Program Committee

   Graduate Faculty Council has clarified guidelines for a Research Masters Degree. A
   research degree must include active faculty engagement, low student/faculty rations
   and a culminating research experience.

5. Updates from the Faculty Senate

   A. Penn State has selected a new email system to replace WebMail. A description of the
   proposed changes was provided. In addition, Penn State IT services conducted a
   series of tests to assess our vulnerability to email phishing attacks. If you received an
   email about a “Mandatory Culture Survey”, that was a test.

   B. The Faculty Senate is discussing the recreation fee and the use of Recreation Hall.
   The Recreation Hall is currently not run by Campus Recreation, and there is the
potential for extra fees to be imposed on the use of facilities beyond those currently covered by Campus Recreational fees.

C. The Office of Research Management is reviewing and updating their policy on the disclosure of financial interests.

D. The Provost provided an update on undergraduate scholarship awards.
Engineering Faculty Council

Meeting Agenda

March 20th, 2018
11:00 a.m.
202 Stavely Conference Room, Hammond Building

1. Approval of minutes for the meeting of February 20th, 2018

2. Updates from Undergraduate Studies Committee
   • Undergrad Agenda
   • EMCH 302 Thermodynamics, Heat Conduction, and Principles of Modeling
   • Computer Engineering Program Proposal
   • CMPEN 270 Digital Design – Theory and Practice
   • CMPEN 462 Wireless Communications Systems and Security
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   • CMPSC 447 Software Security

3. Updates from Graduate Studies Committee
   • GSR Activity Summary
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   • Master of Engineering in Industrial Engineering Degree
   • Nuclear Security Option – Masters of Science and Masters of Engineering Degrees in Nuclear Engineering
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   • AMD 600 – Thesis Research
   • AMD 596 – Individual Studies

4. Updates from Engineering Technology Committee

5. Updates from Faculty Senate

6. Dean’s Report

7. Other business
<table>
<thead>
<tr>
<th>Type and Description of Change</th>
<th>Description or Rationale for Curricular Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EMCH 302 Thermodynamics, Heat Conduction, and Principles of Modeling</strong>  &lt;br&gt;Submitted by: Francesco Costanzo</td>
<td>EMCH 302H is a required course for engineering science students. This course presents the fundamental principles of classical thermostatics, thermodinamics, and heat transfer with relevant engineering applications. The students are expected to develop skills necessary to apply these principles to common engineering problems involving properties of matter, energy, non-reacting mixtures, and energy transport. The classical thermostatics and thermodynamics instruction will typically take 9 weeks. Control volume analysis techniques are introduced for closed and open systems undergoing both quasi-static and dynamic processes. The techniques are applied to analyze common power and refrigeration cycles, including gas and vapor systems. Diffusion in fluid and solid mixtures will also be considered. Special attention will be devoted to the notions of Helmholtz and Gibbs free energies as well as enthalpy. Use and significance of these concepts constitutive theories of gas, fluid, and solid materials systems will be discussed. The heat transfer component of the course will typically take 4 weeks. Instruction on heat transfer, will cover the three classical modes of heat transfer: conduction, convection, and radiation. Heat exchangers and heat transfer from extended surfaces are presented at a very basic level. Two weeks will be devoted to an introduction to statistical thermodynamic concepts in which a thermodynamic system is viewed as an ensemble whose state can be characterized in phase space. Enough background will be provided to compare and contrast the classical and statistical notions of entropy.</td>
</tr>
<tr>
<td><strong>Computer Engineering Program Proposal</strong>  &lt;br&gt;Submitted by: John Hannan</td>
<td>The mission of the faculty of the undergraduate computer engineering program at Penn State is to provide students with the knowledge and experience needed to pursue a productive lifelong career in industry or to engage in further study at the graduate level. Students participate in a balanced program of instruction covering the basic principles of the design and application of computer systems. The program includes coverage in breadth and depth of basic science, engineering, and abstract concepts of information handling. Students specialize in and are prepared for careers in the design, analysis and use of hardware, software and systems. The program is structured to ensure that graduates have a clear understanding of the design and the applications of computers, as well as the ability to apply this knowledge throughout their professional careers.</td>
</tr>
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</table>
Program Educational Objectives:
In particular, within a few years after graduation, graduates in computer engineering should be able to:
1 Work in industry or government producing or evaluating components of computer hardware and/or software systems.
2 Work in teams to design, implement, and/or maintain components of computer hardware and/or software systems.
3 Stay current through professional conferences, certificate programs, post-baccalaureate degree programs, or other professional educational activities.

Program Outcomes (Student Outcomes):
(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

For the B.S. degree in Computer Engineering, a minimum of 128 credits is required. This baccalaureate program in Computer Engineering is accredited by the Engineering Accreditation Commission of ABET, Inc., www.abet.org.

For a Bachelor of Science in Computer Engineering (CMPEN) a minimum of 128 credits are required.

To be consistent with all other majors in the college we added MATH 140 to the list of course for which a C is required. (We believe it was an oversight that this course hadn't been listed as requiring a C.)

We have dropped EBF 200 from the additional course options that included the ECON courses. No student has chosen this course in many, many years. We feel eliminating it as an option provides a simpler set of choices that are more in line with the spirit of the students gaining a general background in economics.
We have updated the short and long descriptions to more accurately describe the major. The existing descriptions were brief and dated.

We have updated the course requirements to allow either the existing introductory programming sequences CMPSC 121/122 or the new (proposed) programming sequence CMPSC 131/132. CMPSC 121 and CMPSC 122 specifically use the programming language C++ as required/desired by some majors. To support a broader range of computing-related majors (e.g., Data Sciences) for which C++ is not a good choice as a first language, we are introducing a new introductory programming course sequence, CMPSC 131 and CMPSC 132, which specifically does not include a prescribed programming language, choosing instead to focus on general programming outcomes and leave the choice of language to the instructor. (Python is expected to be the programming language most typically chosen.). This new sequence was specifically designed to allow either introductory sequence to continue to serve as the beginning programming experience for the CMPEN (and CMPSC) major. We expect some campuses may continue to offer only CMPSC 121 and CMPSC 122, while others may choose to offer only CMPSC 131 and CMPSC 132. As long as one of these sequences is offered, students will continue to be prepared for entrance into the CMPEN (or CMPSC) major.

<table>
<thead>
<tr>
<th>Course Change</th>
<th>Course Change</th>
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| **CMPEN 270 Digital Design: Theory and Practice**  
Submitted by: John Hannan | Introduction to digital systems and their design. Topics include combinational and sequential devices and circuits, modern design tools and design practices. Students may take only one course for credit for CMPEN 270 or 271 and CMPEN 270 or 275. CMPEN 270 Digital Design: Theory and Practice (4)CMPEN 270 is a first course in digital systems and digital system's design. It lays the groundwork for many later courses in computer organization and architecture and switching theory. The course includes both a lecture component to introduce important concepts, principles, methodologies and theories and a laboratory component in which the lecture material can be applied and practiced. The course introduces the theoretical foundation for digital systems including number systems, a variety of commonly used codes and Boolean algebra. Combinational devices, logic gates, and sequential devices, latches and flip-flops are introduced along with design techniques, methods and tools. Design criteria and objectives are considered and design trade-offs are examined. Higher level design elements are also examined such as decoders, multiplexers, counters, and registers, and their use in system design. Students are exposed to a variety of design tools and implementation techniques, including schematic capture tools, simulation tools, Hardware Description Languages (HDL) and HDL design tools. Laboratory work includes the design, construction and debugging of a variety of digital circuits, and the use of standard laboratory tools such as the oscilloscope and logic analyzer, and various software design tools.  
The only change is that PHYS 212 is being changed from a prerequisite to a concurrent course. The content of CMPEN 270 depends upon material in PHYS 212, but taking these
two courses together is academically justified. Based on the current structure of these two courses, material will be covered in PHYS 212 before it is required in CMPEN 270.

<table>
<thead>
<tr>
<th>CMPEN 462 Wireless Communications Systems and Security</th>
<th>Course Add</th>
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</thead>
<tbody>
<tr>
<td>Submitted by: Mark Mahon</td>
<td></td>
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<tr>
<td></td>
<td>This course explores the fundamental concepts and engineering processes of wireless communication systems, sensors, and security algorithms through the design, implementation, and evaluation of next generation wireless network architectures, and network and cryptographic protocols. This course is intended as a senior level course for computational majors such as computer science and computer engineering since it covers hardware and software design concepts associated with wireless access, data transmission, and computational security, security models, and privacy in a broad range of settings. The first part of the course studies programmatic, computational, and engineering issues associated with wireless systems and sensors at the physical protocol layer. Hardware, software, and engineering design considerations associated with MIMO, low latency, high reliability, and high data rate constraints will be analyzed. The next part of this course will introduce virtual machines, function virtualization, and network-slicing for constraint matching, resource scheduling, and mobility management at the data link and network protocol layers. The final component of the course focuses on the security and privacy for wireless systems and sensors including models and algorithms. The design and implementation of cryptographic algorithms for cellular, Wi-Fi, Bluetooth, Zigbee, and next generation systems including Device to Device (D2D), Vehicle to Vehicle (V2V), and Machine Type Communications (MTC) are studied and analyzed. Upon completion of the course students will be able to critically analyze the design, implementation, and protocols associated with wireless systems and sensors and assess the computational security and privacy vulnerabilities associated with these systems.</td>
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<tr>
<th>CMPSC 101 Introduction to Programming</th>
<th>Course Change</th>
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<tbody>
<tr>
<td>Submitted by: Brad Sottile, Steven Shaffer, and John Hannan</td>
<td></td>
</tr>
<tr>
<td></td>
<td>This course introduces the fundamental concepts and processes of solving computational problems through the design, implementation, testing, and evaluation of basic computer programs. The concepts include basic computational constructs such as calculation, iteration, conditions, functions, and data types. These provide the basic building blocks found in virtually all programming languages. The processes include the step-by-step refinement of a problem description into individual components that can be implemented, tested, and integrated into an effective solution.</td>
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<tr>
<td></td>
<td>As a general education course, the central theme to the course is computational thinking which includes a wide range of approaches to solving problems and designing systems that draw upon concepts fundamental to computer science. Computational thinking includes thinking about various types and sources of data, and the correctness, efficiency, elegance, and simplicity of various potential solutions. Computational thinking is applying principles of abstraction at multiple levels to focus on important details; it is applying problem decomposition to identify small problems that can be individually solved then combined to form a solution to the original problem.</td>
</tr>
</tbody>
</table>
Upon completion of this course, the student will be able to conceptualize and implement computational solutions to problems; to utilize the imperative model of computation to solve problems; to reason about problems at multiple levels of abstraction; and to analyze code for its behavior, efficiency, and correctness.

A student may receive credit for only one of the following courses: CMPSC 101, 121, 131, 200, 201.

The current title of CMPSC 101 is "Introduction to C++ Programming," and C++ is the programming language taught. The current Bulletin description reads as: "Properties of algorithms, languages, and notations for describing algorithms, applications of a procedure-oriented language to problem solving." This proposal seeks to remove the specification of C++ from the title and the implicit requirement that C++ be the language taught in the course. We have updated the title of the course and the course description to be more accurate and informative. The outcomes of the course have not changed.

C++ is not the easiest first programming language, particularly for students outside of science and engineering majors. There is no pedagogical or academic reason why this language should be the one taught in this course. The current outcomes of the course can be achieved by using other programming languages, and we believe they can be achieved more effectively using other languages such as Python. The revised course removes the requirement that the course be taught in C++, which will enable the course to be taught in other languages. Emphasis in the course will be on computational thinking, though some attention will be given to language-specific considerations in the language of instruction for the course.

Programs that explicitly list CMPSC 101 as a required or additional course do not explicitly rely on knowledge of C++ in subsequent courses. Most programs specifying CMPSC 101 list alternatives that include CMPSC 203, which is a business-oriented programming course teaching databases. We believe that these programs will continue to be served well by the revised version of CMPSC 101.

This course explores the fundamental concepts and engineering processes of software development and testing to produce software that is designed for security. This course is intended as a senior-level course for computational majors such as computer science and computer engineering since it covers the exploitation of programs based on computer architecture, systems, and software concepts. First, software engineering considerations associated with a variety of software vulnerabilities will be analyzed, along with defensive programming techniques to avoid such vulnerabilities. The next part of this course will introduce systematic software engineering principles for building secure software to defend its attack surface, such as reference monitors, privilege separation, information flow, and program verification. The third part will focus on methods for security testing of software.
including fuzz testing, symbolic execution, grey-box testing, and forensics. The final week of the course will examine adding security into the software engineering life cycle. The design and implementation of techniques to develop reference monitors, information-flow secure programs, testing mechanisms and enhancements, as well as defensive programming against prominent software vulnerabilities will be studied and analyzed. Upon completion of the course students will be able to critically analyze the design and implementation of software for security flaws and build security mechanisms to prevent exploitation of such flaws.
SENATE COMMITTEE ON CURRICULAR AFFAIRS

COURSE SUBMISSION AND CONSULTATION FORM

Principal Faculty Member(s) Proposing Course

<table>
<thead>
<tr>
<th>Name</th>
<th>User ID</th>
<th>College</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRANCESCO COSTANZO</td>
<td>fxc8</td>
<td>Engineering</td>
<td>Not Available</td>
</tr>
</tbody>
</table>

Academic Home: Engineering (EN)

Type of Proposal: [X] Add  [ ] Change  [ ] Drop

Course Designation
(EMCH 302) Thermodynamics, Heat Conduction, and Principles of Modeling

Course Information

Cross-Listed Courses:

Prerequisites:
CHEM 110, PHYS 211, MATH 230; OR MATH 231

Corequisites:

Concurrents:

Recommended Preparations:

Abbreviated Title: Thermo-Model

Discipline: None

Course Listing:

Special categories for Undergraduate (001-499) courses

Foundations

[ ] Writing/Speaking (GWS)
[ ] Quantification (GQ)

Knowledge Domains

[ ] Health & Wellness (GHW)
[ ] Natural Sciences (GN)
[ ] Arts (GA)
[ ] Humanities (GH)
[ ] Social and Behavioral Sciences (GS)

Additional Designations

[ ] Bachelor of Arts
[ ] International Cultures (IL)
[ ] United States Cultures (US)
[ ] Honors Course
[ ] Common course number - x94, x95, x96, x97, x99
[ ] Writing Across the Curriculum

First-Year Engagement Program

[ ] First-Year Seminar

Miscellaneous
Common Course

GE Learning Objectives

- GenEd Learning Objective: Effective Communication
- GenEd Learning Objective: Creative Thinking
- GenEd Learning Objective: Crit & Analytical Think
- GenEd Learning Objective: Global Learning
- GenEd Learning Objective: Integrative Thinking
- GenEd Learning Objective: Key Literacies
- GenEd Learning Objective: Soc Resp & Ethic Reason

Bulletin Listing

Minimum Credits: 4
Maximum Credits: 4
Repeatable: NO

Department with Curricular Responsibility: Engineering Science And Mechanics (UPEN_ESCM)
Effective Semester: Upon Approval
Travel Component: NO

Course Outline

A brief outline or overview of the course content:
1. Temperature (Classical thermodynamics: 2 hours)
   1.1 Macroscopic and microscopic viewpoints
   1.2 Thermal Equilibrium
   1.3 Empirical and absolute temperatures
2. Simple Thermodynamic Systems (Classical thermodynamics: 4 hours)
   2.1 P-V, P-T diagrams, P-V-T surface
   2.2 Equation of State (Constitutive Equations)
   2.3 Intensive and Extensive Quantities
3. Work, Energy, and Heat (Classical thermodynamics: 8 hours; Heat Transfer: 10 hours)
   3.1 Work Calculations on P-V Diagrams
   3.2 Work along a Path
   3.3 Internal Energy and Heat
   3.4 First Law of Thermodynamics
   4. Ideal Gases (Classical thermodynamics: 6 hours)
   4.1 Internal Energy, Free Energy, and Enthalpy
   4.2 Quasi-Static Adiabatic Transformations
   4.3 Determination of the Constitutive Coefficient for the PV Equation
5. Kinetic Theory of Gases (Kinetic Theory: 4 Hours)
   5.1 Microscopic Viewpoint
   5.2 Equation of State for an Ideal Gas
   5.3 Distribution of Velocities and Maxwell's Concept of Temperature
   5.4 Equipartition Theorem
6. Second Law of Thermodynamics (Classical thermodynamics: 8 hours; 6 hours of heat transfer)
   6.1 Work-Heat Conversion
   6.2 Stirling Machine
   6.3 Combustion Engines
   6.4 Kelvin-Plank Statement of the Second Law
   6.5 Heat Conduction/Transfer: Heat Transfer in Pipes
   6.6 Heat Conduction/Transfer: Heat Exchangers and Refrigerating Cycles
   7. Reversibility, Absolute Temperature, and Entropy (Classical thermodynamics: 8 hours)
   7.1 Necessary Conditions for reversibility
   7.2 Integrability of the Heat Differential
   7.3 Entropy as an Integrating Factor in Thermostatics
   7.4 Entropy as the Work Conjugate of Temperature
   7.5 Carnot Cycles
   7.6 Entropy and Energy Available for Mechanical Work
   7.7 Entropy as a Measure of Disorder
7. Introduction to Statistical Mechanics (Statistical Mechanics: 4 hours)
   8.1 Equilibrium Distribution
   8.2 Partition Functions

A listing of the major topics to be covered with an approximate length of time allotted for their discussion:
Classical Thermostatics and Thermodynamics: 36 hours
Course Description:
EMCH 302H is a required course for engineering science students. This course presents the fundamental principles of classical thermostatics, thermodynamics, and heat transfer with relevant engineering applications. The students are expected to develop skills necessary to apply these principles to common engineering problems involving properties of matter, energy, non-reacting mixtures, and energy transport. The classical thermostatics and thermodynamics instruction will typically take 9 weeks. Control volume analysis techniques are introduced for closed and open systems undergoing both quasi-static and dynamic processes. The techniques are applied to analyze common power and refrigeration cycles, including gas and vapor systems. Diffusion in fluid and solid mixtures will also be considered. Special attention will be devoted to the notions of Helmholtz and Gibbs free energies as well as enthalpy. Use and significance of these concepts constitutive theories of gas, fluid, and solid materials systems will be discussed. The heat transfer component of the course will typically take 4 weeks. Instruction on heat transfer, will cover the three classical modes of heat transfer: conduction, convection, and radiation. Heat exchangers and heat transfer from extended surfaces are presented at a very basic level. Two weeks will be devoted to an introduction to statistical thermodynamic concepts in which a thermodynamic system is viewed as an ensemble whose state can be characterized in phase space. Enough background will be provided to compare and contrast the classical and statistical notions of entropy.

The name(s) of the faculty member(s) responsible for the development of the course:
Name: FRANCESCO COSTANZO (fxc8)
Title: PROF ESM AND MATHEMATICS
Phone: +1 814 863 2030
Address: W315 MILLENNIUM SCI COMPLEX
Campus: UP
City: UNIVERSITY PARK
Fax:

CIP Code: 141101

Course Justification

Instructional, Educational, and Course Objectives:
This section should define what the student is expected to learn and what skills the student will develop.
Upon completing this course students should be able to:
1. Use basic principles to describe the state and model the evolution of simple systems.
2. Compute the efficiency of machines in converting heat into work and vice versa.
3. Describe the modes of heat exchange between two systems and quantify the exchange in question.
4. Demonstrate an understanding of the possible ways in which a microscopic view of a phenomenon manifests itself at coarser space–time scales.

Evaluation Methods:
Include a statement that explains how the achievement of the educational objective identified above will be assessed.
The procedures for determining students’ grades should be specifically identified.
Student performance will be evaluated via
1. Biweekly Homework Assignments: 7 assignments at 5% each for a total of 35%
2. Midterm Exam: 25%
3. Final Exam: 25%
4. Project: 15%

The project is envisioned as an individual assignment. The required elements of the project consists in
1. Choosing a physical system to model. For example, one can identify an ideal fluid, or a thermoelastic wire capable of heat conduction.
2. Describing the state of the system by choosing a proper set of state variables.
3. Describing a “thermodynamic process” by identifying the descriptors of such a process.
4. Identifying the equations of state of the system, that is, recognizing the necessity for constitutive equations of those elements of a thermodynamic process that are functions of the state variables.
5. Post functional forms for the equations of state and describe the set of experiments needed to empirically determine the material constants appearing in the equations of state.
6. Combine the equations of state with the appropriate balance laws to create a predictive theory of the system’s behavior. This will take the form of a system of ordinary or partial differential equations, possibly time-dependent.

Suggestions for material systems and/or phenomena to study in a project: Elastic Wire, Thermo-Elastic Wire with Heat Conduction, Elastic Membranes, Paramagnetic Solids, Piezoelectric Solids, Diffusion in Mixtures of Fluids or Gasses, Diffusion in Metallic Alloys.

Where appropriate, advanced team-based projects can be considered on topics such as simple reacting mixtures and phase transitions.

Relationship/Linkage of Course to Other Courses:
This statement should relate the course to existing or proposed new courses. It should provide a rationale for the level
of instruction, for any prerequisites that may be specified, or for the course’s role as a prerequisite for other courses. The Engineering Science (E SC) program is an honors program. The courses that have been selected as “required” were selected because they fitted the needs of the honors program. With this in mind, ME 302, a 4-credit course, is the course that was chosen to be the required thermodynamics course for E SC students, which includes both elements of equilibrium thermodynamics as well as heat transfer. As of the spring 2019 semester, the Mechanical and Nuclear Engineering Department will no longer be offering ME 302, thus creating the need to identify a replacement course that integrates thermodynamics with heat transfer. Other available thermodynamics courses such as MATSE 401 H and EME 301 were considered but deemed insufficient to satisfy the needs of the E SC program. MATSE 401 H is a 3-credit course focused on a “Review of equilibrium thermodynamics and applications to metallurgical and material systems.” As such, both the number of credits and its intended scope are insufficient to replace ME 302. The same comments apply to the 3-credit course, EME 301, which is specifically intended for students in the Department of Energy and Mineral Engineering. The E SC undergraduate curriculum committee concluded that, in the absence of acceptable substitutions, a new core course was needed, thus the current course proposal.

The heart of the proposed course is the modeling of a dynamical system. As such, the concepts and skills will relate to any other course in the curriculum covering the control of a dynamical process. This course is therefore relevant to materials engineering and materials modeling courses. It also serves as a foundation for higher-level modeling courses in classical, quantum, and statistical mechanics. If amenable to the Mechanics and Nuclear Engineering Department, the proposed course could be considered as a possible substitution for ME 300 for students pursuing an honors education and/or counting as an admissible substitution for ME 300 for courses in which ME 300 is a prerequisite.

CHEM 110, PHYS 211, MATH 230 or 231 are prerequisites for this course.

Rationale for CHEM 110: This course provides students with the fundamental concepts to relate the microscopic structure of a substance with some of its material properties. It is needed to provide a microscopic picture of the behavior of matter in support for its macroscopic description. Also, this course provides the students with a minimum of vocabulary and concepts concerning moles, elements, fundamental states of matter (gas, liquid, solid), properties of solutions, and notion of chemical equilibrium. These are all concepts upon which EMCH 302H will expand.

Rationale for PHYS 211: This course provides students with basic concepts pertaining to forces, mechanical equilibrium, work, energy, and kinetic energy. These are all concepts upon which EMCH 302H will expand.

Rationale for MATH 230 or 231: These courses are essential in that they provide students the analytical basis to understand concepts such as path integration (work, thermal exchange), differential, partial differentiation, and elementary differential equations. These are all basic tools in the analytical description of work-heat transformation, and a system’s evolution.

This course will not be a prerequisite for any other course.

Relationship of Course to Major, Option, Minor, or General Education: This statement should explain how the course will contribute to the major, option, or minor and indicate how it may function as a service course for other departments.

EMCH 302H is a required course for engineering science students.

A description of any special facilities: none

Frequency of Offering and Enrollment: EMCH 302H will be offered every spring semester.

Campuses That Have Offered ( ) Over The Past 4 Years

<table>
<thead>
<tr>
<th>semester</th>
<th>AB</th>
<th>AL</th>
<th>BK</th>
<th>BR</th>
<th>BW</th>
<th>CR</th>
<th>DS</th>
<th>ER</th>
<th>FE</th>
<th>GA</th>
<th>GV</th>
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<th>NK</th>
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<th>XC</th>
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<th>XS</th>
<th>YK</th>
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Review History

This section represents all consultation history that has occurred on this proposal

Legend

- ✔ Approve
- ✗ Rejected
- ⚫ Waiting Review
- 🔄 User Action Required
- ⚠ Pending Action(s)
- 🔴 Moved to Rejected Status
- 🔵 Approved

(#) - Review Order Sequence Number

Consultation

Recipient Name: BRUCE GLUCKMAN
Department: Engineering Science And Mechanics
Recipient Name: GARY GRAY  
Department: Engineering Science And Mechanics  
Position: Consultation  
Campus: UNIVERSITY PARK CAMPUS  
Title: ASSOC PROF ENGR SCI & MEC

Request sent: 10/24/2017 at 3:41 PM
Concur: Yes
Comments: My comments and suggestions are listed below.

- The brief outline or overview of the course content should be a short description of the course content in a few sentences. The detailed list of topics should go in the listing of the major topics, along with the time spent on each. It should essentially be an abbreviated version of the **Course Description**.
- Under the Course Description, the proposal should state that it is a required course for "Engineering Science" students, not "Engineering Science and Mechanics" students.
- In **Instructional, Educational, and Course Objectives**: I would change the wording to something like the following.
  - Upon completing this course, students should be able to:
    - Use basic principles to describe the state and model the evolution of simple systems
    - [the remaining three items are ok]
- In **Relationship of Course to Major, Option, Minor, or General Education**: again it should refer to Engineering Science students, not Engineering Science and Mechanics students.

Reviewed On: 10/24/2017 at 7:13 PM
Initiator Comments: Thank you for your comments! While your comment makes perfect sense, the brief outline and course description were left as is since this proposal was modeled after several proposals that were recently approved. All other changes were made as suggested.

Recipient Name: JOSEPH CUSUMANO  
Department: Engineering Science And Mechanics  
Position: Consultation  
Campus: UNIVERSITY PARK CAMPUS  
Title: PROF ENG SCI & MECH

Request sent: 11/9/2017 at 10:43 AM
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 11/24/2017 at 7:15 AM
Recipient Name: LUCAS PASSMORE  Department: Engineering Science And Mechanics

Position: Consultation  Campus: UNIVERSITY PARK CAMPUS

Title: Assistant Professor

Request sent: 10/24/2017 at 3:41 PM
Last sent: 11/6/2017 at 7:30 AM
Concur: Yes
Comments: Under Relationship/Linkage of Course to Other Courses: it might be worth discussing with ME the possibility of making it an optional course in place of ME 300 for students pursuing an honors education, and counting it in place of ME 300 as a prerequisite for later courses in their curriculum.
Reviewed On: 11/6/2017 at 12:25 PM

Initiator Comments: This possibility was added to the proposal. A consultation request will be sent to Dr. Thole.

Recipient Name: SULIN ZHANG  Department: (Not Available)

Position: Consultation  Campus: (Not Available)

Title: PROFESSOR ENGRSCI & MECH

Request sent: 11/9/2017 at 10:34 AM
Last sent: 11/20/2017 at 7:30 AM
Concur: Yes
Comments: In the connection to other courses section, the reference to ME should say "Mechanical and Nuclear Engineering" not "Mechanics and Nuclear Engineering"
Reviewed On: 11/20/2017 at 3:00 PM

Recipient Name: AMY PRITCHETT  Department: Aerospace Engineering

Position: Consultation  Campus: UNIVERSITY PARK CAMPUS

Title: DEPT HEAD/PROF AEROSPACE

Request sent: 11/9/2017 at 12:11 PM
Last sent: 11/20/2017 at 7:30 AM
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 11/24/2017 at 7:15 AM

Recipient Name: JANIS TERPENNY  Department: Industrial And Manufacturing Engineering

Position: Consultation  Campus: UNIVERSITY PARK CAMPUS

Title: DEPT HEAD & PROF INDUSTL

Request sent: 11/9/2017 at 12:11 PM
Last sent: 11/20/2017 at 7:30 AM
Title: DEPT HEAD MNE
Recipient Name: KAREN THOLE
Department: Mechanical Engineering
Position: Consultation
Campus: UNIVERSITY PARK CAMPUS
Title: DEPT HEAD MNE
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 11/24/2017 at 7:15 AM

Title: DEPT HEAD/PROF ELECT ENGR
Recipient Name: KULTEGIN AYDIN
Department: Electrical Engineering
Position: Consultation
Campus: UNIVERSITY PARK CAMPUS
Title: DEPT HEAD/PROF ELECT ENGR
Concur: Yes
Comments: Reviewed On: 11/22/2017 at 11:23 AM

Title: PROFESSOR MECHANICAL ENG
Recipient Name: LAURA PAULEY
Department: Mechanical Engineering
Position: Consultation
Campus: UNIVERSITY PARK CAMPUS
Title: PROFESSOR MECHANICAL ENG
Concur: Yes
Comments: This course includes approximately 70% of the course material in ME 302. The steam power cycles covered in ME 302 have been removed so that more material entropy and statistical thermodynamics can be added. Please correct the name of the Department of Mechanical and Nuclear Engineering.
Reviewed On: 11/14/2017 at 4:09 PM

Title: PROFESSOR ARCH ENGR
Recipient Name: M PARFITT
Department: Architectural Engineering
Position: Consultation
Campus: UNIVERSITY PARK CAMPUS
Title: PROFESSOR ARCH ENGR
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 11/24/2017 at 7:15 AM

Title: PROFESSOR ARCH ENGR
Recipient Name: PATRICK FOX
Department: Civil And Environmental Engineering
Position: Consultation
Campus: UNIVERSITY PARK CAMPUS
Title: PROFESSOR ARCH ENGR
Concur: Yes
Comments: Reviewed On: 11/24/2017 at 7:15 AM
<table>
<thead>
<tr>
<th>Position: Consultation</th>
<th>Campus: UNIVERSITY PARK CAMPUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title: PROF AND DEPT HEAD</td>
<td></td>
</tr>
</tbody>
</table>

| Request sent: 11/9/2017 at 12:11 PM |
| Concur: Yes |
| Comments: |
| Reviewed On: 11/12/2017 at 8:51 PM |

| Title: DEPT HD/PROF AG & BIO ENG |
| Recipient Name: PAUL HEINEMANN |
| Department: Agricultural And Biological Engineering |

| Request sent: 11/9/2017 at 12:11 PM |
| Concur: Yes |
| Comments: |
| Reviewed On: 11/9/2017 at 4:36 PM |

| Title: PROF/DEPT HEAD CHEM ENGR |
| Recipient Name: PHILLIP SAVAGE |
| Department: Chemical Engineering |

| Request sent: 11/9/2017 at 12:11 PM |
| Last sent: 11/20/2017 at 7:30 AM |
| Concur: Yes |
| Comments: (Completed By Default - Exceeded Time Limit) |
| Reviewed On: 11/24/2017 at 7:15 AM |

| Title: Professor and Department Head |
| Recipient Name: SUSAN SINNOTT |
| Department: Materials Science And Engineering |

| Request sent: 11/9/2017 at 12:11 PM |
| Concur: No, this proposal needs significant changes |
| Comments: It is unclear why there is a need for this course given that several similar courses already exist at the undergraduate level (ME 302, MatSE 401, EME 301). Some justification for creating a new course would strengthen the proposal. In addition, the use of the word “materials” in the title is somewhat misleading given that the list of topics does not include solid-state material examples. |
| Reviewed On: 11/13/2017 at 3:25 PM |

Initiator Comments: Thank you for your comments. In response to the need of the course: The Engineering Science program is an honors program and the courses that have been selected as required were selected because they fitted the needs of the honors program. With this in mind, ME 302, a 4 credit course is the course that was chosen to be the required thermodynamic course for its students, which includes both elements of equilibrium thermodynamics as well as heat transfer. As of the spring semester 2018 the Mechanical and Nuclear Engineering Department at Penn State will
This fact is the rationale for the Engineering Science program to identify a proper replacement for ME 302. The available course description for MATSE 401 H (via LionPATH) indicates that this is a 3 credit course focused on a “Review of equilibrium thermodynamics and applications to metallurgical and material systems.” As such, both because of the number of credits it provides and because of its intended scope, this course is not an acceptable replacement of ME 302.

The available course description for EME 301 indicates that this is also a 3 credit course. Furthermore, it is specifically intended for students in the Department of Energy and Mineral Engineering. Again, this course is not an acceptable replacement for ME 302 given the needs of the Engineering Science honors program.

Because of the above reasons, the undergraduate curriculum committee overseeing the Engineering Science program concluded that, in the absence of acceptable substitutions, a new course was needed, thus the current course proposal.

In response to the course title comments:

The reviewer’s point is well taken. In this proposal, the word “materials” WAS USED in a very broad sense as “matter in any of its states”. As we do not wish to confuse students who might consider attending this course, we HAVE REMOVED the word “materials” from the course title. The latter would therefore become (E MCH 302H) Thermodynamics, Heat Conduction, and Principles of Modeling.

---

Request sent: 11/28/2017 at 9:48 AM
Concur: Yes
Comments:
Reviewed On: 11/28/2017 at 10:20 PM

Recipient Name: SVEN BILEN
Department: School of Engr Design, Technology and Prof Pgrms
Position: Consultation
Campus: UNIVERSITY PARK CAMPUS
Title: DEPT HEAD/SEDTAPP

Request sent: 11/9/2017 at 12:11 PM
Last sent: 11/20/2017 at 7:31 AM
Concur: Yes
Comments:
Reviewed On: 11/20/2017 at 11:02 AM

Recipient Name: THOMAS LAPORTA
Department: Computer Science And Engineering
Position: Consultation
Campus: UNIVERSITY PARK CAMPUS
Title: LNHRDCHAIRPROF & DIR EECS

Request sent: 11/9/2017 at 12:11 PM
Concur: Yes
Comments:
Reviewed On: 11/13/2017 at 2:17 PM
Head of Department

Recipient Name: JUDITH TODD
Position: Head of Department
Title: 

Concur: [Not Yet Reviewed]
Comments: [Not Yet Reviewed]
Reviewed On: [Not Yet Reviewed]

SCCA Representative

Recipient Name: ROBERT MELTON
Position: SCCA Representative
Title: 

Concur: [Not Yet Reviewed]
Comments: [Not Yet Reviewed]
Reviewed On: [Not Yet Reviewed]

Dean of the College

Recipient Name: PETER BUTLER
Position: Dean of the College
Title: 

Concur: (Not Available)
Comments: (Not Available)
Reviewed On: (Not Available)
SCCA Subcommittee Review

Recipient Name: ALLISON ALBINSKI
Position: SCCA Subcommittee Review
Title:
Department: (Not Available)
Campus: UNIVERSITY PARK CAMPUS

Concur: [Not Yet Reviewed]
Comments: [Not Yet Reviewed]
Reviewed On: [Not Yet Reviewed]

Recipient Name: KADI CORTER
Position: SCCA Subcommittee Review
Title:
Department: (Not Available)
Campus: UNIVERSITY PARK CAMPUS

Concur: [Not Yet Reviewed]
Comments: [Not Yet Reviewed]
Reviewed On: [Not Yet Reviewed]

Recipient Name: JOY ROBERTSON
Position: SCCA Subcommittee Review
Title:
Department: (Not Available)
Campus: UNIVERSITY PARK CAMPUS

Request sent: 11/9/2017 at 1:51 PM
Concur: [Not Yet Reviewed]
Comments: [Not Yet Reviewed]
Reviewed On: [Not Yet Reviewed]

SCCA Review

Recipient Name: ALLISON ALBINSKI
Position: SCCA Review
Title:
Department: (Not Available)
Campus: UNIVERSITY PARK CAMPUS

Concur: [Not Yet Reviewed]
Comments: [Not Yet Reviewed]
Reviewed On: [Not Yet Reviewed]

Recipient Name: KADI CORTER
Position: SCCA Review
Title:
Department: (Not Available)
Campus: UNIVERSITY PARK CAMPUS
Faculty Senate Review

Recipient Name: JOY ROBERTSON
Position: SCCA Review
Campus: UNIVERSITY PARK CAMPUS

Request sent: 11/9/2017 at 1:52 PM
Concur: [Not Yet Reviewed]
Comments: [Not Yet Reviewed]
Reviewed On: [Not Yet Reviewed]

Faculty Senate Review

Recipient Name: ALLISON ALBINSKI
Position: Faculty Senate Review
Campus: UNIVERSITY PARK CAMPUS

Concur: [Not Yet Reviewed]
Comments: [Not Yet Reviewed]
Reviewed On: [Not Yet Reviewed]

Recipient Name: KADI CORTER
Position: Faculty Senate Review
Campus: UNIVERSITY PARK CAMPUS

Concur: [Not Yet Reviewed]
Comments: [Not Yet Reviewed]
Reviewed On: [Not Yet Reviewed]

Recipient Name: JOY ROBERTSON
Position: Faculty Senate Review
Campus: UNIVERSITY PARK CAMPUS

Request sent: 11/9/2017 at 1:51 PM
Concur: [Not Yet Reviewed]
Comments: [Not Yet Reviewed]
Reviewed On: [Not Yet Reviewed]
Curricular Information

Blue Sheet Item #:
Review Date:

SCRID Numbers

(EMCH 302):
Proposal ID: 5476 created on 3/9/2018 4:12 PM
Proposal Designation: Computer Engineering (CMPEN)

This is a proposed Change to Undergraduate Stand Alone Major

Initiators

<table>
<thead>
<tr>
<th>Name</th>
<th>User ID</th>
<th>College</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOHN HANNAN</td>
<td>JJH9</td>
<td>Engineering (EN)</td>
<td>Not Available</td>
</tr>
</tbody>
</table>

Academic Home: Engineering (EN)

Program Definition
Degree Offered: Bachelor of Science (BS)
Effective Semester: Upon Approval 2012
Offering College(s)
| Engineering |

Entrance and/or Retention Policies

Entrance Requirement
Requested Policy: In addition to the minimum grade point average (GPA) requirements* described in the University Policies, all College of Engineering entrance to major course requirements must also be completed with a minimum grade of C: CHEM 110 (GN), MATH 140 (GQ), MATH 141 (GQ), MATH 250 or MATH 251, PHYS 211 (GN) and PHYS 212 (GN). All of these courses must be completed by the end of the semester during which the admission to major process is carried out.

Justification: No change.
Objectives and Justification

Objectives:
No change

Justification:
No change

Justification For The Change Proposal:

To be consistent with all other majors in the college we added MATH 140 to the list of courses for which a C is required. (We believe it was an oversight that this course hasn't been listed as requiring a C.)

We have dropped EBF 200 from the additional course options that included the ECON courses. No student has chosen this course in many, many years. We feel eliminating it as an option provides a simpler set of choices that are more in line with the spirit of the students gaining a general background in economics.

We have updated the short and long descriptions to more accurately describe the major. The existing descriptions were brief and dated.

We have updated the course requirements to allow either the existing introductory programming sequences CMPSC 121/122 or the new (proposed) programming sequence CMPSC 131/132. CMPSC 121 and CMPSC 122 specifically use the programming language C++ as required/desired by some majors. To support a broader range of computing-related majors (e.g., Data Sciences) for which C++ is not a good choice as a first language, we are introducing a new introductory programming course sequence, CMPSC 131 and CMPSC 132, which specifically does not include a prescribed programming language, choosing instead to focus on general programming outcomes and leave the choice of language to the instructor. (Python is expected to be the programming language most typically chosen.). This new sequence was specifically designed to allow either introductory sequence to continue to serve as the beginning programming experience for the CMPEN (and CMPSC) major. We expect some campuses may continue to offer only CMPSC 121 and CMPSC 122, while others may choose to offer only CMPSC 131 and CMPSC 132. As long as one of these sequences is offered, students will continue to be prepared for entrance into the CMPEN (or CMPSC) major.

Proposal Outline

CIP Code: 140901

Faculty Member(s) in Charge:

1. Name: JOHN HANNAN (JJH9)
   Title: Associate Department Head
   Phone: 814-863-0702
   Address: W331 Westgate Building
   Campus: UP
   City: University Park
   Fax:

2. Name: CHITARANJAN DAS (cxd12)
   Title: DISTINGUISHED PROF CSE
   Phone: +1 814 865 0194
   Address: 0354F INFO SCI & TECH BL
   Campus: UP
   City: University Park
   Fax:

Program Description:

Computer Engineering
University Park, College of Engineering (CMPEN)
PROFESSOR CHITA DAS, Head of the Department of Computer Science and Engineering
The mission of the faculty of the undergraduate computer engineering program at Penn State is to provide students with the knowledge and experience needed to pursue a productive lifelong career in industry or to engage in further study at the graduate
level. Students participate in a balanced program of instruction covering the basic principles of the design and application of computer systems. The program includes coverage in breadth and depth of basic science, engineering, and abstract concepts of information handling. Students specialize in and are prepared for careers in the design, analysis and use of hardware, software and systems. The program is structured to ensure that graduates have a clear understanding of the design and the applications of computers, as well as the ability to apply this knowledge throughout their professional careers.

Program Educational Objectives:
In particular, within a few years after graduation, graduates in computer engineering should be able to:
1. Work in industry or government producing or evaluating components of computer hardware and/or software systems.
2. Work in teams to design, implement, and/or maintain components of computer hardware and/or software systems.
3. Stay current through professional conferences, certificate programs, post-baccalaureate degree programs, or other professional educational activities.

Program Outcomes (Student Outcomes):
(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

For the B.S. degree in Computer Engineering, a minimum of 128 credits is required. This baccalaureate program in Computer Engineering is accredited by the Engineering Accreditation Commission of ABET, Inc., www.abet.org.

For a Bachelor of Science in Computer Engineering (CMPEN) a minimum of 128 credits are required.

Scheduling Recommendation by Semester Standing Given Like (Sem: 1-2)

Academic Outline

REQUIREMENTS FOR THE MAJOR:
A minimum of 110 credits are required
(This includes 27 credits of General Education courses: 9 credits of GN courses; 6 credits of GQ courses; 3 credits of GS courses; 9 credits of GWS courses.)

GENERAL EDUCATION: 45 Credits
(27 of these 45 credits are included in REQUIREMENTS FOR THE MAJOR)

FIRST-YEAR SEMINAR:
Included in Requirements for the Major

UNITED STATES CULTURES AND INTERNATIONAL CULTURES:
Included in General Education Requirements

WRITING ACROSS THE CURRICULUM:
Included in Requirements for the Major

COMMON REQUIREMENTS FOR THE MAJOR: (110 Credits)

PRESCRIBED COURSES (72-73 Credits)

CHEM 110 GN(3)[1], MATH 140 GQ(4)[1], MATH 141 GQ(4)[1], PHYS 211 GN(4)[1], PHYS 212 GN(4)(Sem: 1-2)
CMPSC 221 (3)[1], CMPSC 360 (3)[1], CMPEN 362 (3), EE 210 (4)[1], MATH 220 GQ(2-3), MATH 231 (2), MATH 250 (3), PHYS 214 GN(2)(Sem: 3-4)
CMPEN 331 (3)[1], CMPEN 431 (3)[1], CMPSC 311 (3)[1], CMPSC 465 (3)[1], EE 310 (4)[1], EE 353 (3), ENGL 202C GWS(3), STAT 418 (3)(Sem: 5-6)
CMPEN 482W (3), CMPSC 473 (3)(Sem: 7-8)

ADDITIONAL COURSES (32 Credits)
Select 1 credit of First-Year Seminar (Sem: 1-2)

ENGL 15 (3); ENGL 30 (3)(Sem: 1-2)
CAS 100A (3); CAS 100B (3)(Sem: 3-4)
CMPEN 270 (4)[1]; CMPEN 271 (3)[1]. CMPEN 275 (1)(Sem: 3-4)
CMPSC 121 GQ(3); CMPSC 131 (3)(Sem: 1-2)
CMPSC 122 (3); CMPSC 132 (3)(Sem: 1-2)
ECON 14 (3); ECON 102 (3); ECON 104 (3);

Select 6 credits from:

CMPEN 411 (3); CMPEN 416 (3); CMPEN 417 (3); CMPEN 454 (3); CMPEN 455 (3); CMPEN 471 (3); CMPEN 472 (3); CMPEN 473 (3); CMPEN 475 (3); EE 453 (3); EE 456 (3)(Sem: 5-8)

Select 6 credits from any 400-level CMPEN or CMPSC course (Sem: 5-8)

SUPPORTING COURSES (6 Credits)

Select 6 credits from department list (Students may apply up to 3 credits of Co-op. Students who complete ROTC may apply up to 3 credits of ROTC as department list credits and 3 credits of ROTC as GHA credits.)

[1] A student enrolled in this program must receive a grade of C or better, as specified in Senate Policy 82-44.

Courses modified by this proposal
ECON 104 (3)

Courses added by this proposal
CMPSC 131; CMPSC 132

Existing Courses Added to or Moved Within Requirements for This Program
CMPSC 121 ; CMPSC 122 ; CMPSC 131 ; CMPSC 132

Existing Courses Removed from or Moved Within Requirements for This Program
CMPSC 121 ; CMPSC 122 ; EBF 200

Academic Program Costing Analysis Form

Anticipated Costs: No costs are anticipated.

Academic Program Admissions Form

Baccalaureate (4-year) programs
First-year: N/A
Transfer: N/A
Non-Degree: N/A
Already graduated: N/A

Associate (2-year) programs
First-year: N/A
Transfer: N/A
Non-Degree: N/A
Already graduated: N/A

Review History

This section represents all consultation history that has occurred on this proposal

Legend

Approve  Rejected  Waiting Review  User Action Required
Consultation

Recipient Name: DAVID SALVIA  
Department: Electrical Engineering

Position: Consultation  
Campus: UNIVERSITY PARK CAMPUS

Title: ASST PROF ELECT. ENGR.

Request sent: 6/15/2017 at 3:43 PM
Concur: Yes
Comments: EE supports this proposal. However, the "justification" is not really a justification -- it is merely a list of changes being made. The justification should be expanded to explain the rationale for adding CMPSC 131/132 to the CMPEN degree.
Reviewed On: 6/16/2017 at 9:34 AM

Recipient Name: LINDA MARIE NULL  
Department: Computer Science

Position: Consultation  
Campus: PENN STATE HARRISBURG, THE CAPITAL COLLEGE

Title: ASSOC PROF COMPUTER SCIEN

Request sent: 6/15/2017 at 3:43 PM
Last sent: 6/26/2017 at 7:30 AM
Concur: Yes
Comments: Reviewed On: 6/26/2017 at 10:34 AM

Recipient Name: MARY BETH ROSSON  
Department: Information Sciences And Technology

Position: Consultation  
Campus: UNIVERSITY PARK CAMPUS

Title: Associate Dean

Request sent: 6/15/2017 at 3:43 PM
Last sent: 6/26/2017 at 7:30 AM
Concur: Yes

Recipient Name: XIAOCONG FAN  
Department: Engineering
Title: ASSOC PROF CMPSC/SFTW ENG

Request sent: 6/15/2017 at 3:43 PM
Last sent: 6/26/2017 at 7:30 AM
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 6/30/2017 at 7:15 AM

Recipient Name: ASAD AZEMI
Department: School of Engr Technology and Commonwealth Engr
Position: Consultation
Campus: BRANDYWINE CAMPUS
Title: ASSOC PROF ENGINEERING

Request sent: 6/15/2017 at 3:43 PM
Concur: Yes
Comments:
Reviewed On: 6/23/2017 at 12:51 PM

Recipient Name: CHARLES GASTON
Department: (Not Available)
Position: Consultation
Campus: YORK CAMPUS
Title: ASST. PROF. ENGINEERING

Request sent: 6/15/2017 at 3:43 PM
Last sent: 6/26/2017 at 7:30 AM
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 6/30/2017 at 7:15 AM

Recipient Name: DAUDI WARYOBA
Department: School of Engr Technology and Commonwealth Engr
Position: Consultation
Campus: DUBOIS CAMPUS
Title: ASST PROF / ENGINEERING

Request sent: 6/15/2017 at 3:43 PM
Last sent: 6/26/2017 at 7:30 AM
Concur: Yes
Comments:
Reviewed On: 6/28/2017 at 5:18 PM
Recipient Name: DAVID HUNTER  Department: Statistics
Position: Consultation  Campus: UNIVERSITY PARK CAMPUS
Title: DEPT HEAD STATISTICS

Request sent: 6/15/2017 at 3:43 PM
Last sent: 6/26/2017 at 7:30 AM
Concur: Yes
Comments:
Reviewed On: 6/27/2017 at 1:07 PM

Recipient Name: DAVID MEREDITH  Department: School of Engr Technology and Commonwealth Engr
Position: Consultation  Campus: FAYETTE CAMPUS
Title: ASSOC PROF GEN ENG

Request sent: 6/15/2017 at 3:43 PM
Last sent: 6/26/2017 at 7:30 AM
Concur: Yes
Comments:

Recipient Name: DAVID SALVIA  Department: Electrical Engineering
Position: Consultation  Campus: UNIVERSITY PARK CAMPUS
Title: ASST PROF ELECT. ENGR.

Request sent: 6/15/2017 at 3:43 PM
Last sent: 6/26/2017 at 7:30 AM
Concur: Yes
Comments: The updated justification is much better.
Reviewed On: 6/26/2017 at 5:55 PM

Recipient Name: EDWARD EVANS  Department: Engineering
Position: Consultation  Campus: PENN STATE ERIE, THE BEHREND COLLEGE
Title: SR LECT ENGINEERING

Request sent: 6/15/2017 at 3:43 PM
Last sent: 6/26/2017 at 7:30 AM
Recipient Name: **ERIC LIPSKY**  
Department: Mechanical Engineering  
Position: Consultation  
Campus: GREATER ALLEGHENY CAMPUS  
Title: ASSOCIATE PROFESSOR

Request sent: 6/15/2017 at 3:43 PM  
Last sent: 6/26/2017 at 7:30 AM  
Concur: Yes  
Comments:  
Reviewed On: 6/26/2017 at 4:04 PM

Recipient Name: **HAROLD SCHOLZ**  
Department: (Not Available)  
Position: Consultation  
Campus: LEHIGH VALLEY CAMPUS  
Title: INSTRUCTOR

Request sent: 6/15/2017 at 3:43 PM  
Concur: Yes  
Comments: You have a typo in PHYS 212  
Reviewed On: 6/21/2017 at 5:45 PM

Recipient Name: **JAMES HENDRICKSON**  
Department: (Not Available)  
Position: Consultation  
Campus: (Not Available)  
Title: LECT ENGINEERING

Request sent: 6/15/2017 at 3:43 PM  
Last sent: 6/26/2017 at 7:30 AM  
Concur: Yes  
Comments: (Completed By Default - Exceeded Time Limit)  
Reviewed On: 6/30/2017 at 7:15 AM

Recipient Name: **JANICE MARGLE**  
Department: Abington College (Pre-Major)  
Position: Consultation  
Campus: ABINGTON CAMPUS  
Title: ASSOC PROF ENGINEERING
Recipient Name: JEFFREY CHIAMPI
Position: Consultation
Title: COMPUTER SCIENCE
Department: UC Engineering
Campus: WILKES-BARRE CAMPUS

Recipient Name: JEFFREY STONE
Position: Consultation
Title: SENIOR INSTR INFO SCI/TECH
Department: UC Information Sciences & Technology
Campus: SCHUYLKILL CAMPUS

Recipient Name: JENIFER SHANNON
Position: Consultation
Title: LECTURER ENGINEERING
Department: (Not Available)
Campus: (Not Available)

Recipient Name: KENNETH DUDECK
Position: Consultation
Title: ASSOC PROF ENGR
Department: UC Engineering
Campus: HAZLETON CAMPUS
Recipient Name: KHALED AMLEH  Department: UC Engineering
Position: Consultation  Campus: MONT ALTO CAMPUS
Title: ASSOC PROF ENGINEERING

Recipient Name: LINDA NULL  Department: Computer Science
Position: Consultation  Campus: PENN STATE HARRISBURG, THE CAPITAL COLLEGE
Title: ASSOC PROF COMPUTER SCIE

Recipient Name: MAJID CHATSAZ  Department: School of Engr Design, Technology and Prof Prgrms
Position: Consultation  Campus: WORTHINGTON SCRANTON CAMPUS
Title: ASST PROF GENERAL ENGR

Recipient Name: LINDA NULL  Department: Computer Science
Position: Consultation  Campus: PENN STATE HARRISBURG, THE CAPITAL COLLEGE
Title: ASSOC PROF COMPUTER SCIE

Recipient Name: MAJID CHATSAZ  Department: School of Engr Design, Technology and Prof Prgrms
Position: Consultation  Campus: WORTHINGTON SCRANTON CAMPUS
Title: ASST PROF GENERAL ENGR
Title: ASSOC PROF POLITICAL SCI

Recipient Name: MARIE HOJNACKI
Department: Political Science
Position: Consultation
Campus: UNIVERSITY PARK CAMPUS
Title: ASSOC PROF POLITICAL SCI

Request sent: 6/15/2017 at 3:43 PM
Last sent: 6/26/2017 at 7:30 AM
Concur: Yes
Comments: CMPSC 121 & 122 are part of the core curriculum for the undergraduate SoDA major offered through political science. We plan to modify our core to allow students to take either 121 & 122 or 131 &132.
Reviewed On: 6/29/2017 at 1:29 AM

Title: Associate Dean

Recipient Name: MARY BETH ROSSON
Department: Information Sciences And Technology
Position: Consultation
Campus: UNIVERSITY PARK CAMPUS
Title: Associate Dean

Request sent: 6/15/2017 at 3:43 PM
Last sent: 6/26/2017 at 7:30 AM
Concur: Yes
Comments: 
Reviewed On: 6/28/2017 at 10:14 AM

Title: ASSOC PROF PHYSICS

Recipient Name: MICHAEL GALLIS
Department: UC Science
Position: Consultation
Campus: SCHUYLKILL CAMPUS
Title: ASSOC PROF PHYSICS

Request sent: 6/15/2017 at 3:43 PM
Last sent: 6/26/2017 at 7:30 AM
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 6/30/2017 at 7:15 AM

Title: ASSOC PROF MECH ENG

Recipient Name: RICHARD CIOCCI
Department: Science, Engineering And Technology
Position: Consultation
Campus: PENN STATE HARRISBURG, THE CAPITAL COLLEGE
Title: ASSOC PROF MECH ENG

Request sent: 6/15/2017 at 3:43 PM
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<th>Last sent: 6/26/2017 at 7:30 AM</th>
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<td><strong>Concur:</strong> Yes</td>
<td><strong>Comments:</strong> Under additional courses several ANDs and ORs are necessary as per the current catalog listing. If these are corrected then OK. Please remember to update the Engineering Suggested Academic Plans (SAPs).</td>
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<td><strong>Reviewed On:</strong> 6/26/2017 at 2:33 PM</td>
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Title: ACADEMIC ADVISER 3

(30) Request sent: 6/15/2017 at 3:43 PM  
Last sent: 6/26/2017 at 7:30 AM  
Concur: Yes  
Comments: (Completed By Default - Exceeded Time Limit)  
Reviewed On: 6/30/2017 at 7:15 AM

Recipient Name: XIAOCONG FAN  
Department: Engineering  
Position: Consultation  
Campus: PENN STATE ERIE, THE BEHREND COLLEGE  
Title: ASSOC PROF CMPSC/SFTW ENG

(31) Request sent: 6/15/2017 at 3:43 PM  
Last sent: 6/26/2017 at 7:30 AM  
Concur: Yes  
Comments: (Completed By Default - Exceeded Time Limit)  
Reviewed On: 6/30/2017 at 7:15 AM

Recipient Name: JEFFREY HILL  
Department: (Not Available)  
Position: Consultation  
Campus: WORLD CAMPUS  
Title: ACADEMIC ADVISING MGR 2

(32) Request sent: 6/16/2017 at 1:35 PM  
Last sent: 6/26/2017 at 7:30 AM  
Concur: Yes  
Comments:  
Reviewed On: 6/30/2017 at 7:54 AM

Head of Department

Recipient Name: JOHN JOSEPH HANNAN  
Department: (Not Available)  
Position: Head of Department  
Campus: UNIVERSITY PARK CAMPUS  
Title:  
Concur: [Not Yet Reviewed]  
Comments: [Not Yet Reviewed]  
Reviewed On: [Not Yet Reviewed]
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Comments: [Not Yet Reviewed]  
Reviewed On: [Not Yet Reviewed]

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Concur: [Not Yet Reviewed]  
Comments: [Not Yet Reviewed]  
Reviewed On: [Not Yet Reviewed]

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Concur: [Not Yet Reviewed]  
Comments: [Not Yet Reviewed]  
Reviewed On: [Not Yet Reviewed]

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Concur: [Not Yet Reviewed]  
Comments: [Not Yet Reviewed]  
Reviewed On: [Not Yet Reviewed]
### SCCA Review

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**Request sent**: 11/9/2017 at 1:51 PM  
**Concur**: [Not Yet Reviewed]  
**Comments**: [Not Yet Reviewed]  
**Reviewed On**: [Not Yet Reviewed]

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**Recipient Name**: JOY ROBERTSON  
**Department**: (Not Available)  
**Position**: SCCA Review  
**Campus**: UNIVERSITY PARK CAMPUS  
**Request sent**: 11/9/2017 at 1:52 PM  
**Concur**: [Not Yet Reviewed]  
**Comments**: [Not Yet Reviewed]  
**Reviewed On**: [Not Yet Reviewed]
# Faculty Senate Review

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- Comments: [Not Yet Reviewed]
- Reviewed On: [Not Yet Reviewed]

# Registrar Data Entry

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<td>PAULA HAMATY</td>
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- Concur: [Not Yet Reviewed]
- Comments: [Not Yet Reviewed]
- Reviewed On: [Not Yet Reviewed]
Curricular Information

Blue Sheet Item #: 
Review Date: 

Program Codes

Engineering: CMPEN_BS

Option Codes

Computer Engineering (CMPEN):

Uploaded Documents:

Context Type: Prospectus Memo  
File Description: ENG BS Computer Engineering  
File Name: ENG BS Computer Engineering Revisions.pdf  
Proposal ID: 4611 created on 3/9/2018 4:06 PM
UPLOADED DOCUMENTS FOLLOW:
Thank you for the submission of your P-2 prospectus to make curricular revisions to the Bachelor of Science in Computer Engineering. The ACUE Prospectus Committee has reviewed your prospectus and recommends continued consultation with Penn State Erie, The Behrend College. In line with AAPPM P-2 criteria and consultation, you may now move to the formal P-2 submission process.

cc:  David J. Christiansen
     Kadi K. Corter
     Michele L. Duffey
     Anna M. Griswold
     Daniel R. Hagen
     Tracy S. Hoover
     Robert N. Pangborn
SENATE COMMITTEE ON CURRICULAR AFFAIRS
COURSE SUBMISSION AND CONSULTATION FORM

Principal Faculty Member(s) Proposing Course

Name: MARK MAHON  
User ID: mpm114  
College: Engineering (EN)  
Department: Not Available

Academic Home: Engineering (EN)  
Type of Proposal: ☑ Add  ☐ Change  ☐ Drop

Course Designation
(CMPEN 462) Wireless Communications Systems and Security

Course Information
Cross-Listed Courses:

Prerequisites:
CMPEN 362 OR EE 362

Corequisites:

Concurrents:

Recommended Preparations:

Abbreviated Title: Wireless Security  
Discipline: None

Course Listing:

Special categories for Undergraduate (001-499) courses

Foundations
☐ Writing/Speaking (GWS)  
☐ Quantification (GQ)

Knowledge Domains
☐ Health & Wellness (GHW)  
☐ Natural Sciences (GN)  
☐ Arts (GA)  
☐ Humanities (GH)  
☐ Social and Behavioral Sciences (GS)

Additional Designations
☐ Bachelor of Arts  
☐ International Cultures (IL)  
☐ United States Cultures (US)  
☐ Honors Course  
☐ Common course number - x94, x95, x96, x97, x99  
☐ Writing Across the Curriculum

First-Year Engagement Program
☐ First-Year Seminar

Miscellaneous
Course Outline

A brief outline or overview of the course content:
This course explores the fundamental concepts and engineering processes of wireless communication systems, sensors, and security algorithms through the design, implementation, and evaluation of next generation wireless network architectures, protocols, and cryptographic algorithms. The concepts include modulation techniques, time-frequency plane representation of signals, multiple user access, multiplexing, synchronization, control and data channel establishment, user authentication, privacy, encryption, security models, cryptographic protocols, mobility management, network-slicing, and virtual functions. This course is a 400-level CMPEN elective for the CMPEN, CMPSC, and EE majors.

A listing of the major topics to be covered with an approximate length of time allotted for their discussion:
Week 1 Introduction to Aspects of Wireless Systems
Week 2 Time and Frequency Domain Representation of Signals
Week 3 Introduction to Wireless Modulation Techniques
Week 4 Physical Layer Properties
Week 5 Synchronization
Week 6 Signaling Connection
Week 7 Access Techniques
Week 8 Resource Scheduling and Allocation of Resources
Week 9 Mobility Management
Week 10 Introduction to Security Models for Wireless Systems
Week 11 NG-WLAN Internetworking
Week 12 Security and Privacy
Week 13 Cryptographic Algorithms for Wireless Systems
Week 14 Security for Data and Voice
Week 15 Security for Machine Type Communications

Course Description:
This course explores the fundamental concepts and engineering processes of wireless communication systems, sensors, and security algorithms through the design, implementation, and evaluation of next generation wireless network architectures, and network and cryptographic protocols. This course is intended as a senior level course for computational majors such as computer science and computer engineering since it covers hardware and software design concepts associated with wireless access, data transmission, and computational security, security models, and privacy in a broad range of settings. The first part of the course studies programmatic, computational, and engineering issues associated with wireless systems and sensors at the physical protocol layer. Hardware, software, and engineering design considerations associated with MIMO, low latency, high reliability, and high data rate constraints will be analyzed. The next part of this course will introduce virtual machines, function virtualization, and network-slicing for constraint matching, resource scheduling, and mobility management at the data link and network protocol layers. The final component of the course focuses on the security and privacy for wireless systems and sensors including models and algorithms. The design and implementation of cryptographic algorithms for cellular, Wi-Fi, Bluetooth, Zigbee, and next generation systems including Device to Device (D2D), Vehicle to Vehicle (V2V), and Machine Type Communications (MTC) are studied and analyzed. Upon completion of the course students will be able to critically analyze the design, implementation, and protocols associated with wireless systems and sensors and assess the computational security and privacy vulnerabilities associated with these systems.

The name(s) of the faculty member(s) responsible for the development of the course:
Name: MARK MAHON (mpm114)
Title: Assistant Teaching Professor
Course Justification

Instructional, Educational, and Course Objectives:
This section should define what the student is expected to learn and what skills the student will develop.

Upon completion of this course students will be able to identify and analyze wireless communications systems cryptographic protocols, security models, and privacy mechanisms. Students will also be able to identify security vulnerabilities at the physical, data link, and network layers of the wireless system and identify or design mitigation strategies for limiting the system's susceptibility to malicious attacks.

Evaluation Methods:
Include a statement that explains how the achievement of the educational objective identified above will be assessed. The procedures for determining students' grades should be specifically identified.

The achievement of the course educational objectives will be assessed through the evaluation of assigned homework problems, administered quizzes, midterms, and a final exam as well as assigned projects that will be designed to test their understanding through implementation of the course principles. Achievement of each outcome will be defined through a rubric that directly correlates student performance to level of achievement, based upon a traditional point grading scheme. A recommended point grading scheme follows:
Homework 10%
Semester exams (3) 60%
Design project 30%

Relationship/Linkage of Course to Other Courses:
This statement should relate the course to existing or proposed new courses. It should provide a rationale for the level of instruction, for any prerequisites that may be specified, or for the course’s role as a prerequisite for other courses.

This course is an extension of the communication network architecture and protocol design learned in CMPEN/EE 362. Additionally this course is related to system programming of computer networks found in CMPSC 311, computer security with an emphasis on Internet and operating system applications found in CMPSC 443, and operating system design, implementation, and management of resources found in CMPSC 473.

Relationship of Course to Major, Option, Minor, or General Education:
This statement should explain how the course will contribute to the major, option, or minor and indicate how it may function as a service course for other departments.

This course will serve as a 400-level CMPEN elective for the CMPEN, CMPSC, and EE majors.

A description of any special facilities:
none

Frequency of Offering and Enrollment:
Yearly, enrollment of 60 at University Park anticipated

Campuses That Have Offered ( ) Over The Past 4 Years

| semester | AB | AL | BK | BR | BW | CR | DS | ER | FE | GA | GV | HB | HN | HY | LV | MA | NK | PC | SH | SL | UP | WB | WC | WS | XC | XP | XS | YK |

Review History
This section represents all consultation history that has occurred on this proposal

Legend

Approve
Rejected
Waiting Review
User Action Required
Consultation

Recipient Name: DAVID SALVIA  
Department: Electrical Engineering

Position: Consultation  
Campus: UNIVERSITY PARK CAMPUS

Title: ASST PROF ELECT. ENGR.

Request sent: 4/12/2017 at 9:16 AM
Concur: Yes
Comments: This looks like a great addition to the curriculum.
A few comments:
1) The prerequisite should include EE 362, since it is cross-listed with CMPEN 362.
2) I would prefer that the course description acknowledge that this course is also an elective for Electrical Engineering majors. This is mentioned later in the proposal, but is missing in the official course description.
3) This course doesn't have any signals/systems course as a prerequisite. If it is going to cover modulation techniques, I would think that this background material would be important.
Reviewed On: 4/12/2017 at 9:31 AM

Request sent: 1/31/2018 at 9:14 AM
Concur: Yes
Comments: This looks like a great follow-up to EE/CMPEN 362 and a good addition to the curriculum. I envision software-leaning EE students wanting to take this as an elective.
Reviewed On: 1/31/2018 at 9:22 AM

Recipient Name: LINDA MARIE NULL  
Department: Computer Science

Position: Consultation  
Campus: PENN STATE HARRISBURG, THE CAPITAL COLLEGE

Title: ASSOC PROF COMPUTER SCIEN

Request sent: 4/12/2017 at 9:16 AM
Last sent: 4/17/2017 at 7:30 AM
Concur: Yes
Comments:
Reviewed On: 4/19/2017 at 12:28 PM

Request sent: 1/31/2018 at 9:14 AM
Last sent: 2/13/2018 at 8:25 AM
Concur: Yes
Comments:
Reviewed On: 2/14/2018 at 12:24 PM

Recipient Name: MARY BETH ROSSON  
Department: Information Sciences And Technology

Position: Consultation  
Campus: UNIVERSITY PARK CAMPUS

Title: Associate Dean

Request sent: 4/12/2017 at 9:16 AM
Last sent: 4/24/2017 at 7:30 AM
Concur: Yes
Recipient Name: XIAOCONG FAN  Department: Engineering
Position: Consultation  
Campus: PENN STATE ERIE, THE BEHREND COLLEGE
Title: ASSOC PROF CMPSC/SFTW ENG

Recipient Name: ASAD AZEMI  Department: School of Engr Technology and Commonwealth Engr
Position: Consultation  
Campus: BRANDYWINE CAMPUS
Title: ASSOC PROF ENGINEERING

Recipient Name: CHARLES GASTON  Department: (Not Available)
Position: Consultation  
Campus: YORK CAMPUS

Concur: Yes
Comments: Evaluation method needs to include sample grading and relate dot he "education objectives."
Since the minor in cybersecurity has not been approved, the related statement should be deleted.
Reviewed On: 2/7/2018 at 2:13 PM
Initiator Comments: Asad,
Thank you for your comments. I have added text to relate the evaluation methods to include sample grading and relate them to the educational objectives. I have also deleted the mention of the minor.
Sincerely,
Mark Mahon

Concur: Yes
Comments:
Reviewed On: 2/12/2018 at 12:13 AM
Title: ASST. PROF. ENGINEERING

Request sent: 1/31/2018 at 9:14 AM
Concur: Yes
Comments: Reviewed On: 2/5/2018 at 8:13 AM

Recipient Name: DAUDI WARYOBA
Department: School of Engr Technology and Commonwealth Engr
Position: Consultation
Campus: DUBOIS CAMPUS
Title: ASST PROF / ENGINEERING

Request sent: 1/31/2018 at 9:14 AM
Last sent: 2/12/2018 at 7:30 AM
Concur: Yes
Comments: Reviewed On: 2/13/2018 at 9:26 PM

Recipient Name: DAVID BRUCE MEREDITH
Department: School of Engr Technology and Commonwealth Engr
Position: Consultation
Campus: FAYETTE CAMPUS
Title: ASSOC PROF GEN ENG

Request sent: 1/31/2018 at 9:14 AM
Last sent: 2/12/2018 at 7:30 AM
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 2/15/2018 at 7:15 AM

Recipient Name: EDWARD EVANS
Department: Engineering
Position: Consultation
Campus: PENN STATE ERIE, THE BEHREND COLLEGE
Title: ASSOC TEACHING PROF ENGINEERING

Request sent: 1/31/2018 at 9:14 AM
Last sent: 2/12/2018 at 7:30 AM
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 2/15/2018 at 7:15 AM

Recipient Name: ERIC LIPSKY
Department: Mechanical Engineering
Position: Consultation
Campus: GREATER ALLEGHENY CAMPUS
Title: ASSOCIATE PROFESSOR
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<td>Recipient Name: <strong>HAROLD N SCHOLZ</strong></td>
<td>Department: (Not Available)</td>
<td>Position: Consultation</td>
<td>Campus: LEHIGH VALLEY CAMPUS</td>
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<td>Title: INSTRUCTOR</td>
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<td>Recipient Name: <strong>JAMES HENDRICKSON</strong></td>
<td>Department: (Not Available)</td>
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<td>Recipient Name: <strong>JANICE MARGLE</strong></td>
<td>Department: Abington College (Pre-Major)</td>
<td>Position: Consultation</td>
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<td>Recipient Name: <strong>JEFFREY CHIAMPI</strong></td>
<td>Department: UC Engineering</td>
<td>Position: Consultation</td>
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<td>Linda Null</td>
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<td>Consultation</td>
<td>PENN STATE HARRISBURG, THE CAPITAL COLLEGE</td>
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Concur: Yes
Comments: Excellent class to add to the curriculum.
Reviewed On: 2/14/2018 at 12:26 PM
Title: ASST PROF GENERAL ENGR
Recipient Name: MAJID R CHATSAZ
Department: School of Engr Design, Technology and Prof Prgms
Position: Consultation
Campus: WORTHINGTON SCRANTON CAMPUS

Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 2/15/2018 at 7:15 AM
Title: ASSOC PROF PHYSICS
Recipient Name: MICHAEL ROBERT GALLIS
Department: UC Science
Position: Consultation
Campus: SCHUYLKILL CAMPUS

Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 2/15/2018 at 7:15 AM
Title: ASSOC PROF MECH ENG
Recipient Name: RICHARD CIOCCI
Department: Science, Engineering And Technology
Position: Consultation
Campus: PENN STATE HARRISBURG, THE CAPITAL COLLEGE

Concur: Yes
Comments: Reviewed On: 1/31/2018 at 8:08 PM
Title: SR INSTR COMPUTER SCIENCE AND ENGINEERING
Recipient Name: RICHARD SINGER
Department: Business And Engineering
Position: Consultation
Campus: ALTOONA CAMPUS

Concur: Yes
Comments: Reviewed On: 2/14/2018 at 1:07 PM
Title: ASST PROF GENERAL ENGR
Recipient Name: MAJID R CHATSAZ
Department: School of Engr Design, Technology and Prof Prgms
Position: Consultation
Campus: WORTHINGTON SCRANTON CAMPUS

Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 2/15/2018 at 7:15 AM
Title: ASSOC PROF PHYSICS
Recipient Name: MICHAEL ROBERT GALLIS
Department: UC Science
Position: Consultation
Campus: SCHUYLKILL CAMPUS

Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 2/15/2018 at 7:15 AM
Title: ASSOC PROF MECH ENG
Recipient Name: RICHARD CIOCCI
Department: Science, Engineering And Technology
Position: Consultation
Campus: PENN STATE HARRISBURG, THE CAPITAL COLLEGE

Concur: Yes
Comments: Reviewed On: 1/31/2018 at 8:08 PM
Title: SR INSTR COMPUTER SCIENCE AND ENGINEERING
Recipient Name: RICHARD SINGER
Department: Business And Engineering
Position: Consultation
Campus: ALTOONA CAMPUS

Concur: Yes
Comments: Reviewed On: 2/14/2018 at 1:07 PM
Recipient Name: SALVATORE A MARSICO  
Department: UC Engineering  
Position: Consultation  
Campus: WILKES-BARRE CAMPUS  
Title: ASSOC PROF ENGR CC

(30)  
Request sent: 1/31/2018 at 9:14 AM  
Last sent: 2/13/2018 at 8:25 AM  
Concur: Yes  
Comments: (Completed By Default - Exceeded Time Limit)  
Reviewed On: 2/15/2018 at 7:15 AM

Recipient Name: SHERRY LEA KRATZAS  
Department: (Not Available)  
Position: Consultation  
Campus: BEAVER CAMPUS  
Title: INSTR COMP SCI

(31)  
Request sent: 1/31/2018 at 9:14 AM  
Last sent: 2/13/2018 at 8:25 AM  
Concur: Yes  
Comments: (Completed By Default - Exceeded Time Limit)  
Reviewed On: 2/15/2018 at 7:15 AM

Recipient Name: XIAOCONG FAN  
Department: Engineering  
Position: Consultation  
Campus: PENN STATE ERIE, THE BEHREND COLLEGE  
Title: ASSOC PROF CMPSC/SFTW ENG

(13)  
Request sent: 1/31/2018 at 9:14 AM  
Concur: Yes  
Comments:  
Reviewed On: 2/7/2018 at 9:24 AM

Recipient Name: NICKLAUS A GIACOBE  
Department: Information Sciences And Technology  
Position: Consultation  
Campus: UNIVERSITY PARK CAMPUS  
Title: Assistant Teaching Professor

(7)  
Request sent: 1/31/2018 at 9:14 AM  
Concur: Yes  
Comments:  

This course appears to cover a variety of wireless networking techniques and technologies. I am happy to see a broad perspective of different modulation techniques addressed. As technology changes over time, we need students with a theoretical understanding of different implementations of wireless access technologies.

I also like that this course addresses security techniques as part of the course, with several weeks of content anticipated related to security mechanisms. The wireless industry is rife with examples of poor implementations of security protocols (most notoriously, WEP) and some good, recent examples of robust security implementation, WPA2/AES/Enterprise. It looks like you'll have time to cover many of these, and dig into implementation examples. While my background is in the
implementation of systems using these protocols, it's good to see that you're targeting the development side of these systems. The examples of D2D, V2V and MTC will be motivating for students to design and implement new wireless communications systems. Although as the industry changes over time, new examples and motivating industry examples will change.

Reviewed On: 1/31/2018 at 11:09 AM

Recipient Name: PENG LIU
Department: Information Sciences And Technology
Position: Consultation
Campus: UNIVERSITY PARK CAMPUS
Title: PROFESSOR

Last sent: 2/13/2018 at 8:25 AM
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 2/15/2018 at 7:15 AM

Recipient Name: Vinayak Elangovan
Department: Abington College (Pre-Major)
Position: Consultation
Campus: ABINGTON CAMPUS
Title: Asst Prof Comp Sci

[34] Request sent: 2/2/2018 at 1:38 PM
Last sent: 2/13/2018 at 8:25 AM
Concur: Yes
Comments: 
Reviewed On: 2/15/2018 at 11:06 PM

Head of Department

Recipient Name: JOHN JOSEPH HANNAN
Department: (Not Available)
Position: Head of Department
Campus: UNIVERSITY PARK CAMPUS
Title:

Concur: [Not Yet Reviewed]
Comments: [Not Yet Reviewed]
Reviewed On: [Not Yet Reviewed]

SCCA Representative

Recipient Name: ROBERT MELTON
Department: (Not Available)
Position: SCCA Representative
Campus: UNIVERSITY PARK CAMPUS
Title:

Concur: [Not Yet Reviewed]
Comments: [Not Yet Reviewed]
Reviewed On: [Not Yet Reviewed]
**Dean of the College**

Recipient Name: **PETER BUTLER**  
Position: Dean of the College  
Campus: UNIVERSITY PARK CAMPUS  
Concur: [Not Yet Reviewed]  
Comments: [Not Yet Reviewed]  
Reviewed On: [Not Yet Reviewed]

**SCCA Subcommittee Review**

Recipient Name: **ALLISON ALBINSKI**  
Position: SCCA Subcommittee Review  
Campus: UNIVERSITY PARK CAMPUS  
Concur: [Not Yet Reviewed]  
Comments: [Not Yet Reviewed]  
Reviewed On: [Not Yet Reviewed]

Recipient Name: **KADI CORTER**  
Position: SCCA Subcommittee Review  
Campus: UNIVERSITY PARK CAMPUS  
Concur: [Not Yet Reviewed]  
Comments: [Not Yet Reviewed]  
Reviewed On: [Not Yet Reviewed]

Recipient Name: **JOY ROBERTSON**  
Position: SCCA Subcommittee Review  
Campus: UNIVERSITY PARK CAMPUS  
Concur: [Not Yet Reviewed]  
Comments: [Not Yet Reviewed]  
Reviewed On: [Not Yet Reviewed]

Request sent: 11/9/2017 at 1:51 PM

**SCCA Review**

Recipient Name: **ALLISON ALBINSKI**  
Position: SCCA Review  
Campus: UNIVERSITY PARK CAMPUS  
Concur: [Not Yet Reviewed]  
Comments: [Not Yet Reviewed]  
Reviewed On: [Not Yet Reviewed]
Request sent: 11/9/2017 at 1:51 PM
Concur: [Not Yet Reviewed]
Comments: [Not Yet Reviewed]
Reviewed On: [Not Yet Reviewed]

Curricular Information
Blue Sheet Item #: 
Review Date:

SCRID Numbers
(CMPEN 462):
Proposal ID: 4592 created on 3/9/2018 4:37 PM
SENATE COMMITTEE ON CURRICULAR AFFAIRS
COURSE SUBMISSION AND CONSULTATION FORM

Principal Faculty Member(s) Proposing Course

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<th>Date</th>
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<td>JOHN HANNAN</td>
<td>JJH9</td>
<td>Engineering (EN)</td>
<td>Not Available</td>
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Academic Home: Engineering (EN)

Type of Proposal: [ ] Add  [X] Change  [ ] Drop

[ ] I am requesting recertification of this course for the new Gen Ed and/or University Requirements Guidelines?

Course Designation

(CMPEN 270) Digital Design: Theory and Practice

Course Information

Cross-Listed Courses:

Prerequisites:

Corequisites:

Concurrents:

PHYS 212

Recommended Preparations:

Abbreviated Title: Digital Design

Discipline: None

Course Listing:

Special categories for Undergraduate (001-499) courses

Foundations

[ ] Writing/Speaking (GWS)
[ ] Quantification (GQ)

Knowledge Domains

[ ] Health & Wellness (GHW)
[ ] Natural Sciences (GN)
[ ] Arts (GA)
[ ] Humanities (GH)
[ ] Social and Behavioral Sciences (GS)

Additional Designations

[ ] Bachelor of Arts
[ ] International Cultures (IL)
[ ] United States Cultures (US)
[ ] Honors Course
[ ] Common course number - x94, x95, x96, x97, x99
[ ] Writing Across the Curriculum

First-Year Engagement Program

[ ] First-Year Seminar
Bullet Listing

Minimum Credits: 4
Maximum Credits: 4
Repeatable: NO
Department with Curricular Responsibility: Computer Science And Engineering (UPEN_CSE)
Effective Semester: After approval, the Faculty Senate will notify proposers of the effective date for this course change. Please be aware that the course change may not be effective until between 12 to 18 months following approval.
Travel Component: NO

Course Outline

A brief outline or overview of the course content:

A listing of the major topics to be covered with an approximate length of time allotted for their discussion:

Course Description:
Introduction to digital systems and their design. Topics include combinational and sequential devices and circuits, modern design tools and design practices. Students may take only one course for credit for CMPEN 270 or 271 and CMPEN 270 or 275. CMPEN 270 Digital Design: Theory and Practice (4)CMPEN 270 is a first course in digital systems and digital system's design. It lays the groundwork for many later courses in computer organization and architecture and switching theory. The course includes both a lecture component to introduce important concepts, principles, methodologies and theories and a laboratory component in which the lecture material can be applied and practiced. The course introduces the theoretical foundation for digital systems including number systems, a variety of commonly used codes and Boolean algebra. Combinational devices, logic gates, and sequential devices, latches and flip-flops are introduced along with design techniques, methods and tools. Design criteria and objectives are considered and design trade-offs are examined. Higher level design elements are also examined such as decoders, multiplexers, counters, and registers, and their use in system design. Students are exposed to a variety of design tools and implementation techniques, including schematic capture tools, simulation tools, Hardware Description Languages (HDL) and HDL design tools. Laboratory work includes the design, construction and debugging of a variety of digital circuits, and the use of standard laboratory tools such as the oscilloscope and logic analyzer, and various software design tools.

The name(s) of the faculty member(s) responsible for the development of the course:

- Name: JOHN HANNAN (JJH9)
- Title: Associate Department Head
- Phone: 814-863-0702
- Address: W331 Westgate Building
- Campus: UP
- City: University Park
- Fax:

Course Justification

Instructional, Educational, and Course Objectives:
This section should define what the student is expected to learn and what skills the student will develop.

Evaluation Methods:
Include a statement that explains how the achievement of the educational objective identified above will be assessed.
The procedures for determining students’ grades should be specifically identified.

Relationship/Linkage of Course to Other Courses:
This statement should relate the course to existing or proposed new courses. It should provide a rationale for the level of instruction, for any prerequisites that may be specified, or for the course’s role as a prerequisite for other courses.

Relationship of Course to Major, Option, Minor, or General Education:
This statement should explain how the course will contribute to the major, option, or minor and indicate how it may function as a service course for other departments.

A description of any special facilities:

Frequency of Offering and Enrollment:

Justification for Changing The Proposal:
Include a justification for each change to the course. Particular attention should be paid to the effects of the course change within the discipline and in other disciplines where the course may be required within a major or used as a service course. When a unit submits several course changes, with or without new course proposals, a general statement covering the programmatic effects of the changes should be submitted.

The only change is that PHYS 212 is being changed from a prerequisite to a concurrent course. The content of CMPEN 270 depends upon material in PHYS 212, but taking these two courses together is academically justified. Based on the current structure of these two courses, material will be covered in PHYS 212 before it is required in CMPEN 270.

Campuses That Have Offered (CMPEN 270) Over The Past 4 Years

| semester   | AB | AL | BK | BR | BW | CR | DS | ER | FE | GA | GV | HB | HN | HY | LV | MA | NK | PC | SH | SL | UP | WB | WC | WS | XC | XP | XS | YK |
|------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Spring 2018| ☑ |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Fall 2017  | ☑ |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Spring 2017| ☑ |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Fall 2016  | ☑ |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Spring 2016| ☑ |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Fall 2015  | ☑ |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Spring 2015| ☑ |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Fall 2014  | ☑ |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Spring 2014| ☑ |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

Review History

This section represents all consultation history that has occurred on this proposal

Legend

- Approve
- Rejected
- Waiting Review
- User Action Required
- Pending Action(s)
- Moved to Rejected Status
- Approved
- (#) - Review Order Sequence Number

Consultation

Recipient Name: ASAD AZEMI
Department: School of Engr Technology and Commonwealth Engr
Position: Consultation
Campus: BRANDYWINE CAMPUS
Title: ASSOC PROF ENGINEERING
Concur: Yes
Comments: Having physics 212 as a prerequisite was a big problem for the Commonwealth campuses, and the proposed change from prerequisite to concurrent will be very helpful to us. This will give us the option of offering CMPEN 270 rather than CMPEN 271 (fall) and CMPEN 275 (spring).
Reviewed On: 1/31/2018 at 12:52 PM

Recipient Name: CHARLES GASTON
Position: Consultation
Department: (Not Available)
Title: ASST. PROF. ENGINEERING
Campus: YORK CAMPUS

Concur: Yes
Comments: This is one step in the right direction. Too often an entire course is listed as a prerequisite because of one tiny component easily explained to any student who did not have the prerequisite (or to all those who have forgotten the material).
Reviewed On: 2/5/2018 at 7:49 AM

Recipient Name: DAVID WARYOBA
Position: Consultation
Department: School of Engr Technology and Commonwealth Engr
Title: ASSST PROF / ENGINEERING
Campus: DUBOIS CAMPUS

Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 2/15/2018 at 7:15 AM

Recipient Name: DAVID BRUCE MEREDITH
Position: Consultation
Department: School of Engr Technology and Commonwealth Engr
Title: ASSOC PROF GEN ENG
Campus: FAYETTE CAMPUS

Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 2/15/2018 at 7:15 AM

Recipient Name: EDWARD EVANS
Position: Consultation
Department: Engineering
Title: ASSOC TEACHING PROF ENGINEERING
Campus: PENN STATE ERIE, THE BEHREND COLLEGE
Recipient Name: **ERIC LIPSKY**  
Department: Mechanical Engineering  
Position: Consultation  
Campus: GREATER ALLEHENY CAMPUS  
Title: ASSOCIATE PROFESSOR

**Request sent:** 1/31/2018 at 9:41 AM  
**Last sent:** 2/12/2018 at 7:30 AM  
**Concur:** Yes  
**Comments:**  
Reviewed On: 2/13/2018 at 9:03 AM

Recipient Name: **HAROLD N SCHOLZ**  
Department: (Not Available)  
Position: Consultation  
Campus: LEHIGH VALLEY CAMPUS  
Title: INSTRUCTOR

**Request sent:** 1/31/2018 at 9:41 AM  
**Concur:** Yes  
**Comments:** I totally agree - will we start offering only CMPEN 270 instead of 271/275?  
Reviewed On: 1/31/2018 at 12:20 PM

Recipient Name: **JAMES HENDRICKSON**  
Department: (Not Available)  
Position: Consultation  
Campus: (Not Available)  
Title: LECT ENGINEERING

**Request sent:** 1/31/2018 at 9:41 AM  
**Last sent:** 2/12/2018 at 7:30 AM  
**Concur:** Yes  
**Comments:** (Completed By Default - Exceeded Time Limit)  
Reviewed On: 2/15/2018 at 7:15 AM

Recipient Name: **JANICE MARGLE**  
Department: Abington College (Pre-Major)  
Position: Consultation  
Campus: ABINGTON CAMPUS  
Title: ASSOC PROF ENGINEERING

**Request sent:** 1/31/2018 at 9:41 AM  
**Last sent:** 2/12/2018 at 7:30 AM  
**Concur:** Yes  
**Comments:** (Completed By Default - Exceeded Time Limit)  
Reviewed On: 2/15/2018 at 7:15 AM

Recipient Name: **JEFFREY CHIAMPI**  
Department: UC Engineering  
Position: Consultation  
Campus: WILKES-BARRE CAMPUS

**Request sent:** 1/31/2018 at 9:41 AM  
**Last sent:** 2/12/2018 at 7:30 AM  
**Concur:** Yes  
**Comments:** (Completed By Default - Exceeded Time Limit)  
Reviewed On: 2/15/2018 at 7:15 AM
Title: COMPUTER SCIENCE

Request sent: 1/31/2018 at 9:41 AM
Last sent: 2/12/2018 at 7:30 AM
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 2/15/2018 at 7:15 AM

Recipient Name: JEFFREY STONE Department: UC Information Sciences & Technology
Position: Consultation Campus: LEHIGH VALLEY CAMPUS
Title: ASSISTANT PROF INFO SCI/TECH

Request sent: 1/31/2018 at 9:41 AM
Concur: Yes
Comments: I agree with this proposal. It allows students flexibility to make progress in the major.
Reviewed On: 1/31/2018 at 10:36 AM

Recipient Name: JENIFER MARY SHANNON Department: Electrical Engineering
Position: Consultation Campus: BERKS CAMPUS
Title: LECTURER ENGINEERING

Request sent: 1/31/2018 at 9:41 AM
Concur: Yes
Comments:
Reviewed On: 1/31/2018 at 11:16 AM

Recipient Name: KENNETH DUDECK Department: UC Engineering
Position: Consultation Campus: HAZLETON CAMPUS
Title: ASSOC PROF ENGR

Request sent: 1/31/2018 at 9:41 AM
Concur: Yes
Comments: I total endorse this change to allow students to take Physics 212 concurrently with CMPEN 270. Now the pre-reqs match CMPEN 271/275 which is the only reason I have taught 271/275 instead of 270. Thank you very much for proposing this long over due change!
Reviewed On: 1/31/2018 at 10:24 AM

Recipient Name: KHALED AMLEH Department: UC Engineering
Position: Consultation Campus: MONT ALTO CAMPUS
Title: ASSOC PROF ENGINEERING

Request sent: 1/31/2018 at 9:41 AM
Last sent: 2/13/2018 at 8:25 AM
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Recipient Name: **Linda Null**  
Department: Computer Science  
Position: Consultation  
Campus: PENN STATE HARRISBURG, THE CAPITAL COLLEGE  
Title: ASSOC PROF COMPUTER SCIEN

Request sent: 1/31/2018 at 9:41 AM  
Last sent: 2/13/2018 at 8:25 AM  
Concur: Yes  
Comments:  
Reviewed On: 2/14/2018 at 12:23 PM

Recipient Name: **MAJID R CHATSAZ**  
Department: School of Engr Design, Technology and Prof Prgrms  
Position: Consultation  
Campus: WORTHINGTON SCRANTON CAMPUS  
Title: ASST PROF GENERAL ENGR

Request sent: 1/31/2018 at 9:41 AM  
Last sent: 2/13/2018 at 8:25 AM  
Concur: Yes  
Comments: (Completed By Default - Exceeded Time Limit)  
Reviewed On: 2/15/2018 at 7:15 AM

Recipient Name: **MICHAEL ROBERT GALLIS**  
Department: UC Science  
Position: Consultation  
Campus: SCHUYLKILL CAMPUS  
Title: ASSOC PROF PHYSICS

Request sent: 1/31/2018 at 9:41 AM  
Last sent: 2/13/2018 at 8:25 AM  
Concur: Yes  
Comments: (Completed By Default - Exceeded Time Limit)  
Reviewed On: 2/15/2018 at 7:15 AM

Recipient Name: **RICHARD CIOCCI**  
Department: Science, Engineering And Technology  
Position: Consultation  
Campus: PENN STATE HARRISBURG, THE CAPITAL COLLEGE  
Title: ASSOC PROF MECH ENG

Request sent: 1/31/2018 at 9:41 AM  
Concur: Yes  
Comments:  
Reviewed On: 1/31/2018 at 8:06 PM
Title: SR INSTR COMPUTER SCIENCE AND ENGINEERING

Recipient Name: RICHARD SINGER

Department: Business And Engineering
Position: Consultation
Campus: ALTOONA CAMPUS
Title: SR INSTR COMPUTER SCIENCE AND ENGINEERING

Request sent: 1/31/2018 at 9:41 AM
Last sent: 2/13/2018 at 8:25 AM
Concur: Yes
Comments: I believe the same change should be made to CMPEN 271 as well for those campuses that haven't switched to CMPEN 270.
Reviewed On: 2/14/2018 at 1:24 PM

Recipient Name: SALVATORE A MARSICO

Department: UC Engineering
Position: Consultation
Campus: WILKES-BARRE CAMPUS
Title: ASSOC PROF ENGR CC

Request sent: 1/31/2018 at 9:42 AM
Last sent: 2/13/2018 at 8:25 AM
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 2/15/2018 at 7:15 AM

Recipient Name: SHERRY LEA KRATSAS

Department: (Not Available)
Position: Consultation
Campus: BEAVER CAMPUS
Title: INSTR COMP SCI

Request sent: 1/31/2018 at 9:42 AM
Last sent: 2/13/2018 at 8:25 AM
Concur: Yes
Comments: Perfect. We will then change from a 271/275 listing to 270 to reinforce to all students that they need to take the lab.
Reviewed On: 2/13/2018 at 10:20 AM

Recipient Name: XIAOCONG FAN

Department: Engineering
Position: Consultation
Campus: PENN STATE ERIE, THE BEHREND COLLEGE
Title: ASSOC PROF CMPSC/SFTW ENG

Request sent: 1/31/2018 at 9:42 AM
Concur: Yes
Comments:
Reviewed On: 2/7/2018 at 9:20 AM

Recipient Name: AB Shafaye

Department: Science, Engineering And Technology
Position: Consultation
Campus: PENN STATE HARRISBURG, THE CAPITAL COLLEGE
Title: ASSOC PROF CMPSC/SFTW ENG
Title: EE/EET Programs Chair

**Recipient Name:** David Salvia  
**Department:** Electrical Engineering  
**Position:** Consultation  
**Campus:** UNIVERSITY PARK CAMPUS

**Concur:** Yes
**Comments:**
Reviewed On: 2/13/2018 at 10:03 PM

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**Recipient Name:** Thomas Hemminger  
**Department:** Engineering  
**Position:** Consultation  
**Campus:** PENN STATE ERIE, THE BEHREND COLLEGE

**Concur:** Yes
**Comments:**
Reviewed On: 1/31/2018 at 9:46 AM

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**Recipient Name:** Vinayak Elangovan  
**Department:** Abington College (Pre-Major)  
**Position:** Consultation  
**Campus:** ABINGTON CAMPUS

**Concur:** Yes
**Comments:**
Reviewed On: 2/15/2018 at 11:00 PM

---

Head of Department

**Recipient Name:** Chitaranjan Das  
**Department:** (Not Available)  
**Position:** Head of Department  
**Campus:** UNIVERSITY PARK CAMPUS

**Title:**
SCCA Representative

Recipient Name: ROBERT MELTON  
Position: SCCA Representative  
Title: 
Department: (Not Available)  
Campus: UNIVERSITY PARK CAMPUS  
Concur: [Not Yet Reviewed]  
Comments: [Not Yet Reviewed]  
Reviewed On: [Not Yet Reviewed]  

Dean of the College

Recipient Name: PETER BUTLER  
Position: Dean of the College  
Title: 
Department: (Not Available)  
Campus: UNIVERSITY PARK CAMPUS  
Concur: [Not Yet Reviewed]  
Comments: [Not Yet Reviewed]  
Reviewed On: [Not Yet Reviewed]  

SCCA Subcommittee Review

Recipient Name: ALLISON ALBINSKI  
Position: SCCA Subcommittee Review  
Title: 
Department: (Not Available)  
Campus: UNIVERSITY PARK CAMPUS  
Concur: [Not Yet Reviewed]  
Comments: [Not Yet Reviewed]  
Reviewed On: [Not Yet Reviewed]  

Recipient Name: JOY ROBERTSON  
Position: SCCA Subcommittee Review  
Title: 
Department: (Not Available)  
Campus: UNIVERSITY PARK CAMPUS  
Concur: [Not Yet Reviewed]  
Comments: [Not Yet Reviewed]  
Reviewed On: [Not Yet Reviewed]  

Recipient Name: KADI CORTER  
Department: (Not Available)
SCCA Review

Recipient Name: ALLISON ALBINSKI  Department: (Not Available)
Position: SCCA Review  Campus: UNIVERSITY PARK CAMPUS
Title:

Concur: [Not Yet Reviewed]
Comments: [Not Yet Reviewed]
Reviewed On: [Not Yet Reviewed]

Recipient Name: JOY ROBERTSON  Department: (Not Available)
Position: SCCA Review  Campus: UNIVERSITY PARK CAMPUS
Title:

Concur: [Not Yet Reviewed]
Comments: [Not Yet Reviewed]
Reviewed On: [Not Yet Reviewed]

Recipient Name: KADI CORTER  Department: (Not Available)
Position: SCCA Review  Campus: UNIVERSITY PARK CAMPUS
Title:

Concur: [Not Yet Reviewed]
Comments: [Not Yet Reviewed]
Reviewed On: [Not Yet Reviewed]

Faculty Senate Review

Recipient Name: ALLISON ALBINSKI  Department: (Not Available)
Position: Faculty Senate Review  Campus: UNIVERSITY PARK CAMPUS
Title:

Concur: [Not Yet Reviewed]
Comments: [Not Yet Reviewed]
Reviewed On: [Not Yet Reviewed]
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Curricular Information
Blue Sheet Item #: 
Review Date:

SCRID Numbers
(CMPEN 270):
Proposal ID: 6327 created on 3/9/2018 4:33 PM
SENATE COMMITTEE ON CURRICULAR AFFAIRS

COURSE SUBMISSION AND CONSULTATION FORM

**Principal Faculty Member(s) Proposing Course**

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<td>Brad Sottile</td>
<td>bjs5332</td>
<td>Engineering (EN)</td>
<td>Not Available</td>
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<tr>
<td>STEVEN SHAFFER</td>
<td>scs12</td>
<td>Engineering (EN)</td>
<td>Not Available</td>
<td></td>
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<tr>
<td>JOHN HANNAN</td>
<td>JJH9</td>
<td>Engineering (EN)</td>
<td>Not Available</td>
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Type of Proposal: Add ☒ Change ☐ Drop ☐

☒ I am requesting recertification of this course for the new Gen Ed and/or University Requirements Guidelines?

Course Designation

(CMSPC 101) Introduction to Programming

**Course Information**

Cross-Listed Courses:

Prerequisites:

Corequisites:

Concurrents:

Recommended Preparations:

Abbreviated Title: Intro Programming

Discipline: General Education

Course Listing: Foundation

**Special categories for Undergraduate (001-499) courses**

Foundations

☑ Writing/Speaking (GWS)
☒ Quantification (GQ)

Knowledge Domains

☐ Health & Wellness (GHW)
☐ Natural Sciences (GN)
☐ Arts (GA)
☐ Humanities (GH)
☐ Social and Behavioral Sciences (GS)

Additional Designations

☒ Bachelor of Arts
☐ International Cultures (IL)
☐ United States Cultures (US)
☐ Honors Course
☐ Common course number - x94, x95, x96, x97, x99

First-Year Engagement Program
First-Year Seminar

Miscellaneous

Common Course

GE Learning Objectives

- GenEd Learning Objective: Effective Communication
- GenEd Learning Objective: Creative Thinking
- GenEd Learning Objective: Crit & Analytical Think
- GenEd Learning Objective: Global Learning
- GenEd Learning Objective: Integrative Thinking
- GenEd Learning Objective: Key Literacies
- GenEd Learning Objective: Soc Resp & Ethic Reason

Bulletin Listing

Minimum Credits: 3
Maximum Credits: 3
Repeatable: NO
Department with Curricular Responsibility: Computer Science And Engineering (UPEN_CSE)
Effective Semester: After approval, the Faculty Senate will notify proposers of the effective date for this course change. Please be aware that the course change may not be effective until between 12 to 18 months following approval.
Travel Component: NO

Course Outline

A brief outline or overview of the course content:
This course studies basic concepts and processes of constructing computer programs, including algorithm development, data types, control structures, functions, and software development.

A listing of the major topics to be covered with an approximate length of time allotted for their discussion:
Overview of programming (1 week)
Variables, expressions, and assignment statements (2 weeks)
Basic data types (1 week)
Selection structures (2 weeks)
Repetition structures (2 weeks)
Functions (2 weeks)
Arrays and lists (2 weeks)
Software development principles (3 weeks)

Course Description:
This course introduces the fundamental concepts and processes of solving computational problems through the design, implementation, testing, and evaluation of basic computer programs. The concepts include basic computational constructs such as calculation, iteration, conditions, functions, and data types. These provide the basic building blocks found in virtually all programming languages. The processes include the step-by-step refinement of a problem description into individual components that can be implemented, tested, and integrated into an effective solution.

As a general education course, the central theme to the course is computational thinking which includes a wide range of approaches to solving problems and designing systems that draw upon concepts fundamental to computer science. Computational thinking includes thinking about various types and sources of data, and the correctness, efficiency, elegance, and simplicity of various potential solutions. Computational thinking is applying principles of abstraction at multiple levels to focus on important details; it is applying problem decomposition to identify small problems that can be individually solved then combined to form a solution to the original problem.

Upon completion of this course, the student will be able to conceptualize and implement computational solutions to problems; to utilize the imperative model of computation to solve problems; to reason about problems at multiple levels of abstraction; and to analyze code for its behavior, efficiency, and correctness.

A student may receive credit for only one of the following courses: CMPSC 101, 121, 131, 200, 201.

The name(s) of the faculty member(s) responsible for the development of the course:
Name: Brad Sottile (bjs5332)
Title: Lecturer in Computer Science and Engineering, and Aerospace Engineering
Phone: (814) 865-0165
Course Justification

Instructional, Educational, and Course Objectives:
This section should define what the student is expected to learn and what skills the student will develop.
Upon completion of this course, the student will be able to:
- Conceptualize and implement computational solutions to problems
- Utilize the imperative model of computation to solve problems
- Reason about problems at multiple levels of abstraction
- Analyze code for its behavior, efficiency, and correctness

Evaluation Methods:
Include a statement that explains how the achievement of the educational objective identified above will be assessed.
The procedures for determining students' grades should be specifically identified.
Assignments: Assignments will be graded on attention to requirements, correctness, and programming style.
Projects: Projects are typically larger problems, giving the student an opportunity to have a larger design experience.
Exams: Exams will cover the declarative (knowledge) and procedural (programming) aspects of the course.

Achievement of each educational outcome will be defined through rubrics that directly correlate student performance to level of achievement, adjusted as necessary for delivery method (resident instruction, online, or blended-learning), using a grading scheme such as: assignments: 50%, quizzes/exams: 30%, and final project: 20%.

Relationship/Linkage of Course to Other Courses:
This statement should relate the course to existing or proposed new courses. It should provide a rationale for the level of instruction, for any prerequisites that may be specified, or for the course’s role as a prerequisite for other courses.
CMPSC 101 is a service course offered in fulfillment of the general quantification (GQ) requirement.

Relationship of Course to Major, Option, Minor, or General Education:
This statement should explain how the course will contribute to the major, option, or minor and indicate how it may function as a service course for other departments.
This service course prepares students to think quantitatively, and to apply logic to quantitative problems. This course is currently approved as a GQ and under the BA: Quantification designation. None of the changes proposed for the course materially affect the course’s General Education designations.

A description of any special facilities:
Varies by course design and campus.

Frequency of Offering and Enrollment:
At University Park and the World Campus, sections of the course will be offered every semester, with anticipated enrollment of approximately 200 students. Enrollment and frequency of offering will vary at other campuses.

Justification for Changing The Proposal:
Include a justification for each change to the course. Particular attention should be paid to the effects of the course change within the discipline and in other disciplines where the course may be required within a major or used as a service course. When a unit submits several course changes, with or without new course proposals, a general statement covering the programmatic effects of the changes should be submitted.
The current title of CMPSC 101 is "Introduction to C++ Programming," and C++ is the programming language taught. The current Bulletin description reads as: "Properties of algorithms, languages, and notations for describing algorithms, applications of a
procedure-oriented language to problem solving." This proposal seeks to remove the specification of C++ from the title and the implicit requirement that C++ be the language taught in the course. We have updated the title of the course and the course description to be more accurate and informative. The outcomes of the course have not changed.

C++ is not the easiest first programming language, particularly for students outside of science and engineering majors. There is no pedagogical or academic reason why this language should be the one taught in this course. The current outcomes of the course can be achieved by using other programming languages, and we believe they can be achieved more effectively using other languages such as Python. The revised course removes the requirement that the course be taught in C++, which will enable the course to be taught in other languages. Emphasis in the course will be on computational thinking, though some attention will be given to language-specific considerations in the language of instruction for the course.

Programs that explicitly list CMPSC 101 as a required or additional course do not explicitly rely on knowledge of C++ in subsequent courses. Most programs specifying CMPSC 101 list alternatives that include CMPSC 203, which is a business-oriented programming course teaching databases. We believe that these programs will continue to be served well by the revised version of CMPSC 101.

Alignment with General Education Objectives

- **EFFECTIVE COMMUNICATION** – the ability to exchange information and ideas in oral, written, and visual form in ways that allow for informed and persuasive discourse that builds trust and respect among those engaged in that exchange, and helps create environments where creative ideas and problem-solving flourish.

- **KEY LITERACIES** – the ability to identify, interpret, create, communicate and compute using materials in a variety of media and contexts. Literacy acquired in multiple areas, such as textual, quantitative, information/technology, health, intercultural, historical, aesthetic, linguistic (world languages), and scientific, enables individuals to achieve their goals, to develop their knowledge and potential, to lead healthy and productive lives, and to participate fully in their community and wider society.

- **CRITICAL AND ANALYTICAL THINKING** – the habit of mind characterized by comprehensive exploration of issues, ideas, artifacts, and events before accepting or formulating a conclusion. It is the intellectually disciplined process of conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action.

- **INTEGRATIVE THINKING** – the ability to synthesize knowledge across multiple domains, modes of inquiry, historical periods, and perspectives, as well as the ability to identify linkages between existing knowledge and new information. Individuals who engage in integrative thinking are able to transfer knowledge within and beyond their current contexts.

- **CREATIVE THINKING** – the capacity to synthesize existing ideas, images, or expertise in original ways and the experience of performing, making, thinking, or acting in an imaginative way that may be characterized by innovation, divergent thinking, and intellectual risk taking.

- **GLOBAL LEARNING** – the intellectually disciplined abilities to analyze similarities and differences among cultures; evaluate natural, physical, social, cultural, historical, and economic legacies and hierarchies; and engage as community members and leaders who will continue to deal with the intricacies of an ever-changing world. Individuals should acquire the ability to analyze power; identify and critique interdependent global, regional, and local cultures and systems; and evaluate the implications for people's lives.

- **SOCIAL RESPONSIBILITY AND ETHICAL REASONING** – the ability to assess one's own values within the social context of problems, recognize ethical issues in a variety of settings, describe how different perspectives might be applied to ethical dilemmas, and consider the ramifications of alternative actions. Individuals should acquire the self-knowledge and leadership skills needed to play a role in creating and maintaining healthy, civil, safe, and thriving communities.

What component(s) of the course will help students achieve the General Education Learning Objectives covered in the course? Provide evidence that students in the course have adequate opportunities to achieve the identified learning objectives.

**Key Literacies**: Students identify and interpret information in order to create their own programs to solve computational problems. Problems presented in the course may vary across topical domains (e.g. social sciences, physical sciences, etc.). Students document their work (e.g. programming comments, lab reports, etc.) to communicate their thoughts and ideas.

**Critical and Analytical Thinking**: All real world problems are "word problems." Students must interpret provided information, make judgments about that information, and synthesize both what they have previously learned and what they are provided to elicit requirements, to design, to implement, to test, and to verify and validate the programs that they create.

**Creative Thinking**: Students are taught introductory programming techniques (e.g. input/output, selection structures, repetition structures, functions, etc.) and need to synthesize their knowledge to create new programs. Sometimes it is possible to repurpose code one has written before; sometimes one must develop new strategies for solving new and unfamiliar problems. Often, there can be several unique and distinct approaches to solving a given problem. Students learn to live with (and build upon) their earlier design decisions, or to redevelop their programs to rectify fundamental flaws in a given program's design.

How will students be assessed to determine their attainment of the Learning Objective(s) of General Education covered in this course? This assessment must be included as a portion of the student's overall performance in this course.

Programming courses are often inherently cumulative in nature, requiring students to utilize older course content in order to implement new concepts. All three General Education Learning Objectives addressed by this course tie into the study, analysis, design, and creation of computer programs, which necessarily form an important pedagogical foundation of the course. In addition to evaluating lower-level knowledge (in Bloom's Revised Taxonomy, "remember," "understand," and "apply"), one may also evaluative higher-level learning ("analyze," "evaluate," and "create") with well-posed examination-style questions.

**General Education Domain Criteria**

**General Education Designation**: Foundation
GQ Criteria

☑ Use mathematical, statistical, or computational models, principles, and processes to integrate, synthesize, generalize, or make judgments about real world problems

☑ Recognize patterns, establish mathematical relations, apply problem-solving skills, and think logically and critically

☑ Develop, explore, analyze, and reason about multi-variable relationships using quantitative tools

☐ Use probability to reason and make judgments based on data that exhibit variability

☑ Communicate and explain mathematical and statistical ideas

What components of the course will help students achieve the domain criteria selected above?

Programs (e.g. assignments, projects), and quizzes/examinations; see the prior commentary for the General Education Learning Objectives.

General Education Designation Requirements

Bachelor Of Arts Requirements:

☐ BA: Natural Sciences

☐ BA: Other Cultures

☐ BA: Foreign/World Lang (12th Unit)

☐ BA: Humanities

☐ BA: Social and BA: Behavioral Sciences

☐ BA: Arts

☑ BA: Quantification

☐ BA: Foreign/World Lang (All)

This is a GQ course; cf. the General Education justifications.

Campuses That Have Offered (CMPSC 101) Over The Past 4 Years

| semester          | AB | AL | BK | BR | BW | CR | DS | ER | FE | GA | GV | HB | HN | HY | LV | MA | NK | PC | SH | SL | UP | WB | WC | WS | XC | XP | XS | YK |
|-------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Spring 2018       | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| Fall 2017         | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| Summer 2017       | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| Spring 2017       | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| Fall 2016         | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
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| Spring 2016       | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| Fall 2015         | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| Summer 2015       | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| Spring 2015       | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| Fall 2014         | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| Summer 2014       | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| Spring 2014       | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |

Review History

This section represents all consultation history that has occurred on this proposal

Legend

☑ Approve
☒ Rejected
☐ Waiting Review
☐ User Action Required
Head of Department

Recipient Name: JOHN HANNAN  
Position: Head of Department  
Department: (Not Available)  
Campus: UNIVERSITY PARK CAMPUS  
Title:  
Concur: [Not Yet Reviewed]  
Comments: [Not Yet Reviewed]  
Reviewed On: [Not Yet Reviewed]

SCCA Representative

Recipient Name: ROBERT MELTON  
Position: SCCA Representative  
Department: (Not Available)  
Campus: UNIVERSITY PARK CAMPUS  
Title:  
Concur: [Not Yet Reviewed]  
Comments: [Not Yet Reviewed]  
Reviewed On: [Not Yet Reviewed]

Dean of the College

Recipient Name: PETER BUTLER  
Position: Dean of the College  
Department: (Not Available)  
Campus: UNIVERSITY PARK CAMPUS  
Title:  
Concur: [Not Yet Reviewed]  
Comments: [Not Yet Reviewed]  
Reviewed On: [Not Yet Reviewed]

SCCA Subcommittee Review

Recipient Name: ALLISON ALBINSKI  
Position: SCCA Subcommittee Review  
Department: (Not Available)  
Campus: UNIVERSITY PARK CAMPUS  
Title:  
Concur: [Not Yet Reviewed]  
Comments: [Not Yet Reviewed]  
Reviewed On: [Not Yet Reviewed]
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**Recipient Name:** ALLISON ALBINSKI  
**Department:** (Not Available)  
**Position:** Faculty Senate Review  
**Campus:** UNIVERSITY PARK CAMPUS

**Concur:** [Not Yet Reviewed]  
**Comments:** [Not Yet Reviewed]  
**Reviewed On:** [Not Yet Reviewed]

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**Recipient Name:** JOY ROBERTSON  
**Department:** (Not Available)  
**Position:** Faculty Senate Review  
**Campus:** UNIVERSITY PARK CAMPUS

**Concur:** [Not Yet Reviewed]  
**Comments:** [Not Yet Reviewed]  
**Reviewed On:** [Not Yet Reviewed]

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**Recipient Name:** KADI CORTER  
**Department:** (Not Available)  
**Position:** Faculty Senate Review  
**Campus:** UNIVERSITY PARK CAMPUS

**Concur:** [Not Yet Reviewed]  
**Comments:** [Not Yet Reviewed]  
**Reviewed On:** [Not Yet Reviewed]

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**Curricular Information**

Blue Sheet Item #:  
Review Date:

**SCRID Numbers**

(CMPCS 101):

**Uploaded Documents:**

Context Type: Supporting Documents  
File Description: CMPSC 101 Course Change Proposal as Submitted for Consultation  
File Name: Original CMPSC 101 Proposal with Consultation.pdf

Context Type: Syllabus  
File Description: Steve Shaffer CMPSC 101 Syllabus for World Campus  
File Name: CMPSC 101 SCS Syllabus.pdf

Proposal ID: 6788 created on 3/9/2018 4:28 PM
Uploaded Documents Follow:
SENATE COMMITTEE ON CURRICULAR AFFAIRS
COURSE SUBMISSION AND CONSULTATION FORM

Principal Faculty Member(s) Proposing Course

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<tr>
<th>Name</th>
<th>User ID</th>
<th>College</th>
<th>Department</th>
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<tr>
<td>Brad Sottile</td>
<td>bjs5332</td>
<td>Engineering (EN)</td>
<td>Not Available</td>
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<tr>
<td>STEVEN SHAFFER</td>
<td>scs12</td>
<td>Engineering (EN)</td>
<td>Not Available</td>
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<tr>
<td>JOHN HANNAN</td>
<td>JH9</td>
<td>Engineering (EN)</td>
<td>Not Available</td>
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Academic Home: Engineering (EN)

Type of Proposal: [ ] Add [ ] Change [ ] Drop

☑️ I am requesting recertification of this course for the new Gen Ed and/or University Requirements Guidelines?

Course Designation

(CMSPC 101) Introduction to Programming

Course Information

Special categories for Undergraduate (001-499) courses

Foundations

[ ] Writing/Speaking (GWS)
☑️ Quantification (GQ)

Knowledge Domains

[ ] Health & Wellness (GHW)
[ ] Natural Sciences (GN)
[ ] Arts (GA)
[ ] Humanities (GH)
[ ] Social and Behavioral Sciences (GS)

Additional Designations

☑️ Bachelor of Arts
[ ] International Cultures (IL)
[ ] United States Cultures (US)
[ ] Honors Course
[ ] Common course number - x94, x95, x96, x97, x99
[ ] Writing Across the Curriculum

First-Year Engagement Program

[ ] First-Year Seminar

Miscellaneous

[ ] Common Course

GE Learning Objectives

[ ] GenEd Learning Objective: Effective Communication
[ ] GenEd Learning Objective: Creative Thinking
[ ] GenEd Learning Objective: Crit & Analytical Think
[ ] GenEd Learning Objective: Global Learning
[ ] GenEd Learning Objective: Integrative Thinking
GenEd Learning Objective: Key Literacies

GenEd Learning Objective: Soc Resp & Ethic Reason

Cross-Listed Courses:

Prerequisites:
2 entrance units in mathematics

Corequisites:

Concurrents:

Recommended Preparations:

Abbreviated Title: INTRO PROGRAMMING

Bulletin Listing

Minimum Credits: 3
Maximum Credits: 3
Repeatable: NO
Department with Curricular Responsibility: Computer Science And Engineering (UPEN_CSE)
Effective Semester: After approval, the Faculty Senate will notify proposers of the effective date for this course change. Please be aware that the course change may not be effective until between 12 to 18 months following approval.
Travel Component: NO

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3. Basic Data types (1 week)
4. Selection Structures (2 weeks)
5. Repetition Structures (2 weeks)
6. Functions (2 weeks)
7. Arrays and Lists (2 weeks)
8. Software Development Principles (3 weeks)

Course Description:
This course introduces the basic concepts and processes of constructing computer programs, including algorithm development, data types, control structures, functions, and software development. Student outcomes include the ability to think computationally and to develop computer programs that solve simple quantitative problems. The course emphasizes general problem-solving skills and basic programming concepts found in virtually all programming languages. Introduction to software development principles such as top-down design, reasoning at multiple levels of abstraction, program refinement, testing, and debugging are included. The skills acquired in this course can be utilized in more advanced courses requiring computational thinking.

The name(s) of the faculty member(s) responsible for the development of the course:

Name: Brad Sottile (bjs5332)
Title: Instructor of Computer Science and Engineering, and Aerospace Engineering
Phone: (814) 865-0165
Address: 111J IST Building
Campus: City: University Park, PA
Fax:
Name: STEVEN SHAFFER (scs12)
Title: Assistant Professor
Phone: 814-863-1943
Address: W357 Westgate Building
Campus: UP
City: University Park
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This section should define what the student is expected to learn and what skills the student will develop.
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A description of any special facilities:
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General Education Designation Requirements

Bachelor Of Arts Requirements:

- BA: Natural Sciences
- BA: Other Cultures
- BA: Foreign/World Lang (12th Unit)
- BA: Humanities
- BA: Social and BA: Behavioral Sciences
- BA: Arts
- BA: Quantification
- BA: Foreign/World Lang (All)

No change is proposed to the content of the course required to re-certify the course's BA: Quantification designation.

Campuses That Have Offered (CMPSC 101) Over The Past 4 Years

| Semester       | AB | AL | BK | BR | BW | CR | DS | ER | FE | GA | GV | HB | HN | HY | LV | MA | NK | PC | SH | SL | UP | WB | WC | WS | XC | XP | XS | YK |
|----------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Spring 2018    | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  |
| Fall 2017      | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  |
| Summer 2017    | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  |
| Spring 2017    | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  |
| Fall 2016      | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  |
| Summer 2016    | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  |
| Spring 2016    | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  |
| Fall 2015      | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  |
| Summer 2015    | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  |
| Spring 2015    | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  |
| Fall 2014      | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  |
| Summer 2014    | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  |
| Spring 2014    | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  | ✔  |

Review History

This section represents all consultation history that has occurred on this proposal.

Legend

- ✔ Approve
- X Rejected
- ? Waiting Review
- 🏷 User Action Required
- ! Pending Action(s)
- 🔴 Moved to Rejected Status
- ✅ Approved
- (#) - Review Order Sequence Number

Consultation

Recipient Name: ASAD AZEMI
Department: School of Engr Technology and Commonwealth Engr
Concur: No, this proposal needs significant changes
Comments:
I support the proposed change, but some parts of the proposal need to be changed to reflect the purpose of the course. (i) I am not sure what does “Software Development principles” in this course mean?
(ii) Evaluation method needs to include sample grading and relate to the “education objectives.”

Initiator Comments: After some offline communication with Dr. Azemi, we have updated the proposal to meet his concerns.

Concur: Yes
Comments: A sensible change!
Reviewed On: 2/5/2018 at 8:20 AM

Concur: Yes
Comments: Reviewed On: 2/12/2018 at 12:12 AM

Concur: Yes
Comments: Reviewed On: 2/13/2018 at 9:29 PM

Concur: Yes
Comments: Reviewed On: 2/13/2018 at 9:29 PM
Concur: Yes
Comments: 5. Repetion Structures (2 weeks) Under Course outline, check the spelling of "Repetition"
Reviewed On: 2/12/2018 at 2:05 PM

Recipient Name: EDWARD EVANS
Position: Consultation
Department: Engineering
Campus: PENN STATE ERIE, THE BEHREND COLLEGE
Title: ASSOC TEACHING PROF ENGINEERING

Request sent: 2/2/2018 at 8:35 AM
Last sent: 2/12/2018 at 7:30 AM
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 2/17/2018 at 7:15 AM

Recipient Name: ERIC LIPSKY
Position: Consultation
Department: Mechanical Engineering
Campus: GREATER ALLEGHENY CAMPUS
Title: ASSOCIATE PROFESSOR

Request sent: 2/2/2018 at 8:35 AM
Last sent: 2/12/2018 at 7:30 AM
Concur: Yes
Comments:
Reviewed On: 2/13/2018 at 9:03 AM

Recipient Name: HAROLD N SCHOLZ
Position: Consultation
Department: (Not Available)
Campus: LEHIGH VALLEY CAMPUS
Title: INSTRUCTOR

Request sent: 2/2/2018 at 8:35 AM
Concur: Yes
Comments:
Reviewed On: 2/2/2018 at 4:11 PM

Recipient Name: JAMES HENDRICKSON
Position: Consultation
Department: (Not Available)
Campus: (Not Available)
Title: LECT ENGINEERING

Request sent: 2/2/2018 at 8:35 AM
Last sent: 2/12/2018 at 7:30 AM
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 2/17/2018 at 7:15 AM
Respond To Comments

Recipient Name: JEFFREY CHIAMPI  Department: UC Engineering
Position: Consultation  Campus: WILKES-BARRE CAMPUS
Title: COMPUTER SCIENCE

(19) Request sent: 2/2/2018 at 8:35 AM
Last sent: 2/12/2018 at 7:30 AM
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 2/17/2018 at 7:15 AM

Respond To Comments

Recipient Name: JEFFREY STONE  Department: UC Information Sciences & Technology
Position: Consultation  Campus: LEHIGH VALLEY CAMPUS
Title: ASSISTANT PROF INFO SCI/TECH

(1) Request sent: 2/2/2018 at 8:35 AM
Concur: Yes
Comments: I approve this change.
Reviewed On: 2/2/2018 at 9:13 AM

Respond To Comments

Recipient Name: JENIFER MARY SHANNON  Department: Electrical Engineering
Position: Consultation  Campus: BERKS CAMPUS
Title: LECTURER ENGINEERING

(20) Request sent: 2/2/2018 at 8:35 AM
Last sent: 2/12/2018 at 7:30 AM
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 2/17/2018 at 7:15 AM

Respond To Comments

Recipient Name: KENNETH DUDECK  Department: UC Engineering
Position: Consultation  Campus: HAZLETON CAMPUS
Title: ASSOC PROF ENGR

(3) Request sent: 2/2/2018 at 8:35 AM
Concur: Yes
Comments: This is a good change and makes sense to not specify a specific language to achieve the course objectives.
Reviewed On: 2/2/2018 at 11:56 AM

Respond To Comments

Recipient Name: KHALED AMLEH  Department: UC Engineering
Title: ASSOC PROF ENGINEERING

Position: Consultation
Campus: MONT ALTO CAMPUS

Request sent: 2/2/2018 at 8:35 AM
Last sent: 2/13/2018 at 8:25 AM
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 2/17/2018 at 7:15 AM

Recipient Name: Linda Null
Department: Computer Science
Position: Consultation
Campus: PENN STATE HARRISBURG, THE CAPITAL COLLEGE
Title: ASSOC PROF COMPUTER SCIEN

Request sent: 2/2/2018 at 8:35 AM
Last sent: 2/13/2018 at 8:25 AM
Concur: Yes
Comments: I think this is a good change. It removes a constraint that will surely change in the future.
Reviewed On: 2/14/2018 at 12:22 PM

Recipient Name: MAJID R CHATSAZ
Department: School of Engr Design, Technology and Prof Prgrms
Position: Consultation
Campus: WORTHINGTON SCRANTON CAMPUS
Title: ASST PROF GENERAL ENGR

Request sent: 2/2/2018 at 8:35 AM
Last sent: 2/13/2018 at 8:25 AM
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 2/17/2018 at 7:15 AM

Recipient Name: MICHAEL ROBERT GALLIS
Department: UC Science
Position: Consultation
Campus: SCHUYLKILL CAMPUS
Title: ASSOC PROF PHYSICS

Request sent: 2/2/2018 at 8:35 AM
Last sent: 2/13/2018 at 8:25 AM
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 2/17/2018 at 7:15 AM

Recipient Name: RICHARD CIOCCI
Department: Science, Engineering And Technology
Position: Consultation
Campus: PENN STATE HARRISBURG,
Request sent: 2/2/2018 at 8:35 AM
Concur: Yes
Comments: I concur, but I agree with the previous suggestion to add a suggested grading percentage allocation to the Evaluation Methods section.
Reviewed On: 2/8/2018 at 3:20 PM

Recipient Name: RICHARD SINGER  
Department: Business And Engineering  
Position: Consultation  
Campus: ALTOONA CAMPUS  
Title: SR INSTR COMPUTER SCIENCE AND ENGINEERING

Request sent: 2/2/2018 at 8:35 AM
Concur: Yes
Comments: Concur with the changes proposed.
Reviewed On: 2/5/2018 at 4:34 PM

Recipient Name: ROBERT AVANZATO  
Department: (Not Available)  
Position: Consultation  
Campus: ABINGTON CAMPUS  
Title: ASSOC PROF ENGINEERING

Request sent: 2/2/2018 at 8:35 AM
Last sent: 2/13/2018 at 8:25 AM
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 2/17/2018 at 7:15 AM

Recipient Name: SALVATORE A MARSICO  
Department: UC Engineering  
Position: Consultation  
Campus: WILKES-BARRE CAMPUS  
Title: ASSOC PROF ENGR CC

Request sent: 2/2/2018 at 8:35 AM
Last sent: 2/13/2018 at 8:25 AM
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 2/17/2018 at 7:15 AM

Recipient Name: SHERRY LEA KRATASAS  
Department: (Not Available)  
Position: Consultation  
Campus: BEAVER CAMPUS  
Title: INSTR COMP SCI
Recipient Name: XIAOCONG FAN  
Department: Engineering  
Position: Consultation  
Campus: PENN STATE ERIE, THE BEHREND COLLEGE  
Title: ASSOC PROF CMPSC/SFTW ENG

Recipient Name: MARY BETH ROSSON  
Department: Information Sciences And Technology  
Position: Consultation  
Campus: UNIVERSITY PARK CAMPUS  
Title: Associate Dean

Recipient Name: Vinayak Elangovan  
Department: Abington College (Pre-Major)  
Position: Consultation  
Campus: ABINGTON CAMPUS  
Title: Asst Prof Comp Sci

Recipient Name: CHITARANJAN DAS  
Department: (Not Available)  
Position: Head of Department  
Campus: UNIVERSITY PARK CAMPUS  
Title:
SCCA Representative

Recipient Name: ROBERT MELTON  Department: (Not Available)
Position: SCCA Representative  Campus: UNIVERSITY PARK CAMPUS
Title:


Dean of the College

Recipient Name: PETER BUTLER  Department: (Not Available)
Position: Dean of the College  Campus: UNIVERSITY PARK CAMPUS
Title:


SCCA Subcommittee Review

Recipient Name: KADI CORTER  Department: (Not Available)
Position: SCCA Subcommittee Review  Campus: UNIVERSITY PARK CAMPUS
Title:


Recipient Name: ALLISON ALBINSKI  Department: (Not Available)
Position: SCCA Subcommittee Review  Campus: UNIVERSITY PARK CAMPUS
Title:

Request sent: 2/17/2017 at 2:02 PM


Recipient Name: JOY ROBERTSON  Department: (Not Available)
SCCA Review

Recipient Name: KADI CORTER  Department: (Not Available)
Position: SCCA Review  Campus: UNIVERSITY PARK CAMPUS

Concur: [Not Yet Reviewed]  Comments: [Not Yet Reviewed]
Reviewed On: [Not Yet Reviewed]

Recipient Name: ALLISON ALBINSKI  Department: (Not Available)
Position: SCCA Review  Campus: UNIVERSITY PARK CAMPUS

Concur: [Not Yet Reviewed]  Comments: [Not Yet Reviewed]
Reviewed On: [Not Yet Reviewed]

Recipient Name: JOY ROBERTSON  Department: (Not Available)
Position: SCCA Review  Campus: UNIVERSITY PARK CAMPUS

Concur: [Not Yet Reviewed]  Comments: [Not Yet Reviewed]
Reviewed On: [Not Yet Reviewed]

Faculty Senate Review

Recipient Name: KADI CORTER  Department: (Not Available)
Position: Faculty Senate Review  Campus: UNIVERSITY PARK CAMPUS

Concur: [Not Yet Reviewed]  Comments: [Not Yet Reviewed]
Reviewed On: [Not Yet Reviewed]
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**Curricular Information**

Blue Sheet Item #: 
Review Date: 

**SCRID Numbers**

(CMPSC 101): 
Proposal ID: 2478 created on 3/8/2018 1:36 PM
How to get help: We have a team of computer science students available to help you with questions or problems you encounter. To contact them, send an email to 101help@statecollege.online – Always be sure to reply-to and/or “cc” this email address when interacting with a helper; otherwise you might delay getting a response.

If you have a question about a course policy or something of a personal nature, use the “inbox/compose a new message” feature of Canvas and send me a message.

REQUIRED COURSE MATERIALS

Required textbook (only $9.99): A Gentle Introduction to Computer Programming Fundamentals. Originally it was only available in a Kindle edition (there is a free Kindle reader download for almost any device) – but now, by popular demand, there is a hard-copy edition available ($19.95).

Obtain the book here: https://www.amazon.com/dp/B00ECI0D0S
Obtain the Kindle reader here: https://www.amazon.com/kindle-dbs/fd/kcp

Videos by the instructor: These are stored in Box, and you will need a Penn State access account to get them. Luckily, if you are reading this in Canvas, you already have one!

Other videos and readings: Other videos and/or readings will be assigned throughout the course; these are just as much a part of the course as the above items. If something says “optional” then it will not appear (specifically) in a quiz or exam problem.

Very important information

This course is set up in a way that you probably have not encountered before. There are 12 modules; each module has several steps. You are required to complete each step before moving on to the next step, and you are required to complete each module before moving on to the next module. You can re-try the work as many times as necessary. At each step you are required to confirm that you have completed the work on your own and within the time constraints – sometimes this is enforced by the software, sometimes not. However, you are always required to answer these questions honestly. This course is designed to help you succeed! But, if you try to avoid the work you will likely not learn and not do well. It’s that simple.
How to succeed:

1. Each module has required videos and/or readings. Watch and/or read the material first. Be sure to watch the videos like you would a live lecture, including taking notes, etc.
2. Next, take the quiz on the material. You must achieve at least an 80% on this quiz to move forward. Otherwise, re-engage with the material and try the quiz again.
3. Next, attempt the programming assignments. You must do all of the programming assignments in Vocareum, which is an online platform that runs and tests your programs. Complete each assignment within the specified time period if you can. If you have done so, move ahead to the next item. If you completed the problem, but not within the stated time period, wait at least three hours and try it again. When you try it again, do not look at your previous answer. If you were unable to solve the problem at all within double the time allotted, watch the video where I show you one way to solve the problem. (Note that my answer is only an answer, not the answer.) Now, wait at least three hours, then return to the problem and try to solve it yourself within the allotted time, without looking at any notes (and of course not the video!). Keep doing this until you are able to solve the problem yourself within the time constraints.
4. If you are able to solve the problem on your own and within the time constraints, you should still watch the video for hints and other things you might not have thought of.
5. At the end of modules 3, 6, 9, and 12 is a timed mini-test. This is a single problem which is very much like the problems in the assignments. If you have done all of the work on the assignments, this problem should be fairly simple. Once you begin the problem, a timer will start and you have to complete and submit the problem within the time limit (2 hours). For obvious reasons, there is no posted solution to this problem. You must attempt the mini-test before moving ahead in the course. However, you do not have to obtain a 100% to continue.
6. Go on to the next assignment and/or module! Note, though, that I will be opening the modules approximately one per week, so the next one may not be available yet.

Keep reading!
GRADING

Your grade is 80% determined by your completion of the modules. For example, if you complete all the way through eleven of the twelve modules, then you earn 92% of 80% for this aspect of the grade. Remember that you cannot move forward through the material unless/until you have successfully completed the prior material.

The other 20% of the course grade is based on the four mini-tests, 5% each. Note that this means that even if you only successfully complete one of the mini-tests, as long as you do all of the other work, you will still get a “B” for the course.

There is nothing to stop you from doing well except lack of perseverance!

One important note: As you complete the problems in Vocareum, you are required to answer a question in Canvas that asks if you have done so; this unlocks the next step in the course. If you lie and move forward in Canvas without actually solving the problems in Vocareum, your grade is limited by the last programming problem you solved in Vocareum. So, always answer the questions in the modules truthfully.

Other important Notes:

- All programming assignments must be submitted through Vocareum.
- All of the mini-exams will be run through software which checks for plagiarism. This software is sophisticated, and can not be beaten by obvious things like changed variable names, etc. Be sure that you understand the academic integrity policies discussed below.
- Do not rely on CANVAS to calculate your grade. Only consider CANVAS as the place where your grades are stored. CANVAS will almost assuredly not calculate your grade properly.

Letter grades:

- 94% and above: A
- 90%-93.9999%: A-
- 88%-89.9999%: B+
- 84%-87.9999%: B
- 80%-83.9999%: B-
- 78%-79.9999%: C+
- 70%-77.9999%: C
- 60%-69.9999%: D
- 0%-59.9999%: F

↑ Keep reading!
Academic Integrity: The University defines academic integrity as the pursuit of scholarly activity in an open, honest and responsible manner. All students should act with personal integrity, respect other students' dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts (refer to Senate Policy 49-20). Dishonesty of any kind will not be tolerated in this course. Dishonesty includes, but is not limited to, cheating, plagiarizing, fabricating information or citations, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students. Students who are found to be dishonest will receive academic sanctions and will be reported to the University's Office of Student Conduct for possible further disciplinary sanctions (refer to Senate Policy G-9). The department's academic integrity policy also applies; see it here: http://www.eecs.psu.edu/students/resources/EECS-CSE-Academic-Integrity.aspx

Emergency situations: Information on what to do when facing an emergency or crisis situation can be obtained from the Office of Student and Family Services (Links to an external site.).

Accessibility Statement: Penn State welcomes students with disabilities into the University’s educational programs. Every Penn State campus has an office for students with disabilities. The Student Disability Resources Web site provides contact information for every Penn State campus. For further information, please visit the Student Disability Resources Web site.

In order to receive consideration for reasonable accommodations, you must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation. If the documentation supports your request for reasonable accommodations, your campus’s disability services office will provide you with an accommodation letter. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. You must follow this process for every semester that you request accommodations.

Statement on Nondiscrimination & Harassment (Policy AD42) – The Pennsylvania State University is committed to the policy that all persons shall have equal access to programs, facilities, admission and employment without regard to personal characteristics not related to ability, performance, or qualifications as determined by University policy or by state or federal authorities. It is the policy of the University to maintain an academic and work environment free of discrimination, including harassment. The Pennsylvania State University prohibits discrimination and harassment against any person because of age, ancestry, color, disability or handicap, national origin, race, religious creed, sex, sexual orientation, gender identity or veteran status. Discrimination or harassment against faculty, staff or students will not be tolerated at The Pennsylvania State University. You may direct inquiries to the Office of Affirmative Action, 328 Boucke Building, University Park, PA 16802-5901; Tel 814-865- 4700/V, 814-863-1150/TTY. For reference to the full policy (Policy AD42: Statement on Nondiscrimination and Harassment): http://guru.psu.edu/policies/ad85.html (Links to an external site.).

Keep reading!
Counseling & Psychological Services (CAPS) Statement: Students who experience personal issues that interfere with their academic performance, social development or satisfaction at Penn State are encouraged to seek confidential assistance from Counseling and Psychological Services (CAPS) Center (http://studentaffairs.psu.edu/counseling/ (Links to an external site.)). They can be reached at (814) 863-0395. Some of the more common concerns they can help with include anxiety, depression, difficulties in relationships (friends, roommates, or family); sexual identity; lack of motivation or difficulty relaxing, concentrating or studying; eating disorders; sexual assault and sexual abuse recovery; and uncertainties about personal values and beliefs. Crisis intervention is available from Centre County CAN HELP (http://centrecountypa.gov/index.aspx?NID=593) at 1-800-643-5432, 24 hours a day, seven days a week.

Attendance Policy: (Note: The following is the PSU policy on attendance. As an online, asynchronous course, you can read “attendance” as roughly equivalent to “participation.”)

Class attendance is one of the most important ways students learn and understand course materials. It is a critical element of student success. Class attendance recognizes on exceptional occasions, students may miss a class meeting to participate in a regularly scheduled university-approved curricular or extracurricular activity (such as Martin Luther King’s Day of Service, field trips, debate trips, choir trips, and athletic contests), or due to unavoidable or other legitimate circumstances such as illness, injury, military service, family emergency, religious observance or post-graduate, career-related interviews when there is no opportunity for students to re-schedule these opportunities (such as employment and graduate school final interviews.)

In all cases, students should inform the instructor in advance, where possible, and discuss the implications of any absence. Missing class, even for a legitimate purpose, may mean there is work that cannot be made up, hurting the student’s grade in the class. Likewise, students should be prepared to provide documentation for participation in University-approved activities, as well as for career-related interviews, when requested by the instructor. Students who will miss a class in accordance with Senate Policy 42-27, should present a class absence form: http://www.psu.edu/oue/aappm/classabs.pdf
Recent Announcements

› About timing in exams                     Feb 1 at 12:25pm
› What you need to know...                 Jan 31 at 2:50pm
› About annoying spaces                    Jan 29 at 11:51am
› MODULE 5 is open!                         Jan 29 at 11:28am
› About the mini-exam                      Jan 24 at 2:40pm

Introduction and Administrative information

Welcome to the course from Steve Shaffer

VIDEO: Welcome to the course
1 pts | Score at least 1.0

Review of the syllabus
10 pts | Score at least 10.0

Module 1

READING: Textbook chapter 1 (GETTING STARTED)
1 pts | Score at least 1.0

VIDEO: Lecture 1-1: How to use Vocarium
1 pts | Score at least 1.0

VIDEO: Lecture 1-2: Overview of chapter 1
1 pts | Score at least 1.0

VIDEO: What is an Algorithm? 5 min
1 pts | Score at least 1.0

VIDEO: What's an algorithm? - David J. Malan 5 min
1 pts | Score at least 1.0
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<th>Exercise/Quiz</th>
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<td>VIDEO: Computational Thinking: Pattern Recognition</td>
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<td>VIDEO: Systems Thinking 4: Functions</td>
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### Module 5

**Prerequisites:** Module 4

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<td><strong>Video:</strong> Lecture 5-1 (Chapter review)</td>
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<td><strong>Video:</strong> Computational Thinking: Abstraction and Pattern Generalization -- 10 min</td>
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<td><strong>Video:</strong> Systems Thinking 5: Efficiency -- 6 min</td>
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Module 6

**Prerequisites:** Module 5

**READING:** Textbook chapter 6 (LOOPS)
1 pts  |  Score at least 1.0

**VIDEO:** Lecture 6-1 (hand trace a loop)
1 pts  |  Score at least 1.0

**VIDEO:** Computational Thinking: Algorithm Design 15 min
1 pts  |  Score at least 1.0

**VIDEO:** Systems Thinking 6: Boundary & Environment 7 min
1 pts  |  Score at least 1.0

**CHAPTER 6 Quiz**
10 pts  |  Score at least 8.0

**Book exercise 6.1 (add up some numbers) (30 minutes)**
1 pts  |  Score at least 1.0

**Book exercise 6.2 (triangle) (30 minutes)**
1 pts  |  Score at least 1.0

**VIDEO:** Stretch problem module 6
1 pts  |  Score at least 1.0

Module 7

**Prerequisites:** Module 6

**READING:** Textbook chapter 7 (MORE COMPLEX PROBLEMS)
1 pts  |  Score at least 1.0

**VIDEO:** Solution to Problem 7-2
1 pts  |  Score at least 1.0

**VIDEO:** Systems Thinking 7: Relations & Synergies -- 6 min
1 pts  |  Score at least 1.0

**CHAPTER 7 Quiz**
10 pts  |  Score at least 8.0
### Module 7 Stretch Assignment - 1 hour
1 pts | Score at least 1.0

### Module 8
**Prerequisites:** Module 7

#### READING: Textbook chapter 8 (FUNCTIONS)
1 pts | Score at least 1.0

#### VIDEO: Modularization
1 pts | Score at least 1.0

#### Module 8 Quiz
10 pts | Score at least 8.0

#### Book Exercise 8-1 (20 minutes)
1 pts | Score at least 1.0

#### Book Exercise 8-2 (20 minutes)
1 pts | Score at least 1.0

### Module 9
**Prerequisites:** Module 8

#### READING: Textbook chapter 9 (AN EXTENDED EXAMPLE)
1 pts | Score at least 1.0

#### VIDEO: Module 9 Stretch
1 pts | Score at least 1.0

#### Chapter 9 Quiz
10 pts | Submit

#### Chapter 9 Extended Example
1 pts | Score at least 1.0

---

**WC CMPSC 101, Spring 2018**

https://psu.instructure.com/courses/1879469

7 of 12 2/1/2018, 12:41 PM
Book exercise 9-1 (30 minutes)  
1 pts  |  Score at least 1.0

Book exercise 9-2 (30 minutes)  
1 pts  |  Score at least 1.0

Module 10  
Prerequisites: Module 9

READING: Textbook chapter 10 (USING ARRAYS)  
1 pts

VIDEO: Step-by-step of chapter 10 example  
1 pts  |  Score at least 1.0

CHAPTER 10 Quiz  
10 pts  |  Score at least 8.0

Book exercise 10-1 (30 minutes)  
1 pts

Book exercise 10-2 (30 minutes)  
1 pts

Module 11  
Prerequisites: Module 10

VIDEO: Systems Thinking 8: Emergence 7 min  
1 pts

VIDEO: Systems Thinking 9: Hierarchy & Abstraction -- 7 min  
1 pts

VIDEO: Systems Thinking 10: System Dynamics -- 7 min  
1 pts

VIDEO: Systems Thinking 11: Homeostasis -- 7 min  
1 pts

VIDEO: Systems Thinking 12: Systems Science - 7 min  
1 pts
Systems Thinking Quiz
10 pts

Module 12
Prerequisites: Module 11

Day of the year
1 pts | Score at least 1.0

Get 5 unique names
1 pts | Score at least 1.0

Design a box
1 pts | Score at least 1.0

Naughts and crosses
1 pts | Score at least 1.0

Below average
1 pts | Score at least 1.0

Extra credit
Prerequisites: Module 12

VIDEO: Systems Thinking 2: Synthesis & Analysis Distinction 5 min
1 pts

VIDEO: Computational Thinking: Intro Video Part 2 6 min
1 pts

End of course survey. (4 short questions)

MODULE 4 QUIZ
10 pts
SENATE COMMITTEE ON CURRICULAR AFFAIRS
COURSE SUBMISSION AND CONSULTATION FORM

Principal Faculty Member(s) Proposing Course

<table>
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<tr>
<td>GANG TAN</td>
<td>gxt29</td>
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<td>JOHN JOSEPH HANNAN</td>
<td>jjh9</td>
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<td>PATRICK DREW MCDANIEL</td>
<td>pdm12</td>
<td>Engineering (EN)</td>
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Academic Home: Engineering (EN)
Type of Proposal: [ ] Add [ ] Change [ ] Drop

Course Designation
(CMPSC 447) Software Security

Course Information
Cross-Listed Courses:

Prerequisites:
CMPSC 443
Corequisites:
Concurrents:
Recommended Preparations:
CMPSC 360,
Abbreviated Title: SOFTWARE SEC
Discipline: None
Course Listing:

Special categories for Undergraduate (001-499) courses

Foundations
[ ] Writing/Speaking (GWS)
[ ] Quantification (GQ)

Knowledge Domains
[ ] Health & Wellness (GHW)
[ ] Natural Sciences (GN)
[ ] Arts (GA)
[ ] Humanities (GH)
[ ] Social and Behavioral Sciences (GS)

Additional Designations
[ ] Bachelor of Arts
[ ] International Cultures (IL)
[ ] United States Cultures (US)
[ ] Honors Course
[ ] Common course number - x94, x95, x96, x97, x99
[ ] Writing Across the Curriculum
A brief outline or overview of the course content:
This course explores the fundamental concepts and engineering processes of software development and testing to produce software that is designed for security. Course concepts include learning about different software vulnerabilities and defensive programming to prevent such vulnerabilities, security mechanisms that provide systematic defense, design and validation of software for security properties, software testing, and program forensics. This course is a 400-level CMPSC elective for the CMPEN, CMPSC, and EE majors.

A listing of the major topics to be covered with an approximate length of time allotted for their discussion:

Week 1 Introduction to Software Security
Week 2 Survey of Software Vulnerabilities
Week 3 Survey of Software Vulnerabilities
Week 4 Defensive Programming
Week 5 Software Attack Surface
Week 6 Security Mechanisms: Privilege Separation
Week 7 Security Mechanisms: Reference Monitoring
Week 8 Security Mechanisms: Information Flow
Week 9 Program Verification Challenges
Week 10 Program Verification Methods
Week 11 Penetration Testing Challenges
Week 12 Dynamic Testing Methods
Week 13 Static/Symbolic Testing Methods
Week 14 Provenance and Forensics
Week 15 Integrating Security in Software Life Cycle

Course Description:
This course explores the fundamental concepts and engineering processes of software development and testing to produce software that is designed for security. This course is intended as a senior-level course for computational majors such as computer science and computer engineering since it covers the exploitation of programs based on computer architecture, systems, and software concepts. First, software engineering considerations associated with a variety of software vulnerabilities will be analyzed, along with defensive programming techniques to avoid such vulnerabilities. The next part of this course will introduce systematic software engineering principles for building secure software to defend its attack surface, such as reference monitors, privilege separation, information flow, and program verification. The third part will focus on methods for security testing of software including fuzz testing, symbolic execution, grey-box testing, and forensics. The final week of the course will examine adding security into the software engineering life cycle. The design and implementation of techniques to develop reference monitors, information-flow secure programs, testing mechanisms and enhancements, as well as defensive programming against prominent software vulnerabilities will be studied and analyzed. Upon completion of the course students will be able to critically analyze the design and implementation of software for security flaws and build security mechanisms to prevent exploitation of such flaws.

The name(s) of the faculty member(s) responsible for the development of the course:
Name: GANG TAN (gxt29)
Course Justification

Instructional, Educational, and Course Objectives:
This section should define what the student is expected to learn and what skills the student will develop.
Upon completion of this course students will be able to identify and analyze software for a variety of security flaws, including using program verification and software testing techniques. Students will also be able to program defensively and design security mechanisms into their programs in a systematic way to prevent vulnerabilities. Students will also understand the linkage between software development for security and the software design lifecycle.

Evaluation Methods:
Include a statement that explains how the achievement of the educational objective identified above will be assessed. The procedures for determining students' grades should be specifically identified.
Achievement of educational outcomes will be through evaluation of problem solving skills, programming skills, and communication of technical concepts. Achievement of each educational outcome will be defined through simple rubrics that directly correlate student performance to level of achievement, based upon a traditional point grading scheme. A recommended point grading scheme follows:
Homework 10%
Semester exams (2) 50%
Programming Assignments 40%

Relationship/Linkage of Course to Other Courses:
This statement should relate the course to existing or proposed new courses. It should provide a rationale for the level of instruction, for any prerequisites that may be specified, or for the course's role as a prerequisite for other courses. This course is an extension of the computer security principles learned in CMPSC 443, its prerequisite. Additionally this course is related to system concepts and programming taught in CMPSC 311 and computer science concepts taught in CMPSC 360.

Relationship of Course to Major, Option, Minor, or General Education:
This statement should explain how the course will contribute to the major, option, or minor and indicate how it may function as a service course for other departments.
This course will serve as a 400-level CMPSC elective for the CMPEN, CMPSC, and EE majors. It will also be part of a proposed minor in cybersecurity.
A description of any special facilities:
None

Frequency of Offering and Enrollment:
Yearly, enrollment of 60 at University Park anticipated

Campuses That Have Offered ( ) Over The Past 4 Years

| semester | AB | AL | BK | BR | BW | CR | DS | ER | FE | GA | GV | HB | HN | HY | LV | MA | NK | PC | SH | SL | UP | WB | WC | WS | XC | XP | XS | YK |
|----------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|

Review History
This section represents all consultation history that has occurred on this proposal

Legend
- Approve
- Rejected
- Waiting Review
- User Action Required

Pending Action(s)
- Moved to Rejected Status
- Approved
(#) - Review Order Sequence Number

Consultation

Recipient Name: ASAD AZEMI
Department: School of Engr Technology and Commonwealth Engr
Position: Consultation
Campus: BRANDYWINE CAMPUS
Title: ASSOC PROF ENGINEERING

Request sent: 1/31/2018 at 9:02 AM
Concur: No, this proposal needs significant changes
Comments:
Minor Point (not a significant change):
Evaluation method needs to relate to educational objectives and include a sample grading process, i.e. percentage for each identified category.
Reviewed On: 2/7/2018 at 2:24 PM
Initiator Comments: Achievement of educational outcomes will be through evaluation of problem solving skills, programming skills, and communication of technical concepts. Achievement of each educational outcome will be defined through simple rubrics that directly correlate student performance to level of achievement, based upon a traditional point grading scheme. A recommended point grading scheme follows:
Homework 10%
Semester exams (2) 50%
Programming Assignments 40%

Request sent: 2/13/2018 at 9:13 PM
Concur: Yes
Comments: please update the form by adding your revision
Reviewed On: 2/13/2018 at 11:48 PM

Recipient Name: CHARLES GASTON
Department: (Not Available)
(6)
Request sent: 1/31/2018 at 9:02 AM
Concur: Yes
Comments: Reviewed On: 2/5/2018 at 8:00 AM

Recipient Name: DAUDI WARYOBA
Department: School of Engr Technology and Commonwealth Engr
Position: Consultation
Campus: DUBOIS CAMPUS
Title: ASST PROF / ENGINEERING

(11)
Request sent: 1/31/2018 at 9:02 AM
Last sent: 2/12/2018 at 7:30 AM
Concur: Yes
Comments: Reviewed On: 2/13/2018 at 9:21 PM

Recipient Name: DAVID BRUCE MEREDITH
Department: School of Engr Technology and Commonwealth Engr
Position: Consultation
Campus: FAYETTE CAMPUS
Title: ASSOC PROF GEN ENG

(16)
Request sent: 1/31/2018 at 9:02 AM
Last sent: 2/12/2018 at 7:30 AM
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 2/15/2018 at 7:15 AM

Recipient Name: EDWARD EVANS
Department: Engineering
Position: Consultation
Campus: PENN STATE ERIE, THE BEHREND COLLEGE
Title: ASSOC TEACHING PROF ENGINEERING

(17)
Request sent: 1/31/2018 at 9:02 AM
Last sent: 2/12/2018 at 7:30 AM
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 2/15/2018 at 7:15 AM

Recipient Name: ERIC LIPSKY
Department: Mechanical Engineering
Position: Consultation
Campus: GREATER ALLEGHENY CAMPUS
Title: ASSOCIATE PROFESSOR
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<td>JEFFREY STONE</td>
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<td>Linda Null</td>
<td>Computer Science</td>
<td>Consultation</td>
<td>PENN STATE HARRISBURG, THE CAPITAL COLLEGE</td>
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Comments: There is significant overlap with CMPSC 444 (perhaps 60%). However, there appears to be enough difference in material to warrant a separate class.

Reviewed On: 2/14/2018 at 4:01 PM

Recipient Name: MAJID R CHATSAZ
Department: School of Engr Design, Technology and Prof Prgms
Position: Consultation
Campus: WORTHINGTON SCRANTON CAMPUS
Title: ASST PROF GENERAL ENGR

Concur: Yes

Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 2/15/2018 at 7:15 AM

Recipient Name: MICHAEL ROBERT GALLIS
Department: UC Science
Position: Consultation
Campus: SCHUYLKILL CAMPUS
Title: ASSOC PROF PHYSICS

Concur: Yes

Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 2/15/2018 at 7:15 AM

Recipient Name: RICHARD CIOCCI
Department: Science, Engineering And Technology
Position: Consultation
Campus: PENN STATE HARRISBURG, THE CAPITAL COLLEGE
Title: ASSOC PROF MECH ENG

Concur: Yes

Comments:
Reviewed On: 1/31/2018 at 8:04 PM

Recipient Name: RICHARD SINGER
Department: Business And Engineering
Position: Consultation
Campus: ALTOONA CAMPUS
Title: SR INSTR COMPUTER SCIENCE AND ENGINEERING

Concur: Yes

Comments: Interesting and timely topic.

Reviewed On: 1/31/2018 at 8:04 PM
Reviewed On: 2/14/2018 at 12:53 PM

Recipient Name: SALVATORE A MARSICO
Department: UC Engineering
Position: Consultation
Campus: WILKES-BARRE CAMPUS
Title: ASSOC PROF ENGR CC

Request sent: 1/31/2018 at 9:03 AM
Last sent: 2/13/2018 at 8:25 AM
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 2/15/2018 at 7:15 AM

Recipient Name: SHERRY LEA KRATSAS
Department: (Not Available)
Position: Consultation
Campus: BEAVER CAMPUS
Title: INSTR COMP SCI

Request sent: 1/31/2018 at 9:03 AM
Last sent: 2/13/2018 at 8:25 AM
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 2/15/2018 at 7:15 AM

Recipient Name: XIAOCONG FAN
Department: Engineering
Position: Consultation
Campus: PENN STATE ERIE, THE BEHREND COLLEGE
Title: ASSOC PROF CMPSC/SFTW ENG

Request sent: 1/31/2018 at 9:03 AM
Concur: Yes
Comments: 
Reviewed On: 2/7/2018 at 9:21 AM

Recipient Name: NICKLAUS A GIACOBE
Department: Information Sciences And Technology
Position: Consultation
Campus: UNIVERSITY PARK CAMPUS
Title: Assistant Teaching Professor

Request sent: 1/31/2018 at 9:03 AM
Last sent: 2/13/2018 at 8:25 AM
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)
Reviewed On: 2/15/2018 at 7:15 AM

Recipient Name: PENG LIU
Department: Information Sciences And Technology
Title: PROFESSOR  
Position: Consultation  
Campus: UNIVERSITY PARK CAMPUS

Request sent: 1/31/2018 at 9:03 AM  
Last sent: 2/13/2018 at 8:25 AM  
Concur: Yes  
Comments: (Completed By Default - Exceeded Time Limit)  
Reviewed On: 2/15/2018 at 7:15 AM

Recipient Name: DAVID SALVIA  
Department: Electrical Engineering  
Position: Consultation  
Campus: UNIVERSITY PARK CAMPUS  
Title: ASST PROF ELECT. ENGR.

Recipient Name: LINDA MARIE NULL  
Department: Computer Science  
Position: Consultation  
Campus: PENN STATE HARRISBURG, THE CAPITAL COLLEGE  
Title: ASSOC PROF COMPUTER SCIEN

Recipient Name: MARY BETH ROSSON  
Department: Information Sciences And Technology  
Position: Consultation  
Campus: UNIVERSITY PARK CAMPUS  
Title: Associate Dean

Recipient Name: XIAOCONG FAN  
Department: Engineering  
Position: Consultation  
Campus: PENN STATE ERIE, THE BEHREND COLLEGE  
Title: ASSOC PROF CMPSC/SFTW ENG

Comments: Because of the lengthy prerequisite string (CMPSC 121 --> CMPSC 122 --> CMPSC 221 --> CMPSC 311 --> CMPSC 473 --> CMPSC 443 --> CMPSC 447, I don't envision any EE students (at least undergrads) ever being able to take this class. The proposal is sound, however.

Reviewed On: 1/31/2018 at 9:08 AM

Comments: There is significant overlap with CMPSC 444 (perhaps 60%). However, there appears to be enough difference in material to warrant a separate class.

Reviewed On: 2/14/2018 at 4:01 PM

Comments: (Completed By Default - Exceeded Time Limit)

Reviewed On: 2/15/2018 at 7:15 AM
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<td><strong>Position:</strong> Consultation</td>
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<td><strong>Title:</strong> Asst Prof Comp Sci</td>
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Curricular Information
Blue Sheet Item #:
Review Date:

SCRID Numbers
(CMPSC 447):
Proposal ID: 4994 created on 3/9/2018 4:20 PM
Graduate Studies and Research Committee Activity Summary for EFC Meeting- March 20, 2018

Graduate Faculty Nominations:  
**Approved:**  
- Mahfuza Frooque - Category P, Fixed-Term  
- John Gershenson - Category R, Fixed-Term

Course Proposals:  
**Approved:**  
- (AMD 596) Individual Studies – Add  
- (AMD 600) Thesis Research – Add  
- (CSE 583) Pattern Recognition and Machine Learning - Change

Return to Proposer for Revisions:  
- (E MCH 501) Mechanics in Emerging Electronics – Add  
- (ESC 546) Advanced Metallic Material Feedstocks for Additive Manufacturing - Add

Program Proposals:  
**Approved:**  
- Industrial Engineering MENG (Add degree to existing program) – approved w/ minor changes  
- Nuclear Security Option - Masters of Science and Masters of Engineering Degrees in Nuclear Engineering - Add
# EFC Proposal Report

**Recommendation of Proposal Actions from the GS&R Committee**

Prepared for March 20th, 2018 EFC Meeting

## Proposals Submitted to EFC

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<th>Proposal Type</th>
<th>Title</th>
<th>Action Requested (Add/Change/Drop)</th>
<th>Vote GS&amp;R*</th>
<th>Summary of Discussion Points</th>
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<tr>
<td>Program</td>
<td>Master of Engineering in Industrial Engineering Degree</td>
<td>Add</td>
<td>Approve (minor revisions)</td>
<td>For well over 60 years, a Master of Science with thesis degree program in Industrial Engineering (MSIE) has been offered as a resident program at Penn State - University Park. With the arrival of the new Dean of the College of Engineering (COE) in 2014, there was a strong push for a one-year Master of Science (MS) with paper degree program. To accommodate a new degree, the Graduate School required that an existing degree program, the Master of Engineering (MEngIE) be dropped. The original MSIE with thesis was retained. Two main factors have led to this proposal of requesting the renewal of the MEng degree but in an online format. First, nine years of experience with the Human Factors Engineering and Ergonomics (HFEIE) Post-Baccalaureate Certificate has indicated that many of these graduates have requested further education in the form of a master's degree. In addition, many potential certificate applicants have been holding off until there is a strong possibility of such a degree. Secondly, a 2015 marketing study by the World Campus Outreach group (Appendix A), strongly recommended pursuing a full master's degree rather than extending or developing additional graduate certificates. The goal of this proposal is to seek approval for offering an off-campus (online) MEngIE degree. This initiative also supports the Core Council's recommendation for the COE (Appendix B) to explore revenue opportunities through more expansive World Campus programs. A professional master's degree with a culminating industrial experience rather than a research master's degree (with a thesis or paper requirement) seems to be appropriate vehicle for distance students who would not be able to have the day-to-day contact with advisors that resident students have. The proposed MEngIE will have comparable content and rigor to our on-site degrees, since most of the faculty who will be teaching the online graduate courses will be the same IE Graduate Faculty who are research-active, advise doctoral students, and will be teaching the same courses to our resident students. In fact, in the early stages, until enrollment grows, the courses may be taught in parallel, i.e. on-site students in one-section and distance students in another section, as is done presently for the HFEIE Certificate courses.</td>
</tr>
<tr>
<td>Program</td>
<td>Nuclear Security Option - Masters of Science and Masters of Engineering Degrees in Nuclear Engineering</td>
<td>Add</td>
<td>Approve</td>
<td>The Nuclear Engineering Program has been very successful in offering an online Masters of Engineering in Nuclear Engineering degree program. We currently have over 70 students in degree-seeking status and have graduated over 160 students since 2001. We envision that many of the online students will be attracted to this program, which will be the first in the nation. The Nuclear Engineering Program, the Mechanical and Nuclear Engineering Department, and the College of Engineering are anxious to further expand the offering of this program given the potential and interest. It is in the near term plans that this program will also be offered through Penn State's World Campus, which is the organization that manages all online program delivery.</td>
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<tr>
<td>Course</td>
<td>(CSE 583) Pattern Recognition and Machine Learning</td>
<td>Change</td>
<td>Approve</td>
<td>* The only change is the course title. The old title “Pattern Recognition – Principles and Applications” is a historic name inherited from a course taught before 2006 and a name-change is long overdue. The phrase “Machine learning” is a modern term commonly accepted in state-of-the-art technical literature in this field, so adding this phrase to the title better reflects the content of the course.</td>
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<tr>
<td>Course</td>
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<td>Common Course</td>
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<tr>
<td>Course</td>
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Graduate Council  
Program, Option, or Minor Proposal Form

Submit 1 original, signed Graduate Council proposal form and 2 hardcopies of the graduate program proposal document, with a copy of the signed proposal form attached to each proposal copy, to the Office of the Dean of the Graduate School, 211 Kern Building, University Park. For more information about the process, see the Overview of the Graduate Council Curricular Review Process.

The Program Proposal Procedures provide guidance for the development of a graduate program proposal. If you have questions regarding the preparation of a graduate program proposal or how to complete this Graduate Council proposal form, contact the Office of the Dean of the Graduate School.

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New Graduate Program, Option, or Minor: Add

Designation of new graduate program: MEEng IE  
Classification of Instructional Programs (CIP) Code: 14.3501

Designation of new graduate option:

Designation of new graduate minor:

Indicate effective semester:  
- First semester following approval  
- Second semester following approval

Existing Graduate Program Option, or Minor: Change Drop

Current designation of graduate program:

Current designation of graduate option:

Current designation of graduate minor:

New designation of existing graduate program (if changing):

New designation of existing graduate option (if changing):

New designation of existing graduate minor (if changing):

Brief description of the change (if not noted above):

Indicate effective semester:  
- First semester following approval  
- Second semester following approval

Submitted by Graduate Program Head

Printed name: ROBERT C. VOIGT  
Signature:  
Date: 12/6/12

Noted by College/School Representative to Graduate Council Subcommittee on New and Revised Programs and Courses:

Printed name:  
Signature:  
Date:

Approved by College/School Dean/Chancellor (or Designee):

Printed name:  
Signature:  
Date:
Proposal for Off-Campus (On-Line) Delivery of a New Master of Engineering in Industrial Engineering Degree

Submitted by:

Dr. Andris Freivalds
Lucas Professor
Industrial & Manufacturing Engineering (IME) Department
The Pennsylvania State University
310 Leonhard Building
University Park, PA 16801

Revised: February 1, 2018;
December 6, November 7, August 3, April 19, 2017
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<td>Proposal for Off-Campus (On-Line) Delivery of a New Master of Engineering in Industrial Engineering Degree</td>
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<td>Appendix A - Market Scan: Opportunities in Human Factors in Engineering and Ergonomics and Industrial Engineering</td>
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<td>Appendix C - Plan for Online Delivery of Engineering Programs and the Development of a New Office for Digital Learning in the College of Engineering</td>
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<td>Appendix D - Graduate Bulletin Listing</td>
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<td>Appendix F - Course Submission and Consultation Form - IE 894</td>
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Proposal for Off-Campus (On-Line) Delivery of a New Master of Engineering in Industrial Engineering Degree

A. Justification Statement

1. Program Goals

For well over 60 years, a Master of Science with thesis degree program in Industrial Engineering (MSIE) has been offered as a resident program at Penn State - University Park. With the arrival of the new Dean of the College of Engineering (COE) in 2014, there was a strong push for a one-year Master of Science (MS) with paper degree program. To accommodate a new degree, the Graduate School required that an existing degree program, the Master of Engineering (MEngIE) be dropped. The original MS with thesis was retained. Two main factors have led to this proposal of requesting the renewal of the MEng degree but in an online format. First, nine years of experience with the Human Factors Engineering and Ergonomics (HFEE) Post-Baccalaureate Certificate has indicated that many of these graduates have requested further education in the form of a master’s degree. In addition, many potential certificate applicants have been holding off until there is a strong possibility of such a degree. Secondly, a 2015 marketing study by the World Campus Outreach group (Appendix A), strongly recommended pursuing a full master’s degree rather than extending or developing additional graduate certificates.

The goal of this proposal is to seek approval for offering an off-campus (online) MEngIE degree. This initiative also supports the Core Council’s recommendation for the COE (Appendix B) to explore revenue opportunities through more expansive World Campus programs. A professional master's degree with a culminating industrial experience rather than a research master’s degree (with a thesis or paper requirement) seems to be appropriate vehicle for distance students who would not be able to have the day-to-day contact with advisors that resident students have.

The proposed MEngIE will have comparable content and rigor to our on-site degrees, since most of the faculty who will be teaching the online graduate courses will be the same IE Graduate Faculty who are research-active, advise doctoral students, and will be teaching the same courses to our resident students. In fact, in the early stages, until enrollment grows, the courses may be taught in parallel, i.e. on-site students in one-section and distance students in another section, as is done presently for the HFEE Certificate courses.

Presently the IME department has approximately: 170-180 BSE degree recipients per year and 80 PhD and 110 MS students. However, the primary focus of the proposed MEngIE degree will not be for the current students but will be for the thousands of IE alumni who are working as professional engineers and cannot easily take leave from their careers to return physically to the University Park campus for on-site courses and degrees. Coincidentally, the proposed MEngIE degree may also help alleviate some of the overcrowding of the classrooms for our popular graduate classes. It may also assist us in increasing enrollments in less popular graduate level courses that have few enrolled on-site students and are often canceled.

In summary, there are two program goals for offering an online MEngIE degree: i) to provide an opportunity for our employed alumni and other professionals to seek further education in the
form of a professional graduate degree and ii) to provide the HFEE Certificate graduates a further opportunity to continue their education.

2. Needs Assessment

The motivation for developing an online MEngIE degree is being driven largely by an increased demand for advanced degrees, especially for those working as a practicing engineer. There are approximately 240,000 practicing industrial engineers in the United States (https://collegegrad.com/careers/industrial-engineers), many of which could be seeking advanced degrees that could be obtained online. There are many universities providing this service, but, interestingly, of the top 10 IE programs in 2016 (actually 12 schools due to ties), only four, including Penn State, do not have an online master’s degree. Therefore, it is imperative that the Penn State IE program, being one of the top 10 IE programs in the country, both in quality and size, provide such a desired service to its thousands of alumni (at least 4,300 on the active mailing list). There are no other online MEngIE degree programs offered within Penn State.

3. Proposed Course Offerings and Schedule

The MS with thesis IE degree has been offered for decades at Penn State - University Park. The objective of the existing and the proposed online degree programs is to provide students with the opportunity to gain advanced knowledge for analysis and design in industrial engineering. Our proposal is to offer essentially the same program in an online, professional format, replacing the thesis requirement with a culminating professional experience.

The requirements for the online MEngIE degree program include:
1. Minimum of 30 course credits at the 400- ,500-level or higher, of which 21 course credits must be earned at Penn State (i.e. only 9 credits can be transferred from other institutions).
2. All students must successfully complete three credits of IE 894, Capstone Design.
3. At least 18 credits in 500-level or higher courses (including IE 894).
4. At least 15 credits in 500-level or higher IE courses (including IE 894).
5. At least 21 credits of IE courses (including IE 894).
5. The culminating experience for professional degrees will be satisfied with IE 894, Capstone Design. Students will apply the analysis and design skills learned in their previous IE courses in order solve a problem in their workplace. This will be written up in report to be to the course instructor.

Presently there are ten courses (30 credits) of 500-level IE courses and four courses (12 credits) of 400-level IE courses regularly offered. Based on our experience from the HFEE graduate certificate, students generally enroll in three courses per year, which would allow them to complete their degree in approximately three years. The exact distribution of the course offerings may change based on both on-site and online enrollment needs, since many of these courses, as mentioned previously for the HFEE Certificate, will be offered in parallel, one section on-site in parallel to another section online. However, a tentative schedule is as follows:
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<td>IE 402*</td>
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<td>IE 479</td>
<td>IE 505(?)</td>
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<td>IE 894</td>
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(?) depends on which semester the instructor in charge teaches it
* instructor retired, need new one to take over
** every other year

There are numerous other courses already online within engineering at Penn State (particularly in mechanical engineering, systems engineering, data analytics, and business supply chains), that the online students will be able to select from throughout their degree program. There are specifically three online IE courses that have already been developed and offered for the Smeal College of Business Online Supply Chain MPS, but haven’t received final University approval (IE 587, Additive Manufacturing; IE 573, Manufacturing with Materials; IE 574, Advanced Manufacturing) and one offered through the online Master of Engineering in Additive Manufacturing (IE 427, Additive Manufacturing). Once those have final approval, they will also be available to the students desiring the MEng IE degree.

4. Admission Requirements for Online Degree

To maintain a high quality program, it is important that our students be of the caliber to successfully complete the degree. As such, the admission requirements for the students enrolling in the online program will not differ from those of our resident students. The IME Graduate Admissions Committee (made up of IME Graduate Faculty) will provide recommendations to the Graduate Program Coordinator and Director on accepting online students to the MEngIE degree program. It is expected that students have a Bachelor of Science degree in engineering or an Engineering Technology degree from a 4 year ABET accredited institution. Admission decisions will also be based upon the undergraduate GPA, GRE scores, and recommendation letters.

The language of instruction at Penn State is English. All international applicants must take and submit scores for the TOEFL (Test of English as a Foreign Language) or the IELTS International English Language Testing System, with the exceptions noted below. The minimum acceptable score for the TOEFL is 550 for the paper-based test, or a total score of 80 with a 19 on the speaking section for the Internet-based test (iBT). The minimum acceptable composite score for the IELTS is 6.5.

5. Size of Program and Duration

Estimates on the size of the program are based on two pieces of data: i) the number of HFEE Certificate students and ii) the size our current graduate program. The HFEE Certificate handles approximately eight students per class/year (each takes three classes per year and finishes). The human factors specialty accounts for 10% of the faculty and 10% of the graduate study body in the IME Department. Therefore, it is expected that eventually there could be ten times as many
or 80 students per year in the steady-state MEngIE program. Given it takes most students to complete their degrees in three years (~3 courses per year); we would eventually graduate 25 students per year.

6. Impact on Existing Programs

The initial impact on the existing graduate programs in the IME Department would be nominal, in the sense that the increase in the number of students will be gradual over 3-4 years as word of the program spreads. Any increase in the size of existing courses can be compensated by using PhD level teaching assistants for large mainly MS courses. Eventually, there may be need to start offering certain courses or sections more than once per year, in which case (probably after 4-5 years) there may be a need to hire more faculty. That cost of that would be covered by the additional revenue generating by the online student tuition money.

7. Fiscal Responsibility

Financial arrangements between the COE and World Campus will follow the COE Plan for Online Delivery of Engineering Programs and the Development of a New Office for Digital Learning in the College of Engineering (March 3, 2016, Appendix C) report, in which existing capture-stream video methods will be utilized. Most of the IE courses have already been developed using this approach and we will continue to use this approach for any IE courses being prepped for online delivery. The on-line MEng in IE will be advertised and operated through the IME Department and, thus, will fall under the SAVE plan. However, some of the IE courses were originally developed for other programs (e.g. Smeal College of Business Online Supply Chain MPS) and may have received instructional support from World Campus and, thus, may operate on different financial plan.

8. Scholarship and Research Integrity (SARI) Training

During the first year of enrollment, all MEngIE students will be required to complete an online RCR training program provided by the Collaborative Institutional Training Initiative (CITI). The Office for Research Protections (ORP) provides a link to this training via the SARI Resource Portal. An additional five hours of SARI training will be obtained from online material prepared by both the IME Department and the COE.

B. Graduate Degree Programs Bulletin Listing

The proposed MEngIE degree Bulletin listing is given in Appendix D.

C. Essential Elements of Residency

1. Interaction Between Faculty and Students Beyond Direct Instruction

Interaction between faculty and students will take place through the courses and through the completion of their capstone design report to fulfill the degree requirements. During course offerings, the distance students will interact with the faculty during specified office hours either
by phone or through some type of web-conferencing such as that provided by Skype and through email exchanges.

2. Interaction among Students

Some of the courses utilize laboratories as part of the course instruction. Typically, for the HFEE Certificate instructors have utilized ‘mixed’ teams of on-site and online students. This will be continued for the other courses offered in the MEngIE program. So as to provide the online students opportunities to be engaged with resident students and faculty at Penn State.

3. Access to Information and Instructional Resources

The Penn State library system is one of the largest research libraries in North America with more than 100,000 e-books. Online students enrolled in the MEngIE degree program will have access to the library resources to access e-journals, e-books, course reserves, and database searches. The University Libraries also provides access to interlibrary loan and document delivery materials in both hard copy and electronic format, which would also be available to online students. In addition, assistance can be requested anytime from reference librarians via email, phone calls, or chat services.

4. Access to Suitable Academic Advising and Support Services

Just as our Graduate Program Coordinator advises our resident MSIE students, the Director of MEngIE will advise our online MEngIE students. The Director will closely monitor the course selections made by the online students to ensure the appropriate technical courses are taken and normal degree progression is maintained. Advising for students in the online program will take place through a mutually agreeable combination of email, web/audio conferencing, telephone calls, and in-person meetings when appropriate.

World Campus Admissions and Financial Aid will typically be the first point of contact for prospective students for the online program. The Admissions staff will address questions from prospective students, and discuss financial aid options.

5. Students’ Contribution to the Program, College, and University

As was previously mentioned, the work experiences that the online students will bring into the classroom will be of benefit to our faculty and to our on-campus students. These contributions could lead to enhanced discussions as well as potential research collaborations. These discussions are expected to take place between our residential and online students through the use of course chat rooms and joint office hours administered by the faculty member for the course.

6. Identification with Penn State

The students enrolling in the online MEngIE degree program will identify with Penn State through several avenues:
i) interacting directly with Penn State faculty through courses and office hours;
ii) being advised by a Penn State IME faculty member and,
iii) feeling as being part of the on-site class if they choose to watch the courseynchronously (rather than asynchronously as typically presented on the Canvas course site).

D. Program Operation and Maintenance

1. Program Coordination

The coordination for the MEngIE will reside within the Industrial & Manufacturing Engineering Department at Penn State at University Park, with the primary operations occurring within the IME Graduate Office. Those involved in administering the online program will include the following:

Dr. Janis Terpenny, Professor and Peter and Angela Dal Pezzo Department Head, IME Department

Dr. Andris Freivalds, Lucas Professor and Director of the MEngIE degree, IME Department

Dr. Robert Voigt, Professor and Graduate Program Coordinator, IME Department

Ms. Lisa Fuoss, Graduate Staff Assistant, IME Department, who will serve as the primarycontact within the Department for the online students

Ms. Cathy Holsing, Director, COE Office for Digital Learning, who will serve as the liaison withWorld Campus

Ms. Sonya Leitzell, Director of Academic Affairs, World Campus, who will serve as the personwho will coordinate the online MEngIE degree program with the World Campus

2. Academic Support to Students

In addition to the support listed above in section D.1, online students will be supported throughstudent scheduling, registration, and billing which are all integrated into the World Campussupport system for students. The reporting of grades will occur through LionPath. In addition, the Help Desk will provide the needed technical support through email or by phone. As stated onPenn State’s World Campus website, the following support will be provided to our online students:

i) walking students through the program application process, including identifying therequired supporting documentation; finding financial aid, scholarships, and other types of financial support; and preparing them for learning in an online environment;

ii) using University systems to access course syllabi and assignments; interact with professors and peers; make tuition payments; order textbooks and software through the online bookstore; and use the University Libraries system;

iii) providing resources for online students including career counseling, exam proctoring
and tech support;

iv) linking online students with communities and special services for military members and veterans, international students, alumni, corporate education, students with disabilities, and those transferring from other universities and colleges; and,

v) providing connections for the online students to the Penn State community by keeping students up-to-date with events, important dates, and Penn State news.

3. Instructional Design Support and Available Facilities

The online course delivery for the MEngIE degree will mostly coincide with the resident course delivery such that the courses will be offered both synchronously and asynchronously. While the online students will be able to view the lecture synchronously or asynchronously, the resident students will receive the information live at the specified course meeting times and will have access to the recorded classes to further promote learning. During the Summer Semester, all courses will be solely on-line.

Canvas will be the primary web-based course management system. Through Canvas, students will receive the needed course materials (syllabi, readings, etc.) and lectures. Canvas also supports access to course content including asynchronous threaded discussion and real-time chat, automated quizzing with immediate feedback, grade management, and reporting functions. To assist faculty members in converting existing course material to a fully online environment, we will primarily utilize the COE Office for Digital Learning, which will assist with course or program design and course or program implementation and delivery. Note, that the current streaming videos will be updated with more innovative approaches being developed by the COE Office for Digital Learning.

4. Technological Resources Needed by Students

Students in the online MEngIE degree program are expected to possess or have access to a personal computer and a broadband internet connection. The minimum system and software specifications are outlined at [http://www.worldcampus.psu.edu/general-technical-requirements](http://www.worldcampus.psu.edu/general-technical-requirements)

E. Consultation with Other Units Affected by the Proposed Program

Written responses are included in the Appendix E.

Agricultural & Biological Engineering, Paul Heinemann, Department Head. Supportive
Aerospace Engineering, Philip Morris, Interim Department Head. No Response
Architectural Engineering, M. Kevin Parfitt, Interim Department Head. No Response
Bioengineering, Cheng Dong, Department Head. No Response
Chemical Engineering, Philip Savage, Department Head. Supportive
Civil and Environmental Engineering, Patrick J. Fox, Department Head. Supportive
Computer Science and Engineering, Chitarayan Das, Department Head. No Response
Electrical Engineering, Kultegin Aydin, Department Head. Supportive
Engineering Science and Mechanics, Judith Todd, Department Head. No Response
Mechanical and Nuclear Engineering, Karen Thole, Department Head. Supportive
School of Engineering, Design, Technology and Professional Programs,
Sven Bilén, Department Head. No Response
Great Valley, Colin Neill, Online Data Analytics MPS, Supportive
Smeal College of Business, Gary Gittings, Online Supply Chain MPS, No Response
World Campus, Karen Pollack, Director of Academic Affairs. Supportive

F. Program Quality

Assessment of the program quality will be done continuously through many avenues. It will be the responsibility of the Department Head, Director of the MEngIE degree, Graduate Program Coordinator, and the Director of the Academic Affairs in World Campus to ensure that the program is maintained at a high quality. Final exit surveys will also be given to each student upon their degree completion. Peer teaching reviews will be conducted each semester for non-tenured faculty members and annually for Associate Professors. Students’ assignments will be submitted electronically through their online classroom environment-just, as they would turn them in to their professor on campus. Most exams will be taken either through an approved University proctor or through online proctoring services (such as Examity)
Appendix A: Market Scan: Opportunities in Human Factors Engineering and Ergonomics and Industrial Engineering

Prepared By:
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Context

- The College of Engineering has proposed a graduate level Advanced Human Factors Engineering and Ergonomics (HFEE) Certificate to be offered online through Penn State World Campus. There is currently a Human Factors Engineering and Ergonomics graduate certificate offered through World Campus, in partnership with the College. This existing nine credit certificate program would be a prerequisite for the proposed advanced certificate program.

- The proposed certificate is intended to provide additional courses for the four to five students taking the current HFEE certificate program. For the fall 2015 semester, there are only three students enrolled in the existing World Campus HFEE certificate program. The unduplicated student headcount for BAY 2014-15 was nine.

- The courses for the existing World Campus certificate program are listed below.

<table>
<thead>
<tr>
<th>Course</th>
<th>Prerequisites</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>IE 479 Human-Centered Product Design and Innovation</td>
<td>IE 408 Cognitive Work Design or IE 419 Work Design—Productivity and Safety</td>
<td>3</td>
</tr>
<tr>
<td>IE 553 Engineering of Human Work</td>
<td>BIOL 141 (GN) Introductory Physiology or BIOL 472 Mammalian Physiology</td>
<td>3</td>
</tr>
<tr>
<td>IE 558 Engineering of Cognitive Work</td>
<td>IE 323 Statistical Methods in Industrial Engineering and IE 408 Cognitive Work Design</td>
<td>3</td>
</tr>
</tbody>
</table>

- The courses for the proposed advanced certificate are listed in Table 2. All three courses exist in-residence. According to the intake form, IE 552 is already prepared for online delivery, while IE 511 and IE 557 will be developed and taught in an online format during the 2015-2016 academic year.

<table>
<thead>
<tr>
<th>Course</th>
<th>Prerequisites</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>IE 511 Experimental Design in Engineering</td>
<td>IE 323 Statistical Methods in Industrial Engineering</td>
<td>3</td>
</tr>
<tr>
<td>IE 552 Mechanics of the Musculoskeletal System</td>
<td>BIOL 472 Mammalian Physiology</td>
<td>3</td>
</tr>
<tr>
<td>IE 557 Human-in-the-Loop Simulation</td>
<td>IE 453 Simulation Modeling for Decision Support (bulletin also says IE 418)</td>
<td>3</td>
</tr>
</tbody>
</table>
Recommendations

- Based on market factors and current enrollments in the existing HFEE certificate, development of an additional certificate in HFEE carries significant risk and is not recommended. The existing HFEE certificate program has only three students enrolled for fall 2015. The intent of the proposed certificate is to provide additional courses for this audience and therefore is expected to be very small, as well.
  - Students who would earn the 18 credits required for both certificates would only be able to apply 15 of those credits toward a Penn State master’s degree. This may make the second certificate less appealing to some who may want to continue their studies and earn a degree.
  - Rather than develop a second, advanced certificate, it is recommended that the current certificate be extended to 12 credits and the proposed new courses be developed as electives.
  - It should also be noted that adding courses is not likely to attract net new students, and so enrollments are expected to be very low, regardless of the number of courses offered.
- There does not appear to be a high demand for a graduate-level credential in this area, as most related job postings only desired bachelor’s degrees, primarily in engineering. Coursework in human factors and ergonomics is typically included within industrial engineering programs. There are few online programs in the market focusing solely on human factors or ergonomics.
- The College may want to consider developing the master’s degree in Industrial Engineering. The market for the master’s degree is more viable than the proposed certificate and would be a better opportunity for the College. There were approximately 2,000 master’s degrees in industrial engineering conferred in 2012-13. There are around 3,000 bachelor’s degree conferred in this area each year to serve as a pipeline into a master’s program. While jobs in the field typically require a bachelor’s degree for entry into the field, a master’s degree will reach an audience of engineers looking for advanced study or wanting to enter the industrial engineering field.
  - HFEE could be a potential emphasis area within a broader industrial engineering master’s program. Additional options in a broad master’s degree might also be viable. An intake form and additional research would need to be conducted to explore these options.
Key Findings

- For the fall 2015 semester, there are only three students enrolled in the existing World Campus HFEE certificate program. The unduplicated student headcount for BAY 2014-15 was nine.

- The educational attainment required for certification as a Certified Professional Ergonomist (CPE), Certified Human Factors Professional (CHFP), or a Certified User Experience Professional (CUXP) through the Board of Certification in Professional Ergonomics (BCPE) is only a bachelor’s degree.

- One-hundred job postings were collected from the indeed.com online job postings aggregation site, using the keywords ergonomics, human factors, human factors engineer, and industrial engineer. Overall, 75 percent of the job postings required a bachelor’s degree. Only a limited number of jobs included human factors or ergonomics related tasks as primary aspects of the job or desired experience.

- The target occupations for the proposed certificate program are industrial engineers, occupational health and safety specialists, and health and safety engineers. Industrial engineers make up the majority of the target audience, with 243,926 workers currently employed in the occupation and seven percent growth anticipated over the next ten years. The typical level of education required for entry into the field for all three of the target occupations is a bachelor’s degree. One-half of current industrial engineers and health and safety engineers and approximately one-third of occupational health and safety specialists already have bachelor’s degrees. Twenty-two to twenty-three percent of current employees in these occupations have master’s degrees or higher.

- There were 3,624 bachelor’s degrees and 2,023 master’s degrees in industrial engineering conferred in 2012-13. Conferrals for certificates are significantly fewer than those for the full degrees. There were only 58 postbaccalaureate certificates conferred in 2012-13. None of these certificates were awarded by Penn State.

- There were 25 online industrial engineering master’s degree programs identified in the market. Competitors of note include Arizona State University, Auburn University, Columbia University, New York University, Purdue University, Texas A&M University-College Station, and University of Southern California. More than half of these programs include human factors or ergonomics content in their marketing or course content. There were only seven online master’s degrees and four online graduate certificates in human factors identified in the market. Auburn University offered a certificate in occupational safety and ergonomics.

- The average in-state total program cost for a master’s degree in industrial engineering within the competitive set was $25,930, while the average out-of-state total program cost was $33,047. A 32-credit World Campus engineering degree would cost $29,760 at the $930 tuition rate.

- The average in-state cost for an online graduate certificate program in human factors/ergonomics was $10,599, while the average out-of-state cost was $11,551. While a nine-credit World Campus HFEE certificate would cost $7,245, placing it toward the bottom of the small competitive set, completion of the first certificate would be required for students to take the proposed advanced certificate program. At the standard graduate tuition rate of $805, 18 credits would cost $14,490, which is more expensive than the other certificates in the competitive set.
Overview of Professional Human Factors/Ergonomics Organizations

- Board of Certification in Professional Ergonomics (BCPE)
  - The BCPE provides professional certification for practitioners of human factors/ergonomics (HFE) who demonstrate expertise and comprehensive understanding of the discipline.
  - There are two levels of certification available, professional and associate, with choice of designation dependent on the applicant’s career focus. Available professional certifications are Certified Professional Ergonomist (CPE), Certified Human Factors Professional (CHFP), and Certified User Experience Professional (CUXP), with an associate certification also available in each area. Professional certification requires a non-specific bachelor’s degree and coursework covering core competencies, a minimum of three years of related work experience, and a passing score on the certification exam.
  - The core competencies are displayed in Figure 1 below.

Figure 1: Core Competencies for BCPE Certification

Source: bcpe.org
A specific number of academic units are required in each of the core competencies, as listed in Table 3. A total of 24 semester units of content are required.

<table>
<thead>
<tr>
<th>Table 3: Core Competencies for BCPE Certification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
</tr>
<tr>
<td>Methods and Content Specific to Application Area</td>
</tr>
<tr>
<td>Human-Machine Interaction</td>
</tr>
<tr>
<td>Human-Environment Interaction</td>
</tr>
<tr>
<td>Human-Software Interaction</td>
</tr>
<tr>
<td>Human-Job Interaction</td>
</tr>
<tr>
<td>Human-Organization Interaction</td>
</tr>
<tr>
<td>Core Methodology: Analysis and Design of Processes and Product</td>
</tr>
<tr>
<td>Statistics and Design of Investigations</td>
</tr>
<tr>
<td>Basic Process Analysis</td>
</tr>
<tr>
<td>Design Methods</td>
</tr>
<tr>
<td>Basic Usability</td>
</tr>
<tr>
<td>Core Background Relevant to Ergonomics</td>
</tr>
<tr>
<td>Human Attributes (Anthropometry &amp; Demography, Physiology &amp; Biomechanics, Psychology)</td>
</tr>
<tr>
<td>Environmental Context (Physical Environment, Social Environment, Organizational Environment)</td>
</tr>
<tr>
<td>Basic Principles of Ergonomics</td>
</tr>
<tr>
<td>System Concepts</td>
</tr>
<tr>
<td>Design Concepts</td>
</tr>
<tr>
<td>Application</td>
</tr>
<tr>
<td>Professional Issues</td>
</tr>
<tr>
<td>Source: bcpe.org</td>
</tr>
</tbody>
</table>

There is one exam for Professional certification. It covers the core competencies, consists of 125 multiple choice questions, and takes approximately three hours to complete. The exam is proctored and administered electronically twice a year. Successful candidates receive a certificate, access to the Private Certificant Directory, and use of the credential selected at the time of application.

Certification fees include an application processing fee ($150), an examination fee ($350), a certification maintenance fee ($150), and an additional one-time fee ($150) for a total of $800.
• **Human Factors and Ergonomics Society (HFES)**
  
  o *The Human Factors and Ergonomics Society is a multidisciplinary professional association of more than 4,500 persons in the United States and throughout the world. Its members include psychologists, engineers, designers, and scientists, all of whom have a common interest in designing systems and equipment to be safe and effective for the people who operate and maintain them.***

  o *Members are employed in industries, universities and colleges, government agencies, consulting firms, military research centers, public utilities, and other settings. More than 40% hold a doctoral degree, a third hold a master's degree, and about 15% have a bachelor's degree. Students make up about 15% of the total membership.***

  o There are several categories of membership. The regular membership categories include full member, associate member, and affiliate member. A full member must have a bachelor's degree and five years of full-time, applicable experience. Educational attainment beyond a bachelor’s degree can substitute for up to four years of work experience. Full members can vote and hold office. An associate member needs two years of full-time, relevant experience and an affiliate member can be someone who is interested in the human factors field, but does not qualify for the full or associate member status. Dues for a regular membership at full, associate, or affiliate level are $215. Dues for a student membership are $35. Members can pay additional money for special membership categories and additional acknowledgment.

  o Membership benefits include access to journals and publications, events, the HFES career center, technical groups, webinars, local and student chapters, an online member directory, an online consultants directory, the HFES LinkedIn group, and special discounts from companies like Academic Press and Hertz.
Market Scan: Opportunities in Human Factors Engineering and Ergonomics and Industrial Engineering

> **Current Job Postings**

- A search of the indeed.com online job postings aggregation site was conducted to better understand what jobs are currently available, as well as to determine what education, skills, and work experience employers desire.

- **Overall Summary**
  - One-hundred job postings were collected for analysis, using the keywords ergonomics, human factors, human factors engineer, and industrial engineer. Nearly half of the job postings were for industrial engineers.

**Table 4: Summary of Job Titles**

<table>
<thead>
<tr>
<th>Job Titles</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Director of User Experience</td>
<td>Industrial/Manufacturing Engineer</td>
</tr>
<tr>
<td>Environmental Health and Safety Director</td>
<td>Lean Facilitator</td>
</tr>
<tr>
<td>Environmental Health and Safety Engineer</td>
<td>Occupational Health and Safety Specialist</td>
</tr>
<tr>
<td>Environmental Health and Safety Specialist</td>
<td>Operations Industrial Engineer</td>
</tr>
<tr>
<td>Ergonomist</td>
<td>Senior Human Factors and Ergonomics Engineer</td>
</tr>
<tr>
<td>Health and Safety Engineer, Ergonomics</td>
<td>Senior Industrial Engineer</td>
</tr>
<tr>
<td>Human Centered Design/Human Factors</td>
<td>Specialty Engineer</td>
</tr>
<tr>
<td>Human Factors Engineer</td>
<td>Usability Engineer</td>
</tr>
<tr>
<td>Human Factors/Industrial Engineer</td>
<td>User Experience Designer/Human Factors Engineer</td>
</tr>
<tr>
<td>Human Systems Analyst/Systems Engineer</td>
<td>User Experience Specialist</td>
</tr>
<tr>
<td>Industrial Engineer</td>
<td>UX Designer/Researcher</td>
</tr>
</tbody>
</table>

*Source: indeed.com*

- Overall, 75 percent of the job postings only required a bachelor’s degree. Only six percent of job postings required a master’s degree.
- More than half of the job postings desired an engineering credential, most commonly in industrial engineering.
- Only 27 percent of job postings specifically mentioned human factors within the job description, job responsibilities, desired experience, and or desired skills, while slightly more (35%) mentioned ergonomics. Human factors and ergonomics job postings are discussed in more detail below, as are industrial engineering job postings.

- **Human Factors**
  - There were 26 job postings that specifically mentioned human factors within the job description, job responsibilities, desired experience, and/or desired skills. Only seven job postings mentioned both human factors and ergonomics.

**Table 5: Human Factors Job Titles**

<table>
<thead>
<tr>
<th>Human Factors Job Titles</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human Centered Design/Human Factors</td>
<td>Industrial Engineer</td>
</tr>
<tr>
<td>Human Factors Engineer</td>
<td>Senior Human Factors and Ergonomics Engineer</td>
</tr>
<tr>
<td>Human Factors/Industrial Engineer</td>
<td>User Experience Designer/Human Factors Engineer</td>
</tr>
<tr>
<td>Human Systems Analyst/Systems Engineer</td>
<td>UX Designer/Researcher</td>
</tr>
</tbody>
</table>

*Source: indeed.com*
More than half of the 26 human factors job postings (57%) required a bachelor's degree. Human factors was mentioned as a preferred field of study in fifteen of the job postings. Engineering was mentioned in nine of the job postings, typically general or industrial, while psychology (primarily general or cognitive) was mentioned in eight job postings.

For slightly more than half of the human factors job postings, (14 of the 26), human factors tasks were a primary part of the job. These job postings were almost exclusively for human factors engineers. For the other job postings, human factors duties were part of a wider variety of unrelated responsibilities.

Most would-be employers were interested in human factors in terms of knowledge, design, research, data and analysis, the establishment and understanding of standards, prior experience in the field, and testing.

- The Human Factors Engineer will develop human factors design, testing, and applied research.
- Demonstrated knowledge and ability of developing valid test plans and experimental design to support the Human Factors Engineering research metrics.
- A background in human factors/ergonomics, product support, system analysis, industrial analysis, product/process design activities, and/or system safety is desired.
- Actively participate on device program teams to ensure sound human factors principles are considered and implemented.

**Ergonomics**

- There were 35 job postings that specifically mentioned ergonomics within the job description, job responsibilities, desired experience and/or desired skills. Only seven job postings mentioned both human factors and ergonomics.

- Job titles are listed in Table 6 below.

<table>
<thead>
<tr>
<th>Ergonomics Job Titles</th>
<th>Human Factors/Industrial Engineer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Health and Safety Specialist</td>
<td></td>
</tr>
<tr>
<td>Environmental Health and Safety Director</td>
<td>Human Factors Engineer</td>
</tr>
<tr>
<td>Ergonomist</td>
<td>Industrial Engineer</td>
</tr>
<tr>
<td>Health and Safety Engineer, Ergonomics</td>
<td>Senior Human Factors and Ergonomics Engineer</td>
</tr>
</tbody>
</table>

*Source: indeed.com*

- More than three-quarters of the 35 ergonomics job postings (77%) required a bachelor's degree. Engineering as a field of study was mentioned in nineteen of the job postings (54%), most commonly industrial or general engineering. Human factors as a field of study was only mentioned in nine of the job postings, while ergonomics was mentioned in three of them.

- Only 11 of the 35 ergonomics job postings included ergonomics as a primary part of the job, with most of these job postings being for ergonomists. For the other job postings, ergonomics related duties were secondary and part of a larger list of responsibilities.

- Would-be employers were interested in ergonomics assessments, experience, possessing and sharing ergonomics knowledge, and training.
• Lead the evaluation and subsequent revision of all work methods and workflow for all functions to ensure they are ergonomically correct.

• You must have 3+ years of proven experience in occupant packaging, human factors, or ergonomics, 7+ years preferred.

• Must have a strong working knowledge of Industrial Ergonomics.

• Provides advice to Legal on issues requiring ergonomic expertise.

• Identify and implement ergonomic opportunities, including education and retraining with respect to work station evaluation, posture review and body mechanics.

• **Industrial Engineers**
  
  o There were 47 job postings with ‘industrial engineer’ as part of the job title.

  o Nearly all of the job postings (45 of 47) required a bachelor’s degree. Approximately three-quarters (34 of 47) of the industrial engineering job postings mentioned industrial engineering as a preferred field of study. Manufacturing engineering was mentioned in ten job postings, while general engineering and mechanical engineering were mentioned in six postings each.

  o Employers desired engineering-related and general skills like project planning/management, analysis skills, problem-solving skills, Microsoft Office, AutoCAD or CAD, familiarity with lean manufacturing, the ability to work in teams, and presentation skills.

  o Thirteen of the industrial engineer job postings mentioned ergonomics somewhere within the description, responsibilities, desired experience, and/or desired skills; however, ergonomics was only a primary part of one of the job postings.

  o Only three of the job postings mentioned human factors, and human factors were a primary part of two of the postings.

  o **Industrial Engineers and Ergonomics**
    
    • Thirteen of the forty-seven industrial engineer job postings (28%) mentioned ergonomics somewhere within the job description, responsibilities, or desired experience. Ergonomics was only a primary part of one of the job postings.

    • Employers were most interested in ergonomic and performance assessment, experience in ergonomics, and the ability to determine opportunities and improvements in ergonomics.

      • Experience using ergonomic principles to develop and improve tools, equipment, and work stations preferred.

      • Lead the evaluation and subsequent revision of all work methods and workflow for all functions to ensure they are ergonomically correct.

      • Perform time studies, ergonomic/safety assessments, process flow analysis, line balancing, and productivity evaluations for all production areas and implement identified improvements.

      • Typical projects could include spearheading a redesign effort for the inbound unload, evaluating the ergonomic needs and issues induct work areas, or conducting a capacity planning and analysis study for peak season.
Industrial Engineers and Human Factors

- Only three of the job postings mentioned human factors. Human factors were a primary part of two of the job postings. All three of the industrial engineer job postings that mentioned human factors also mentioned ergonomics.
  - Other responsibilities will include initiating and participating in concurrent engineering efforts, evaluating conceptual designs, technical analysis and resolution of engineering problems on all aspects of human factors engineering discipline.
  - A background in human factors/ergonomics, product support, system analysis, industrial analysis, product/process design activities, and/or system safety is desired. Certified Human Factors professional or prior military acquisition program experience a plus. Experience in developing and conducting Human Factors test and evaluation programs is highly preferred.
  - Identify opportunities, and successfully implement improvements, in the area of human factors (ergonomics)
Market Scan: Opportunities in Human Factors Engineering and Ergonomics and Industrial Engineering

➤ **Target Audience**

- The Occupational Information Network (O*NET) was used to match job titles found in the market with their corresponding occupational codes. Occupational data is reported at the Standard Occupational Classification (SOC) level.

- Most of the job titles fell under the O*NET classification of human factors engineers and ergonomists, which is reported under the SOC classification for industrial engineers. Environmental health and safety positions were reported under occupational health and safety specialists and/or health and safety engineers.

- The three occupations in the right hand column are the target occupations for the proposed certificate program.

- Examples are shown in Figure 2 below.

**Figure 2: Matching Job Titles in the Market to Target Occupations**

<table>
<thead>
<tr>
<th>Job Titles</th>
<th>O*Net Sub-Categorization</th>
<th>SOC Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Health and Safety Director</td>
<td>17-2111.01 Industrial Safety and Health Engineers</td>
<td>17-2111 Health and Safety Engineers, Except Mining Safety Engineers and Inspectors</td>
</tr>
<tr>
<td>Industrial Engineer</td>
<td>17-2112.00 Industrial Engineers</td>
<td></td>
</tr>
<tr>
<td>Director of User Experience</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ergonomist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Human Factors Engineer</td>
<td>17-2112.01 Human Factors Engineers and Ergonomists</td>
<td>17-2112 Industrial Engineers</td>
</tr>
<tr>
<td>Senior Human Factors and Ergonomics Engineer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>User Experience Specialist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental Health and Safety Specialist</td>
<td>29-9011.00 Occupational Health and Safety Specialists</td>
<td>29-9011 Occupational Health and Safety Specialists</td>
</tr>
<tr>
<td>Occupational Health and Safety Specialist</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Source:** Indeed.com, O*NET, Bureau of Labor Statistics (BLS)
Market Scan: Opportunities in Human Factors Engineering and Ergonomics and Industrial Engineering

- **Occupation and Employment Trends**
  - Industrial engineers make up the majority of the target audience, with 243,926 workers currently employed in the occupation and seven percent growth from new jobs anticipated over the next ten years. There are approximately 90,000 openings anticipated over the next ten years due to replacement needs (i.e. retirements, layoffs).
  - The typical level of education required for entry into the field for all of the target occupations is a bachelor’s degree.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Health and Safety Engineers, Except Mining Safety Engineers and Inspectors</td>
<td>25,357</td>
<td>28,118</td>
<td>2,761</td>
<td>11%</td>
<td>10,533</td>
<td>Bachelor’s degree</td>
</tr>
<tr>
<td>Industrial Engineers</td>
<td>243,926</td>
<td>261,812</td>
<td>17,886</td>
<td>7%</td>
<td>91,293</td>
<td></td>
</tr>
<tr>
<td>Occupational Health and Safety Specialists</td>
<td>67,150</td>
<td>74,059</td>
<td>6,909</td>
<td>10%</td>
<td>26,220</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>336,433</td>
<td>363,990</td>
<td>27,557</td>
<td>8%</td>
<td>128,047</td>
<td></td>
</tr>
</tbody>
</table>

*Source: EMSI 2015.2–Employees*

- Approximately one-quarter of the work force in all three of the target occupations are age 55 or older, but the split between the various age ranges is relatively even.

**Figure 3: Age Ranges of Current Workforce in Target Occupations, 2015**

*Source: EMSI 2015.2–Employees*
- One-half of current industrial engineers and health and safety engineers already have bachelor’s degrees, while only about one-third of current occupational health and safety specialists already have bachelor’s degrees.

- Around 20 percent of current industrial engineers, health and safety engineers, and occupational health and safety specialists already have master’s degrees.

**Figure 4: Educational Attainment for Workers 25 Years and Older by Target Occupation, 2010-11**

**Source: BLS**
Market Scan: Opportunities in Human Factors Engineering and Ergonomics and Industrial Engineering

- **Degrees Awarded**
  - There were 3,624 bachelor’s degrees in industrial engineering conferred in 2012-13. While this number is 27 percent higher than conferral numbers five years ago, it is still small compared to areas of engineering like civil, electrical, and mechanical.

  **Figure 5: Five-Year Trends in Engineering Bachelor’s Degrees**

  ![Figure 5: Five-Year Trends in Engineering Bachelor’s Degrees](image)

  *Source: IPEDS*

  - Master’s degree conferrals have remained relatively consistent over the last five years, up by one percent since 2008-09. There were 2,023 master’s degrees in industrial engineering conferred in 2012-13, but more than half of those master’s degrees were earned by international students.

  - Conferrals for certificates are significantly fewer than those for the full degrees. There were only 58 postbaccalaureate certificates conferred in 2012-13, down from the 81 postbaccalaureate certificates conferred five years ago. None of these certificates were awarded by Penn State.

  **Figure 6: Five-Year Trends in Industrial Engineering Conferrals**

  ![Figure 6: Five-Year Trends in Industrial Engineering Conferrals](image)

  *Source: IPEDS*
Market Scan: Opportunities in Human Factors Engineering and Ergonomics and Industrial Engineering

> **Competition**

- **Graduate Certificates**
  - There were four online graduate certificate programs found in the market that were related to human factors and/or ergonomics. Two of the programs were in human systems integration, one was in occupational safety and ergonomics, and one was in lean ergonomics for manufacturing and healthcare.
  - Auburn University is a peer institution and offers the certificate in occupational safety and ergonomics.

<table>
<thead>
<tr>
<th>Table 8: Online Graduate Certificate Programs in Human Factors/Ergonomics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Institution</strong></td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>Auburn University</td>
</tr>
<tr>
<td>Missouri University of Science and Technology</td>
</tr>
<tr>
<td>Naval Postgraduate School</td>
</tr>
<tr>
<td>Wright State University</td>
</tr>
</tbody>
</table>

- **Non-credit Certificates**
  - There were three online non-credit certificate programs found in the market that related to human factors and/or ergonomics. Colorado State University offers a non-credit professional development certificate in occupational ergonomics.
  - OccuPro is owned by a Physical Therapist and Occupational Therapist with a combined 40 years of experience in industrial rehab, on-site services, and owning businesses. The Office Ergonomics Certification continuing education course is designed for professionals and taught by Certified Professional Ergonomists. Students can participate through a live webcast or on demand. A certificate and CEUs are awarded.
  - The Occupational Safety and Health Administration (OSHA) Training Institute offers a one-hour ergonomics certificate course that awards an OSHA Training Institute Education Center Certificate of Completion.

- **Master’s Degrees**
  - There were 25 online industrial engineering master’s degree programs found in the market. A table listing all of the competitive programs can be found in the Appendix. Competitors of note include Arizona State University, Auburn University, Columbia University, New York University, Purdue University, Texas A&M University-College Station, and University of Southern California.
  - Fourteen of the competitors mentioned human factors and/or ergonomics in the program description, within the curriculum, or had a concentration available. Primarily, this entailed having human factors or ergonomics courses available within the curriculum. For some programs, curricular information was not available.
  - Wright State University’s program was in both industrial and human factors engineering.
Table 9: Online Industrial Engineering Programs with Human Factors/Ergonomics Content

<table>
<thead>
<tr>
<th>Institution</th>
<th>Concentration</th>
<th>Curriculum</th>
<th>Program Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auburn University</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Iowa State University</td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Mississippi State University</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>North Carolina State University</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Oklahoma State University</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Purdue University</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Texas A&amp;M University-College Station</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Texas A&amp;M University-Kingsville</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>University of Central Florida</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>University of Michigan-Dearborn</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>University of Southern California</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>University of Tennessee Space Institute</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>University of Texas-Arlington</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Wright State University</td>
<td></td>
<td>x</td>
<td></td>
</tr>
</tbody>
</table>

While there were 25 master’s degrees in industrial engineering, more than half of which mentioned human factors or ergonomics somewhere in the marketing or course requirements, there were only seven online master’s degree programs found in the market that related to human factors and/or ergonomics. These included specific areas of human factors like design or aeronautics.

Table 10: Online Master’s Degree Programs in Human Factors/Ergonomics

<table>
<thead>
<tr>
<th>Institution</th>
<th>Degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bentley University</td>
<td>Masters of Human Factors in Information Design</td>
</tr>
<tr>
<td>Brandeis University</td>
<td>M.S. User-Centered Design</td>
</tr>
<tr>
<td>Embry-Riddle Aeronautical University</td>
<td>M.S. Human Factors: Tracks in Aerospace and Systems Engineering</td>
</tr>
<tr>
<td>Florida Institute of Technology</td>
<td>M.S. Human Factors in Aeronautics</td>
</tr>
<tr>
<td>Grand Canyon University</td>
<td>M.S. Psychology: Emphasis in Human Factors</td>
</tr>
<tr>
<td>University of Idaho</td>
<td>M.S. Human Factors</td>
</tr>
<tr>
<td>Wright State University</td>
<td>M.S. Industrial and Human Factors Engineering: Tracks in Human-Computer Integration, Logistics and Supply Chain, Systems Modeling, Ergonomic Engineering and Neuroengineering</td>
</tr>
</tbody>
</table>
According to IPEDS, 84 institutions conferred the 2,023 master’s degrees in industrial engineering earned in 2012-13. This number does not separate out degrees earned through distance education from degrees earned in-residence. Seven of the top ten programs appear on the competitive list, while Penn State University Park’s in-residence program is eleventh.

Table 11: Top Ten Master’s Degree in Industrial Engineering Conferrals

<table>
<thead>
<tr>
<th>Institution</th>
<th>2013 Master’s Degree Conferrals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Georgia Institute of Technology-Main Campus</td>
<td>129</td>
</tr>
<tr>
<td>Florida International University</td>
<td>114</td>
</tr>
<tr>
<td>University of Michigan-Ann Arbor</td>
<td>92</td>
</tr>
<tr>
<td>Texas A&amp;M University-College Station*</td>
<td>84</td>
</tr>
<tr>
<td>University of Central Florida*</td>
<td>74</td>
</tr>
<tr>
<td>University of Southern California*</td>
<td>69</td>
</tr>
<tr>
<td>Columbia University in the City of New York*</td>
<td>63</td>
</tr>
<tr>
<td>New Mexico State University-Main Campus*</td>
<td>59</td>
</tr>
<tr>
<td>North Carolina State University at Raleigh*</td>
<td>51</td>
</tr>
<tr>
<td>Virginia Polytechnic Institute and State University</td>
<td>50</td>
</tr>
<tr>
<td>Pennsylvania State University-Main Campus</td>
<td>47</td>
</tr>
</tbody>
</table>

*On competitor list

Key Competitors

- Auburn University—Graduate Certificate in Occupational Safety and Ergonomics
  - The certificate is offered by the Department of Industrial and Systems Engineering and includes six courses for a total of eighteen credits. Auburn’s graduate programs in this area are recognized by the National Institute of Occupational Safety and Health (NIOSH). (Note: Information on this program was not found on NIOSH’s website.)
  - Courses are listed in Table 12 below:

Table 12: Auburn Occupational Safety and Ergonomics (OSE) Graduate Certificate Courses

<table>
<thead>
<tr>
<th>Auburn OSE Certificate Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>INSY 6016: Safety I</td>
</tr>
<tr>
<td>INSY 7026: Safety II: System Safety</td>
</tr>
<tr>
<td>INSY 7056: Industrial Hygiene and Environmental Hazards</td>
</tr>
<tr>
<td>INSY 7086: Ergonomics I: Fundamentals</td>
</tr>
<tr>
<td>INSY 7076: Ergonomics II: Biomechanics</td>
</tr>
<tr>
<td>INSY 7086: Human Factors Engineering</td>
</tr>
</tbody>
</table>

- According to Auburn’s website, 51 OSE graduate certificates have been earned to date and 146 students are currently enrolled in OSE graduate certificate courses.
- The engineering course fee per credit hour is $795 for a total certificate program cost of $14,310. Auburn also offers an online Master of Industrial and Systems Engineering with coursework available in human factors/ergonomics.
> **Tuition**

- The average in-state cost for an online graduate certificate program in human factors/ergonomics was $10,599, while the average out-of-state cost was $11,551. The least expensive graduate certificate was Wright State University’s 15-credit certificate at $5,751 in-state ($9,560 out-of-state).

- While a nine-credit World Campus HFEE certificate would cost $7,245, placing it toward the bottom of the small competitive set, completion of the first certificate would be required for students to take the proposed advanced certificate program. At the standard graduate tuition rate of $805, 18 credits would cost $14,490, which is more expensive than the other certificates in the competitive set.

- The other certificates in the competitive set have 12-18 credits. Auburn’s 18-credit certificate costs $14,310 ($795 per credit hour).

*Figure 7: Tuition Costs for Online Graduate Certificate Programs*

![Image showing tuition costs for various programs]

*Converted from quarter credits to semester credits*

- Online non-credit certificate options are significantly less expensive than for-credit options. Colorado State University’s certificate was the most expensive non-credit certificate at $395. OSHA’s training certificate only cost $25.

<table>
<thead>
<tr>
<th>Table 13: Total Costs for Online Non-Credit Certificates</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Institution</strong></td>
</tr>
<tr>
<td>Colorado State University</td>
</tr>
<tr>
<td>OccuPro</td>
</tr>
<tr>
<td>OSHA Training Institute</td>
</tr>
</tbody>
</table>
- The average in-state total program cost for a master's degree in industrial engineering within the competitive set was $25,930, while the average out-of-state total program cost was $33,047.

- The in-residence industrial engineering master's degree offered through Penn State University Park is 32 credits. A 32-credit World Campus engineering degree would cost $29,760 at the $930 tuition rate. At the standard $805, it would cost $25,760.
  - Non-thesis program options were used to calculate tuition amounts, as a World Campus degree would likely be a non-thesis program with some sort of capstone.

**Figure 8: Online Master's Degree Programs in Industrial Engineering**
Appendix: Online Master’s Degree Programs in Industrial Engineering

<table>
<thead>
<tr>
<th>Institution</th>
<th>Degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arizona State University</td>
<td>M.S. Industrial Engineering</td>
</tr>
<tr>
<td>Auburn University*</td>
<td>Master of Industrial and Systems Engineering</td>
</tr>
<tr>
<td>Clemson University</td>
<td>Master of Engineering in Industrial Engineering</td>
</tr>
<tr>
<td>Columbia University</td>
<td>M.S. Industrial Engineering: Concentration in Systems Engineering</td>
</tr>
<tr>
<td>Georgia Institute of Technology</td>
<td>M.S. Industrial Engineering</td>
</tr>
<tr>
<td>Iowa State University*</td>
<td>Master of Engineering in Industrial Engineering</td>
</tr>
<tr>
<td>Lawrence Technological University</td>
<td>M.S. Industrial Engineering</td>
</tr>
<tr>
<td>NC State University*</td>
<td>Master of Industrial Engineering</td>
</tr>
<tr>
<td>New Mexico State University</td>
<td>M.S. Industrial Engineering</td>
</tr>
<tr>
<td>New York University e-Poly</td>
<td>M.S. Industrial Engineering</td>
</tr>
<tr>
<td>Purdue University*</td>
<td>M.S. Industrial Engineering</td>
</tr>
<tr>
<td>SUNY at Binghamton</td>
<td>M.S. In Industrial and Systems Engineering: Concentration in Health Systems</td>
</tr>
<tr>
<td>Texas A&amp;M University-College Station*</td>
<td>Master of Engineering in Industrial Engineering</td>
</tr>
<tr>
<td>Texas A&amp;M University-Kingsville*</td>
<td>M.S. Industrial Engineering</td>
</tr>
<tr>
<td>University of Alabama in Huntsville</td>
<td>M.S. Engineering: Concentration in Industrial Engineering</td>
</tr>
<tr>
<td>University of Arizona</td>
<td>M.S. Industrial Engineering</td>
</tr>
<tr>
<td>University of Southern California*</td>
<td>M.S. Industrial and Systems Engineering</td>
</tr>
<tr>
<td>University of Tennessee Space Institute*</td>
<td>M.S. Industrial and Systems Engineering: Concentration in Engineering Management</td>
</tr>
<tr>
<td>University of Texas-Arlington*</td>
<td>M.S. Industrial Engineering</td>
</tr>
<tr>
<td>University of Washington</td>
<td>Master of Industrial and Systems Engineering</td>
</tr>
<tr>
<td>Wright State University*</td>
<td>M.S. Industrial and Human Factors Engineering: Tracks in Human-Computer Integration, Logistics and Supply Chain, Systems Modeling, Ergonomic Engineering and Neuroengineering</td>
</tr>
</tbody>
</table>

*Includes human factors/ergonomics in program description, concentrations, and/or curricula
Market Scan: Opportunities in Human Factors Engineering and Ergonomics and Industrial Engineering

> Sources

Board of Certification in Professional Ergonomics (BCPE) [http://www.bcpe.org/](http://www.bcpe.org/)
EMSI Complete Employment 2015.2 Class of Worker [http://www.economicmodeling.com](http://www.economicmodeling.com)
Human Factors and Ergonomics Society (HFES) [https://www.hfes.org/web/Default.aspx](https://www.hfes.org/web/Default.aspx)
Indeed.com [http://www.indeed.com](http://www.indeed.com)
Occupational Information Network (O*NET) [http://www.onetcenter.org](http://www.onetcenter.org)
Appendix B: Core Council Recommendation Memo (excerpt)

David N. Wormley  
October 20, 2010  
Page 4

5. **World Campus and Outreach.** The Core Council encourages the College of Engineering to aggressively explore revenue opportunities through a more expansive World Campus program. Data suggest that there are untapped markets for online or blended learning engineering programs, especially professional Master's programs. There may also be potential for delivering some of the very successful curricular offerings in engineering leadership and engineering entrepreneurship to an online audience. If we don't move on this initiative soon, other universities and organizations will fill the online market. We recommend that you consult with the World Campus leadership concerning potential online markets that mesh with the College's strengths, and consult dean/al peers with more expansive programs to discuss ways of increasing faculty capacity. We also understand that the faculty in Computer Science and Engineering have suggested an option in computer and network security within the new professional Master's program in Homeland Security. We encourage the College to pursue this aggressively given the market research suggesting that this would be an important specialization in considerable demand.

We encourage you to take a look at your Continuing Education administrative structure. In addition, the College should discuss areas of collaboration with Outreach regarding their Continuing Education (CE) offerings. The recent decision to move non-credit CE programs to an auxiliary fiscal model pushes all colleges and campuses to reconsider the costs and management of their CE operations. There may be opportunities to eliminate redundancies and to maximize administrative performance through collaboration with Outreach's CE units.
Appendix C
Plan for Online Delivery of Engineering Programs and the Development of a New Office for Digital Learning in the College of Engineering

Date: March 3, 2016

Prepared by:

Peter Butler
Associate Dean for Education, College of Engineering

Thomas Litzinger
Assistant Dean, Educational Innovation and Accreditation
Director, The Leonhard Center for the Enhancement of Engineering Education

Committee members who contributed:

Susan Stewart
Research Associate, Aerospace Engineering and Architectural Engineering

Gary Chinn
Director, eLearning Institute, College of Arts and Architecture
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## Executive Summary

We propose a significant refocusing and expansion of online engineering education by the College of Engineering. The goal of expansion is to increase Penn State’s market share in engineering education and preparation of the engineering workforce, increase in the geographic reach and intellectual impact of Penn State engineering faculty, and enhance revenue generation for the college. The goal of refocusing will be to innovate in online engineering education, with the expectation that innovation will translate into improved reputation and revenue. The committee has met with the major institutes and centers offering online education on the Penn State campus, and with World Campus representatives from program planning and management, financial operations, marketing, corporate sales, international opportunities, academic learner support services, learning design, and faculty development. The committee has also heard from faculty and program administrators already offering engineering content online, and with faculty whose main research focus is on how people learn in the online environment.

**Year 0 (Summer/Fall 2016):** We will create the College’s Office of Digital Learning (COE-ODL). World campus will staff this with an interim-director and instructional designer. This interim director will assist in designing the office (job descriptions, etc.). This office will also work with Continuing and Distance Education to develop new graduate certificates comprised of existing and new courses taught using capture-stream technology. A plan will be developed to transition this office and all existing online activity to oversight by a college-wide committee on graduate education chaired by the director.
Year 1 (Fall 2017): We will extend four (4) existing Master’s of Engineering programs to distance learners using synchronous delivery via capture-stream (CS) methods. The goal will be to recruit 100 students per program, for a total of 300 enrollments per year.

Year 2 (Fall 2018): We will deliver two (2) purely online, novel professional master’s programs that integrate traditional engineering disciplines with state-of-the-art instruction in professional practice. These programs will be developed using World Campus instructional design (ID) and new guidelines for online delivery crafted by the COE ODL. The goal will be to recruit 133 students per program for a total of 400 enrollments year.

Year 3 (Fall 2019): Four (4) Master’s of Engineering programs will be brought online using synchronous delivery via capture-stream (CS) methods. The goal will be to recruit 100 students per program, for a total of 300 enrollments per year.

Overview of online engineering education

Interest in engineering disciplines continues to grow each year. However, capacity for resident instruction in the College of Engineering has remained stagnant, making capturing this market increasingly difficult. The building of larger buildings, more classrooms, and hiring additional faculty to meet this demand are not feasible in the near term. Furthermore, some of the clientele who could benefit from a Penn State Engineering degree are highly mobile professionals, military personnel, and international students, and others who may not be able to move to State College because of practical, professional, or personal reasons. One way to address these challenges is to take advantage of advances and accessibility of high-speed internet and deliver engineering content online.

Despite the promise of the internet to reach an expanding group of students, there are significant challenges to providing online education. While delivering a course online can provide some efficiencies of scale, preparation of course materials and teaching online can be more challenging than resident instruction. Research suggests that students at a distance need much of the same engagement with faculty as resident students. Such engagement can be hampered by the fact that students are accessible only through the internet and are at a distance. In addition, the preparation of material for online delivery can take extensive preplanning, careful consideration of pedagogical/andragogical methods, and design of assessment tools. So the cost of delivering online engineering
content must take into account the costs of faculty time or the hiring of highly qualified instructors and instructional designers. Further, there may be particular differences in resident instruction and distance education that require special innovations. Pedagogical techniques that work well in resident instructions (e.g. team work, question and answer periods, demonstrations, laboratory exercises, etc.) require careful planning to replicate or modify them for distance learners. Conversely, it is possible that an online course could have advantages over resident instruction because its students come from many geographical locations, exhibit multiple types of learning styles, and bring a wider array of professional and personal experiences than the typical resident graduate student who might be 22-25 years old. These unique perspectives and experiences could, in turn, enrich the traditional resident-instruction (RI)-based courses.

This plan seeks to chart a course for a world-class online program in engineering education. The main goal is to create a professional office of sustainable, high quality, online programs that serve the needs of existing programs that seek to expand their intellectual impact, and to create new programs at the interface of traditional disciplines and novel professional practice. This goal will be implemented with careful collaboration between the World Campus, College of Engineering administration, academic departments, and the Leonhard Center staff in order to guide the development along sound economic, administrative, and educational standards. The next section describes the plan itself, which takes into account the challenges and promises of online education. The appendix contains all of the results of meetings, considerations of principles of online education, benchmarking against highly ranked online education programs, and all calculations and assumptions used in revenue projections. The ultimate goal will be to capitalize on the potential of online education to reinvigorate residential instruction, increase market share and impact in engineering education, and to provide substantial revenue to the college, departments, and faculty.

The plan recognizes that the important elements of online education are student engagement by faculty, academic and technical support and advising for students, efficient collection and distribution of tuition revenues, and continual quality improvement of online instruction through assessment by educational experts and constituents, and the development of content and delivery mechanisms consistent with the latest pedagogical and andragogical methods. The plan highlights income and expenses primarily because these are the important elements of sustainability. There are implicit assumptions that program quality will follow after the competitive hiring of qualified directors, administrators, and instructional designers. The plan arises from consideration of the collaboration necessary between faculty, departments, the college, and World Campus. It describes the resulting administrative and financial structures necessary for the development of sustainable, world-class programs in online engineering education.
Plan for online engineering education

Year 0 (2016): A new Office for Digital Learning (ODL) will be staffed and charged with creating new certificate programs and transitioning existing programs and courses to oversight by this office.

World Campus administrators have pledged to cover the cost of an interim director of digital learning in the college and one instructional designer. This interim director will help create the administrative structure of the Office of Digital Learning (ODL) by designing positions and writing job descriptions. The interim director will also interface with the Continuing and Distance Education group to transition all online (WC courses) to be delivered through WC mechanisms and supported by WC. Effects of transition of summer “web-only” courses to WC will be assessed with the goal of increasing quality and support without sacrificing summer revenue to the college. There will also be a select group of courses developed to comprise graduate certificates in engineering. These will be delivered using capture stream (CS) technologies (described in the appendix). Revenue sharing for CS courses is described in the next section.

Years 1 and 3 (2017 and 2019): To existing Master’s of Engineering programs, we will add 4 online sections each in years 1 and 3, using capture-stream technology.

All revenue projections are based on an agreement (still to be negotiated) that all CS-based courses will share revenue as follows: 20% to WC, 80% to the College of Engineering. Of the college portion, 2/3 will go to the departments offering the course or program, 1/3 will go to the college. This results in the following revenue sharing mode for a CS-based course/program: WC (20%), COE (26%), Dept. (54%). We anticipate an aggressive recruitment of 100 students per semester per program under this model. Students will register for, on average, one course per semester (fall/spring/summer) for a total of 300 enrollments per year per program. In a typical program 3 courses are added in the first year, 8 in year 2, and 12 in year 3.

Instructional costs for the college include course set up, capture/delivery/operation, course maintenance, fringe (36%) resulting in a cost per course of $8,636 and a total per program cost of $103,632 (12 courses per program) (see Figure 1 and appendix).
In a typical program 3 courses are added in the first year, 8 in year 2, and 12 in year 3. Instructional costs per program for departments are $300 per student resulting in $90,000 for 300 enrollments (100 students taking 3 courses per year). Net revenue projections are gross tuition (at $1,100 per credit) minus these instructional costs (see Figure 2).

Figure 1: Gross and net revenue to the College of Engineering per program for 12 CS-based courses.

Instructional costs per program for departments are $300 per student resulting in $90,000 for 300 enrollments (100 students taking 3 courses per year). Net revenue projections are gross tuition (at $1,100 per credit) minus these instructional costs (see Figure 2).

Figure 2: Income per program to a department for CS-based delivery of 12 courses per year, 300 enrollments total with instructional costs of $300 per enrollment. In a typical program 3 courses are added in the first year, 8 in year 2, and 12 in year 3. Net income is gross income from tuition minus instructional costs.
Year 2 (2018): We will deliver 2 full programs created using Instructional Design-based (ID) courses.

All revenue projections for WC-developed courses (here called Instructional designed (ID)) are based on the RDC1 graduate program model. Revenue sharing will be as follows: 45% to WC, 55% to the College of Engineering. Of the college portion, 2/3 will go to the departments offering the course or program, 1/3 will go to the college. This results in the following revenue sharing mode for ID-based course: WC (45%), COE (18%), Dept. (37%). We anticipate an aggressive recruitment of 133 students per semester per program under this model. Students will register for one course per semester (fall/spring/summer) for a total of 400 enrollments per year per program. There are no course development costs for the college because under RDC1, the World Campus assumes all development costs (faculty release time and instructional design). Net revenue to the college under this program is shown in Figure 3. In a typical program year 0 is used for instructional design, 4 courses are delivered in the first year, 8 courses in the second year, and 12 in year 3.

![World Campus ID-based (RDC1) Single Program - COE Income & Costs](image)

**Figure 3**: Revenue to COE for an ID program. Under RDC1, World Campus pays the cost of course development. There are no costs to COE. In a typical program year 0 is used for instructional design, 4 courses are delivered in the first year, 8 courses in the second year, and 12 in year 3.

Instructional costs per course for departments are $17,000. This number assumes $100,000 instructor salary, 36% fringe, and 8 sections per instructor. The total instructional cost is then $204,000 for 12 sections. Net revenue projections are gross tuition minus these instructional costs (Figure 4).
Impact of plan on the institution

It is expected that online education will allow departments to extend the reach of expertise of their faculty. In many disciplines, Master’s degrees are becoming valuable entry level degrees, are mechanisms for promotion in the workplace, count as experience for professional engineering exams, and can help make students more competitive for PhD and MD programs and other advanced professional degrees. By providing a residence experience to distance learners, CS technology can allow students to reach these objectives without the burden of travelling to State College.

Faculty: Projections of revenue predict that this goal can be accomplished in a sustainable way by generating income for faculty, which can be used as supplemental salary or for supporting additional research objectives. Under CS technologies, faculty can generate $300 per student. This can be a necessary incentive for faculty to teach online, as online instruction can carry with it an extra burden of preparing lessons and in managing an increased student load. A program that offers 12 courses a year that can attract 100 students will have instructional costs of $90,000 if each student is enrolled in 1 course per semester (fall, spring, summer). So, on average, a faculty member can generate $7,500 per course ($90,000/12) to teach these additional students. Our analysis suggests that faculty teaching a fully instructional-design-based course on load is not economically viable (see appendix). However, for ID courses, a fixed term instructor can earn $100,000 to teach 8 sections of a course. This competitive salary is likely to attract high quality instructors.
**Departments:** In addition, the revenue projections appear to be adequate for the generation of funds for departments that can be used to design innovative programs, accumulate funds for improved faculty start-up packages, fund graduate students, and other initiatives. For example, after instructional costs, a full Master’s of Engineering program that has an online section for each course could generate $440,000 per year (see table 1 and figure 2) using capture-stream methods. This suggests that 12 courses would be available to students over the course of a year and that 100 students would be enrolled over 3 of those courses on average. An ID-based program could net $284,278 per year at 133 students per semester (figure 4). Therefore **at steady state, the plan described herein could generate $728,878 per year, for a department offering 1 CS program and 1 ID program.**

**College:** Similarly, revenue projections appear to be adequate for the generation of funds for the college to run the ODL, hire instructional designers for college-wide courses and programs, contribute to improved faculty start-up packages, fund graduate student stipends and support programs, and other initiatives. For example, after instructional costs, 8 full Master's of Engineering programs that have an online section for each course could generate a net for the college of $1,230,144 per year (figure 5) using CS methods and enrolling 800 students per semester. Two ID-based programs with 266 enrollments could net $475,081 per year (figure 5). Therefore **at steady state, the plan described herein could generate for the college, a net of $1,705,225 per year** (figure 5).

---

**Figure 5:** Total revenue predictions for the college under a program that combines 8 CS-based programs and 2 ID-based programs. Revenue is based on 26% of revenue from CS-based courses and 18% of ID-based courses comes to the college. This revenue will be used to support salaries for the ODL, creation of new programs and courses, and support of capture stream and ID equipment (details in appendix).
Figure 6: Total revenue predictions for the departments under a program that combines 8 CS-based programs and 2 ID-based programs. Revenue is based on 54% of revenue from CS-based courses and 37% of ID-based courses comes to the department. This revenue will be used to support salaries of instructional designers and faculty salaries (supplemental pay for tenure track faculty and salaries for fixed term instructors), and creation of new programs and courses.

Because ID programs can accommodate more students than CS courses, the revenues per ID program can be comparable to CS-based programs, despite disparities in percent revenue sharing. All existing programs (e.g. Acoustics, Mechanical Engineering, Electrical Engineering, Nuclear Engineering) will be reviewed, and transitioned to governance by ODL and appropriate revenue sharing over 3 years (described in appendix).

Overall, this aggressive approach would yield new revenues of $791,852 to the World Campus and a total gross of $10,559,340 to the departments, college, and university. Such revenues would reduce strain of current resident programs on the college by providing funds for new faculty, TAs, and enhanced digital learning resources for resident students.

It is hoped that the RDC1 model for these ID-based courses could be renegotiated to RDC2 so that the ODL and the Leonhard Center could better influence course revisions with the goal of employing the best pedagogical/andragogical practices in engineering education. Nevertheless, as the College transitions into instructional-design-based courses, the model proposed could scale to much larger numbers than indicated here.
Appendix

Development of the plan:

The interviews

The committee met with each of the major institutes providing online education, most of the engineering departments with significant investment in putting courses online, instructors, and with our own continuing and distance education group. Significantly, the committee had 3 meetings covering six major topics in online course delivery provide by World Campus personnel. Here is a list of the interviewees:

**WC Presentation #1 of 3: Program Planning & Management and Financial Operations**
Scheduled: Nov 13, 2015, 11:00 AM to 12:30 PM
Location: 241 Outreach Building

**Larry Ragan @ COIL--Center for Online Innovation in Learning**
Scheduled: Nov 13, 2015, 1:00 PM to 2:00 PM
Location: 329 Building - 313C Conference Room

**Avis Kunz @ Filippelli Institute for e-Education and Outreach**
Scheduled: Nov 13, 2015, 3:30 PM to 4:30 PM
Location: 127 Sparks

**Lunch Discussion for One-year Master's Online Delivery**
Scheduled: Nov 16, 2015, 12:00 PM to 2:00 PM
Location: 125 Reber

**Brian Cameron and Pete Forster  RE: Online Engineering Programs Meeting**
Scheduled: Nov 20, 2015, 12:00 PM to 1:00 PM
Location: 387 Business Building

**Ann Taylor @ the John A. Dutton e-Education Institute**
Scheduled: Nov 25, 2015, 9:30 AM to 10:30 AM
Location: 418 EES Bldg.

**WC Presentation #2 of 3: World Campus Marketing, Corporate Sales and International Opportunities**
Scheduled: Nov 25, 2015, 12:00 PM to 1:30 PM
Location: 241 Outreach Building

**WC Presentation #3 of 3: - World Campus Academic Learner Support Services, Learning Design, and Faculty Development**
Scheduled: Nov 30, 2015, 12:00 PM to 1:30 PM
Location: 324 Outreach Building

1-year Masters Directors, User group (current professors teaching online; e.g. from Acoustics, ME, EE, NucE, others)

Continuing and Distance Ed group (Led by Terry Reed).

Principles for online education

We propose 4 main principles of online education, specific for the College of Engineering. These principles arise from recognition, after many interviews, that online education has similar goals as resident instruction, but may be fundamentally different in its delivery and in its ability to successfully achieve key learning outcomes. It also recognizes the important work faculty do in research and the need to incentivize faculty, departments, and the college to offer online versions of courses. Finally, it recognizes that online delivery of engineering content has the potential to significantly extend the impact of Penn State College of Engineering.

1. **Faculty**: Online education should not significantly divert research faculty (tenured and tenure line) from research, service to the university, or resident instruction.
2. **Students**: The quality of online instruction should be dictated by student learning outcomes, positive student experiences, and academic integrity.
3. **College and Departments**: online education should enhance the prestige and financial well being of the college and its departments.
4. **Engineering education**: Efforts in the college should lead to increased innovation in online learning; increased dissemination of faculty expertise; and increased dissemination of technical content to the public.

Models for online courses

**Delivery methods**: In our interviews we identified three main types of content delivery, each of which is best carried out by a specific method of course design.

1. **Synchronous**: in this model, a faculty member delivers a lecture much like he/she might do in a typical classroom. This lecture is streamed live to students at a distance synchronously using software such as Adobe Connect. The software provides a means for distance students to interact with the faculty member in real time, with a technician monitoring the classroom, and with the students in the classroom. Because the content is streamed it can be captured and recorded and provided to both the resident and distance students for later viewing. In addition, the stored lectures could potentially be used for instruction in subsequent semesters of the instructor could not deliver them, or for flipped classrooms.
2. **Asynchronous** – lectures are recorded in a special recording studio or during a lecture and delivered to distance students asynchronously. These lectures can by used in subsequent semesters. They could also be used to create course content that is enriched with multimedia, reinforcement exercises, and assessments. Content could be used in resident flipped courses.

3. **Multi modal** - all course content is converted to exercises that are predominately based on reading, assessment, followed by interaction with a lead instructor. A tenured faculty member would provide consultation on actual content and methods of presenting material. However, they might provide little or no actual lectures to supplement the content. This method is labor intensive but is very scalable. Course content could be used in flipped courses.
**Course Development Process:** For each of these delivery modes there are course development processes that are more or less appropriate for the delivery mode. Each of the models is described based on development process, and costs associated with course development.

<table>
<thead>
<tr>
<th>Course Development Process</th>
<th>Description of Process</th>
<th>Costs associated with course development</th>
</tr>
</thead>
</table>
| Lecture Capture (Nuclear Engineering, Acoustics) | • Ideal for synchronous delivery mode; but can provide lectures for asynchronous delivery mode  
  • Instructor teaches a resident course in a classroom equipped to capture teaching into digital format. Instructor uses digitizing tablet or similar technology so that online students can see what is being written or projected.  
  • The lecture is streamed live using software like Adobe Connect and also captured for later viewing.  
  • The video is typically posted with minimal processing other than that required by ADA compliance.  
  • Classrooms may be equipped with microphones and speakers to allow online students to engage in Q&A | • Videography and any related processing costs  
  • Minimal faculty time is needed for course development  
  • Amortized cost of equipment needed for lecture capture |
| Instructional Design (Aero, AE, EE as well as World-campus, Dutton, Fillipelli, A&A, Smeal and IST) | • Works best for multimodal delivery mode  
  • Instructor works with instructional designer to create multi-media materials for asynchronous course delivery.  
  • Duration of development process is 1 to 2 semesters | • Faculty time – one or two course buyout or the equivalent amount of time  
  • Instructional designer, typically 1/3 to ½-time |
Criteria for a high quality online program

The US News and World Report uses particular best practices to rank programs. We have found that these metrics are consistent with best practices articulated by the World Campus and by online instructors at Penn State. These are as follows: (From http://www.usnews.com/education/online-education/articles/engineering-methodology)

**Student engagement (30 percent):** Quality engineering programs promote participation in courses, allowing students opportunities to readily interact with their instructors and classmates. In turn, instructors are not only accessible and responsive, but they are also tasked with helping to create an experience rewarding enough that students stay enrolled and complete their degrees in a reasonable amount of time.

**Faculty credentials and training (25 percent):** Strong online engineering programs employ instructors with academic credentials that mirror those of instructors for campus-based programs, and they have the resources to train these instructors on how to teach distance learners.

**Student services and technology (20 percent):** Programs that incorporate diverse online learning technologies allow greater flexibility for students to take classes and labs from a distance. Outside of classes, strong support structures provide learning assistance, career guidance and financial aid resources commensurate with quality campus-based programs.

**Peer reputation (15 percent):** A survey of high-ranking academic officials in engineering helps account for intangible factors affecting program quality that are not captured by

| Hybrid model – Lecture Capture + Instructional Design (Aero) | • Works well for asynchronous/multimodal delivery mode • Can be appropriate for Asynchronous delivery mode provided the captured lectures are acknowledged • Lectures are captured as the starting point for multimedia-based, instructional design. Since the lectures are not captured for direct streaming, a special classroom is not required. • Faculty member works with instructional designer to create the online course materials • Substantial processing/editing of videos is required | • Instructional designer, typically 1/3 to ½-time • Faculty time – some faculty compensation may be required |

• Faculty member works with instructional designer to create the online course materials • Substantial processing/editing of videos is required
statistics. Also, degrees from programs that are well respected by academics may be held in higher regard among employers.

**Admissions selectivity (10 percent):** Student bodies entering with proven aptitudes, ambitions and accomplishments can handle the demands of rigorous course work. Furthermore, online degrees that schools award judiciously will have greater legitimacy in the job market.

**Benchmarking the top 12 online programs**

The following tables are assembled from US News and World Report data from the top 12 ranked online graduate programs in the United States. Each table is described with conclusions about what the relevance is for CoE online education.

**Program metrics and Rankings:** We found that rankings were tightly correlated to faculty credentials and student services. According to our benchmarking, Penn State could improve its rankings by focusing on student services and admissions selectivity. Penn State's tuition is competitive with others in the top 12, and its enrollment is comparable. Almost all Penn State programs arise from Great Valley.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Institution</th>
<th>Faculty Credentials and Training</th>
<th>Student Services and Technology</th>
<th>Student Engagement</th>
<th>Admissions Selectivity</th>
<th>Peer Assessment Score ($)</th>
<th>Total Enrollment</th>
<th>Tuition*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>University of California—Los Angeles</td>
<td>98</td>
<td>100</td>
<td>94</td>
<td>99</td>
<td>3.4</td>
<td>312</td>
<td>$916</td>
</tr>
<tr>
<td>2</td>
<td>Columbia University</td>
<td>94</td>
<td>60</td>
<td>100</td>
<td>100</td>
<td>3.8</td>
<td>210</td>
<td>$1,710</td>
</tr>
<tr>
<td>3</td>
<td>University of Southern California</td>
<td>84</td>
<td>56</td>
<td>78</td>
<td>95</td>
<td>4</td>
<td>888</td>
<td>$1,706</td>
</tr>
<tr>
<td>4</td>
<td>Purdue University—West Lafayette</td>
<td>90</td>
<td>90</td>
<td>48</td>
<td>67</td>
<td>3.9</td>
<td>731</td>
<td>$1037/1,145 out</td>
</tr>
<tr>
<td>5</td>
<td>Pennsylvania State University—World Campus</td>
<td>89</td>
<td>56</td>
<td>78</td>
<td>39</td>
<td>3.6</td>
<td>437</td>
<td>$930</td>
</tr>
<tr>
<td>6</td>
<td>University of Wisconsin—Madison</td>
<td>53</td>
<td>50</td>
<td>98</td>
<td>61</td>
<td>3.9</td>
<td>201</td>
<td>$670/1,503 out</td>
</tr>
<tr>
<td>7</td>
<td>University of Tennessee—Chattanooga</td>
<td>78</td>
<td>85</td>
<td>95</td>
<td>69</td>
<td>1.9</td>
<td>205</td>
<td>$428 in/475 out</td>
</tr>
<tr>
<td>8</td>
<td>New York University</td>
<td>66</td>
<td>69</td>
<td>81</td>
<td>50</td>
<td>3</td>
<td>138</td>
<td>$1,452</td>
</tr>
<tr>
<td>9</td>
<td>University of Michigan—Ann Arbor</td>
<td>90</td>
<td>42</td>
<td>46</td>
<td>49</td>
<td>3.9</td>
<td>409</td>
<td>$1,373 in/1,504 out</td>
</tr>
<tr>
<td>10</td>
<td>Cornell University</td>
<td>57</td>
<td>51</td>
<td>68</td>
<td>39</td>
<td>3.9</td>
<td>88</td>
<td>$1,960</td>
</tr>
<tr>
<td>11</td>
<td>North Carolina State University</td>
<td>95</td>
<td>49</td>
<td>34</td>
<td>63</td>
<td>3.5</td>
<td>690</td>
<td>$744 in/748 out</td>
</tr>
<tr>
<td>12</td>
<td>Johns Hopkins University (Whiting)</td>
<td>45</td>
<td>76</td>
<td>72</td>
<td>34</td>
<td>3.3</td>
<td>2,626</td>
<td>$1,177</td>
</tr>
</tbody>
</table>
Faculty Composition: Rankings were not tightly coupled to whether a program used tenured faculty. Most programs provided training for faculty to teach online. This table indicates that the top programs have high involvement of tenure track faculty. These faculty and instructors have dedicated training in online course delivery; with good technical staff. It also indicates that class size for online courses are comparable to resident classes. Many classes in the top schools mix online and resident students. Such a mix is consistent with the synchronous mode, but could also indicate that some resident students are allowed to take online courses. Average time to completion is less than 3 years (not shown), indicating most students are part time ad take approximately 1 course per semester.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Institution</th>
<th>Instructional faculty that teach courses accessible online</th>
<th>Tenured / tenure-track faculty</th>
<th>Average experience teaching online courses (years)</th>
<th>Required hours of training</th>
<th>Technical Staff Supporting faculty</th>
<th>Average class size</th>
<th>Maximum class size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>University of California—Los Angeles</td>
<td>39 full-time; 8 part-time</td>
<td>39</td>
<td>5</td>
<td>8</td>
<td>14 full, 22 part</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>Columbia University</td>
<td>75 full-time; 35 part-time</td>
<td>70</td>
<td>10</td>
<td>10</td>
<td>9 full, 10 part</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>University of Southern California</td>
<td>104 full-time; 64 part-time</td>
<td>83</td>
<td>8</td>
<td>8</td>
<td>24 full, 75 part</td>
<td>46</td>
<td>125</td>
</tr>
<tr>
<td>4</td>
<td>Purdue University—West Lafayette</td>
<td>65 full-time; 0 part-time</td>
<td>61</td>
<td>5</td>
<td>3</td>
<td>210 full, 30 part</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>5</td>
<td>University of Wisconsin—Madison</td>
<td>47 full-time; 13 part-time</td>
<td>33</td>
<td>7</td>
<td>4</td>
<td>15 full, 2 part</td>
<td>12</td>
<td>35</td>
</tr>
<tr>
<td>6</td>
<td>University of Tennessee—Chattanooga</td>
<td>20 full-time; 5 part-time</td>
<td>20</td>
<td>15</td>
<td>10</td>
<td>1 full, 2 part</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>7</td>
<td>New York University</td>
<td>17 full-time; 43 part-time</td>
<td>11</td>
<td>8</td>
<td>4</td>
<td>28 full, 40 part</td>
<td>11</td>
<td>30</td>
</tr>
<tr>
<td>8</td>
<td>University of Michigan—Ann Arbor</td>
<td>15 full-time; 6 part-time</td>
<td>15</td>
<td>6</td>
<td>5</td>
<td>5 full, 3 part</td>
<td>25</td>
<td>60</td>
</tr>
<tr>
<td>9</td>
<td>Cornell University</td>
<td>10 full-time; 3 part-time</td>
<td>8</td>
<td>4</td>
<td>N/A</td>
<td>3 full</td>
<td>32</td>
<td>N/A</td>
</tr>
<tr>
<td>10</td>
<td>North Carolina State University</td>
<td>125 full-time; 10 part-time</td>
<td>120</td>
<td>10</td>
<td>5</td>
<td>403 full, 16 part</td>
<td>45</td>
<td>80</td>
</tr>
<tr>
<td>11</td>
<td>Johns Hopkins University (Whiting)</td>
<td>4 full-time 133 part-time</td>
<td>3</td>
<td>4</td>
<td>24</td>
<td>12 full, 0 part</td>
<td>14</td>
<td>20</td>
</tr>
</tbody>
</table>
Student experience: The top programs blended online and resident instruction. Online programs tended to have a similar imbalance between male and female students as resident programs (resident: 21% female), but higher than average number of underrepresented minorities (resident: 8.8% UR). Most students are working while taking courses and the average age is significantly higher than our resident courses (not shown). Many, though not all, programs offer 24-7 technical support (not shown).

<table>
<thead>
<tr>
<th>Rank</th>
<th>Institution</th>
<th>Can earn degree entirely online</th>
<th>Classes include campus-based students</th>
<th>2013-14 retention rates</th>
<th>3-year graduation rate</th>
<th>Male</th>
<th>Female</th>
<th>UR**</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>University of California—Los Angeles</td>
<td>Yes</td>
<td>Yes</td>
<td>88%</td>
<td>84%</td>
<td>80%</td>
<td>20%</td>
<td>67%</td>
</tr>
<tr>
<td>2</td>
<td>Columbia University</td>
<td>Yes</td>
<td>Yes</td>
<td>99%</td>
<td>88%</td>
<td>77%</td>
<td>23%</td>
<td>19%</td>
</tr>
<tr>
<td>3</td>
<td>University of Southern California</td>
<td>Depends</td>
<td>Yes</td>
<td>96%</td>
<td>73%</td>
<td>76%</td>
<td>24%</td>
<td>27%</td>
</tr>
<tr>
<td>4</td>
<td>Purdue University—West Lafayette</td>
<td>Yes</td>
<td>Yes</td>
<td>92%</td>
<td>44%</td>
<td>77%</td>
<td>23%</td>
<td>19%</td>
</tr>
<tr>
<td>5</td>
<td>Pennsylvania State University—World Campus</td>
<td>Yes</td>
<td>No</td>
<td>86%</td>
<td>78%</td>
<td>82%</td>
<td>18%</td>
<td>23%</td>
</tr>
<tr>
<td>6</td>
<td>University of Wisconsin—Madison</td>
<td>Depends</td>
<td>No</td>
<td>99%</td>
<td>91%</td>
<td>90%</td>
<td>10%</td>
<td>15%</td>
</tr>
<tr>
<td>7</td>
<td>University of Tennessee—Chattanooga</td>
<td>Yes</td>
<td>Yes</td>
<td>96%</td>
<td>N/A</td>
<td>71%</td>
<td>29%</td>
<td>29%</td>
</tr>
<tr>
<td>8</td>
<td>New York University</td>
<td>Yes</td>
<td>Yes</td>
<td>77%</td>
<td>78%</td>
<td>84%</td>
<td>16%</td>
<td>23%</td>
</tr>
<tr>
<td>9</td>
<td>University of Michigan—Ann Arbor</td>
<td>Yes</td>
<td>Yes</td>
<td>90%</td>
<td>28%</td>
<td>85%</td>
<td>15%</td>
<td>16%</td>
</tr>
<tr>
<td>10</td>
<td>Cornell University</td>
<td>No</td>
<td>No</td>
<td>90%</td>
<td>90%</td>
<td>82%</td>
<td>18%</td>
<td>30%</td>
</tr>
<tr>
<td>11</td>
<td>North Carolina State University</td>
<td>Yes</td>
<td>Yes</td>
<td>95%</td>
<td>N/A</td>
<td>82%</td>
<td>18%</td>
<td>21%</td>
</tr>
<tr>
<td>12</td>
<td>Johns Hopkins University (Whiting)</td>
<td>Yes</td>
<td>No</td>
<td>83%</td>
<td>60%</td>
<td>78%</td>
<td>22%</td>
<td>26%</td>
</tr>
</tbody>
</table>
**Most popular programs:** The table below is compiled from all of the most highly subscribed programs from each school. The most popular programs are Electrical Engineering, Mechanical Engineering, and Computer Science (Computer Science may be the more popular if one adds Computer engineering (3 programs). Industrial engineering and Engineering Management are also popular.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Institution</th>
<th>Number of programs</th>
<th>Electrical/Electronic/Communications</th>
<th>Mechanical</th>
<th>Computer Science</th>
<th>Industrial</th>
<th>Engineering Management</th>
<th>Aerospace/Aeronautical/Astronautical</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>University of California—Los Angeles</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Columbia University</td>
<td>16</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>University of Southern California</td>
<td>40</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Purdue University—West Lafayette</td>
<td>9</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Pennsylvania State University—World Campus</td>
<td>5</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>University of Wisconsin—Madison</td>
<td>8</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>University of Tennessee—Chattanooga</td>
<td>3</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>8</td>
<td>New York University</td>
<td>7</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>University of Michigan—Ann Arbor</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Cornell University</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>North Carolina State University</td>
<td>15</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Johns Hopkins University (Whiting)</td>
<td>9</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>SUM</strong></td>
<td><strong>9</strong></td>
<td><strong>7</strong></td>
<td><strong>6</strong></td>
<td><strong>4</strong></td>
<td><strong>4</strong></td>
<td><strong>3</strong></td>
<td><strong>51</strong></td>
</tr>
</tbody>
</table>
Assumptions used in revenue models

Estimates of Tuition Income from “Nominal” Online Masters Program
Disclaimer: Making these estimates is quite challenging because there are many variables. Results should be used with caution!

Models for online course development
Across most of the groups that we spoke with, including the World Campus, online courses are developed using a formal instructional design (ID) process. This process requires a close collaboration between a content expert and an instructional designer. A multi-media designer is often involved as well. The process takes roughly two semesters. The content expert is compensated for the time spent on developing the course. Within the College of Engineering, Aerospace, Architectural Engineering, and Electrical Engineering are using this approach for development of online courses.

The College of Engineering appears to be the only unit on campus that uses simultaneous resident instruction and lecture capture to create online courses. The instructor teaches a resident course in a classroom equipped to capture teaching into digital format. An instructor uses a digitizing tablet or similar technology so that online students can see what is being written or projected. The lecture is streamed live using software such as Adobe Connect and also captured for later viewing (Capture-stream, CS). The video is typically posted with minimal processing (it is not clear if the College is currently in compliance with ADA processing of the videos.) The classrooms may be equipped with microphones and speakers to allow online students to engage in Q&A. This approach is used in Acoustics and Nuclear Engineering as well as the new MS in Mechanical Engineering. Table A1 contains the overall revenue sharing details proposed for CS courses.
These two approaches have different costs structures. The first approach, capture–stream, does not require nearly as much upfront investment. However, there are continuing costs for lecture capture because the courses are captured live for most semesters. Also there is capital equipment costs as well as the need to have dedicated classrooms. The second approach, Instructional Design or ID, requires substantial upfront investment. A typical course development process costs approximately $50K. Structure of an ID program is shown in table A2.

<table>
<thead>
<tr>
<th>Cap-Stream Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution of Gross Tuition Income</td>
</tr>
<tr>
<td>World Campus/University</td>
</tr>
<tr>
<td>Department*</td>
</tr>
<tr>
<td>College*</td>
</tr>
<tr>
<td>Total number of students</td>
</tr>
<tr>
<td>Total enrollments per year</td>
</tr>
<tr>
<td>Courses/sections per year</td>
</tr>
<tr>
<td>Faculty compensation <em>(for illustration purposes only)</em></td>
</tr>
</tbody>
</table>

* 80% of gross income to Department/College is split approximately 2/1

Table A1: Structure of capture stream program
## World Campus ID-based courses (RDC1)

<table>
<thead>
<tr>
<th>Distribution of Gross Tuition Income</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>World Campus/University</td>
<td>45%</td>
</tr>
<tr>
<td>Department*</td>
<td>37%</td>
</tr>
<tr>
<td>College*</td>
<td>18%</td>
</tr>
</tbody>
</table>

| Total number of students                              | 133    |
| Total enrollments per year                            | 400    |
| Courses/sections per year                             | 12     |

**Faculty compensation (for illustration purposes only)**

- $17,000 per section (Fixed term instructor)

* 55% of gross income to Department/College is split approximately 2/1

*Table A2: Structure of instructional design program*
Calculations for revenue and expenses for both CS and ID courses is presented in table A3. The total gross income is the appropriate number to consider for total money coming into the program that can be used for all elements of the program in addition to initiatives not directly related to online instruction.

<table>
<thead>
<tr>
<th></th>
<th>Cap-Stream</th>
<th>WC-ID (RDC1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Programs</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Number of students</td>
<td>100</td>
<td>133</td>
</tr>
<tr>
<td>Avg. annual course enrollment per student</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Annual course enrollments</td>
<td>300</td>
<td>400</td>
</tr>
<tr>
<td>Courses/sections per year</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Average students per course/section</td>
<td>25</td>
<td>33</td>
</tr>
<tr>
<td>Tuition per course</td>
<td>$3,300</td>
<td>$3,300</td>
</tr>
<tr>
<td>Total Annual Gross Tuition</td>
<td>$990,000</td>
<td>$1,319,670</td>
</tr>
<tr>
<td>WC % of Gross Tuition</td>
<td>20%</td>
<td>45%</td>
</tr>
<tr>
<td>CoE % of Gross Tuition</td>
<td>26%</td>
<td>18%</td>
</tr>
<tr>
<td>DEPT % of Gross Tuition</td>
<td>54%</td>
<td>37%</td>
</tr>
<tr>
<td>WC Gross Tuition</td>
<td>$198,000</td>
<td>$593,852</td>
</tr>
<tr>
<td>COE Gross Tuition</td>
<td>$257,400</td>
<td>$237,541</td>
</tr>
<tr>
<td>DEPT Gross Tuition</td>
<td>$534,600</td>
<td>$488,278</td>
</tr>
<tr>
<td>COE Course Development Costs</td>
<td>$8,636</td>
<td>($103,632)</td>
</tr>
<tr>
<td>COE Net Annual Income per program</td>
<td>$153,768</td>
<td>$237,541</td>
</tr>
<tr>
<td>COE Total Annual Income at SS</td>
<td>$1,230,144</td>
<td>$475,081</td>
</tr>
<tr>
<td>DEPT Instructional Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cap-Stream $ per student</td>
<td>$300</td>
<td>($90,000)</td>
</tr>
<tr>
<td>ID-based course $ per section</td>
<td>$17,000</td>
<td>($204,000)</td>
</tr>
<tr>
<td>DEPT Net annual income</td>
<td>$444,600</td>
<td>$284,278</td>
</tr>
<tr>
<td>Total income to 8 DEPTS</td>
<td>$3,556,800</td>
<td>$568,555.80</td>
</tr>
</tbody>
</table>

Table A3

The total for the whole program is $10,559,340 which is the amount that can be apportioned to WC for operations of student support, advertising, restoration services, and other administrative duties and the college and departments for instructional and student support services. Even though tuition is not specifically being earmarked for the University, this income can be used to offset financial obligations the university has to support COE functions.
Note: We found that developing courses in the College under RDC 2 does not lead to substantially greater income compared to partnering with the World Campus under RDC1.

Models for Faculty Compensation

Prior to settling on the formula for cap stream of $300 per student; or the $17K course for ID-based courses, we tried other scenarios listed below. To illustrate the impact of faculty compensation on the net income from a nominal online Masters, RDC1 is used as a base model, and three faculty compensation models are compared:

1. Tenure-track faculty teaching the online courses “on load”
2. Fixed-term faculty teaching the online courses “on load”
3. Tenure-track faculty teaching both resident and online students simultaneously (this corresponds most directly to the Capture-Stream model.)

For sake of simplicity, these three models are compared when the Master’s program has reached full enrollment, and 12 courses are being offered each year with 25 students per section. Assuming a cost per credit of $1100 (from MS ME program), RDC1 leads to a gross income before instructional costs of approximately $45K per course.

The table below shows that having tenure-track faculty in the College of Engineering teach on-load in a nominal Master’s program is not financially viable.

The assumptions used to make the estimates are:

1. Tenure-track on load: AY salary $140K; 4 courses per year; fringe 36%
2. Fixed-term on load: AY salary $96K; six courses per year; fringe 36%
3. Tenure-track teaching both resident and online students: $10,000 per course

<table>
<thead>
<tr>
<th>Instructor cost per course</th>
<th>Income per course after instructor costs</th>
<th>Estimated Annual Income after instructor costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tenure-track &quot;on load&quot;</td>
<td>($47,600)</td>
<td>($2,225)</td>
</tr>
<tr>
<td>Fixed-term &quot;on load&quot;</td>
<td>($21,760)</td>
<td>$23,615</td>
</tr>
<tr>
<td>Tenure track teaching resident and online simultaneously</td>
<td>($10,000)</td>
<td>$35,375</td>
</tr>
</tbody>
</table>

Table A4
There are additional costs related to having a master’s program, which are not included here. These additional program costs include:

- Costs associated with faculty supervision of “culminating experience”
- Administrative costs of advising an additional 100 students per year

**Summary of costs for CS-based and ID-based courses.**

The table below contains the detailed calculations for costs for CS and ID delivery of courses for the college and for departments. These costs are used to calculate net revenue to the college and departments for CS and ID programs.

<table>
<thead>
<tr>
<th>Estimated course development costs</th>
<th>(Using estimates from Terry Reed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course set up, capture</td>
<td>$3,100</td>
</tr>
<tr>
<td>Delivery/operation</td>
<td>$3,000</td>
</tr>
<tr>
<td>Course maintenance</td>
<td>$250</td>
</tr>
<tr>
<td>Fringe (36%)</td>
<td>36%</td>
</tr>
<tr>
<td>Cost per course</td>
<td>$8,636</td>
</tr>
</tbody>
</table>

**COE costs per ID-course**

Faculty comp for course development. (Assumes max amount of $15K. WC pays 11% of 36 week salary up to $15K).  
- ($15,000)
- Instructional designer (1/3 per course at $60K)  
- ($20,000)
- Fringe (estimated at 36%)  
- ($47,600)

**DEPT costs for ID-based sections**

<table>
<thead>
<tr>
<th>48 week salary</th>
<th>$100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fringe</td>
<td>36%</td>
</tr>
<tr>
<td>Course per year</td>
<td>8</td>
</tr>
<tr>
<td>Cost per course</td>
<td>17000</td>
</tr>
</tbody>
</table>

Table A5
Organizational and governance structure

Based on all of the available data, we conclude that the best structure would be to adopt a three-component approach to cover the needs of existing and future online programs:

1. **Master's of Engineering:** We propose to add online sections to Master's of Engineering programs using the synchronous delivery model (CS). We propose to negotiate with the World Campus to apply a revenue sharing model already in place with acoustics. Under this agreement, World Campus recovers 20% of the revenue, while the college receives 80%. The revenue to the college would be split 2:1 between departments and college. Departments would cover the cost of a technician to support each of the online sections. A benefit of this model is that there are minimal instructional costs beyond the cost of a technician, and faculty can teach using the teaching load adopted for the 1-year masters. Some of the video content could be used later by instructional designers in an asynchronous or multi-modal version of the course, and the students have the maximum engagement with the instructor. This model fits in well with the 4 principles outlined earlier in this paper. One caveat is that we will need to offer M.Eng. versions of the one-year masters because the graduate school has not yet approved the M.S. to be offered online. If the 80:20 model cannot be negotiated, we will use the RDC2 model (34% to WC, 44% to department, 22% to college).

2. **Existing Programs:** The transition for existing online programs to ones that are under the ODL still needs to be negotiated. Currently, Mechanical Engineering is working with World Campus to develop a master's of science under the RDC2 model. Under a possible transition, the Mechanical Engineering department would phase in a 27%: 53% split between the college and department, respectively, after year 3 at which point the college would begin to assist the department in development and revision costs. Electrical Engineering and Computer Science will also be invited to deliver M.Eng programs, although they could adopt a synchronous delivery mode as well. These programs would be phased in similarly to Mechanical Engineering. While the percentage share for the college is less (11%) under this mode, once the courses are authored using an ID or hybrid model, they can be delivered to a larger number of students than under CS.

3. **Office of Digital Learning:** We will create an Office of Digital Learning with a new director for that office. This office will oversee all aspects of modern digital aspects of engineering education. These include:
   
   a. Learning Management Systems
i. CANVAS
   1. Training of faculty, collection of aggregate data
b. Online Programs
   i. Development of New Professional Master’s
c. Integration of LMS and Civitas, a predictive analytics software
d. Oversight of the Continuing and Distance Education Group
   i. Web-only courses
   ii. Summer Courses
e. Research in digital learning
f. Interface with COIL and Leonhard Center
   i. Seed grant proposals
g. Clickers and other in-class instructional tools

One major goal of the new office will be to develop online only professional master's degrees that would be centered on core technical content in engineering (e.g. fluids mechanics, solid mechanics, heat and mass transfer, research and design methods and ethics, presentation skills, corporate teams; these would be supplemented by discipline-specific certificates (e.g. drug delivery, structures, supply chain). The new office would be funded initially by the college and later by revenues from revenue sharing of online master's programs. These master's programs would be developed under RDC1 model and phased in to RDC2 over time (to be negotiated with WC).

We would work with CD&E to transition their cost recovery system to one that reflects the revenue sharing outlined in this plan.

Proposed organizational chart is as follows:
Appendix D

Industrial Engineering (I E)

Program Home Page (Opens New Window)

JANIS P. TERPENNY, Peter and Angela Dal Pezzo Chair and Department Head, Harold and Inge Marcus Department of Industrial and Manufacturing Engineering
310 Leonhard Building
814-865-7601

Degrees Conferred:

M.Eng., M.S., Ph.D.

The Graduate Faculty

Graduate study and research are conducted in manufacturing process, information engineering operations research-management science, production engineering, process design, systems engineering, human factors, ergonomics, quality engineering, and robotics.

Admission Requirements

Scores from the Graduate Record Examination (GRE) are required for admission. To be admitted into the program, an applicant must have received a baccalaureate degree from a regionally accredited institution. Graduates in engineering, physical sciences, and mathematics who present a 3.00 grade-point average will be considered for admission.

All international applicants must submit scores for the TOEFL (Test of English as a Foreign Language) or the IELTS (International English Language Testing System), with the exceptions noted below. The minimum acceptable score for the TOEFL is 550 for the paper-based test, 213 for the computer-based test, or a total score of 80 with a 19 on the speaking section for the Internet-based test (iBT). The minimum composite score for the IELTS is 6.5.

International applicants who have received a baccalaureate or Master’s degree from a college, university, or institution in any of the following countries are exempt from the TOEFL requirement: Australia, Belize, British Caribbean and British West Indies, Canada (except Quebec), England, Guyana, Republic of Ireland, Liberia, New Zealand, Northern Ireland, Scotland, the United States, or Wales.

Degree Requirements

Two Three degrees are offered: Master of Science (M.S.) with thesis and non-thesis tracks, online Master of Engineering (M.Eng) and the Doctor of Philosophy (Ph.D.).
The M.S. degree program is intended for students to gain advanced knowledge for research, analysis, and design in industrial engineering. The M.S. degree is offered with thesis or research paper tracks, both requiring 32 credits. The M.S. degree with thesis track requires 24 credits of coursework and two credits of I E 590 (Colloquium). Out of the 24 credits of coursework, at least 15 must be I E courses, and at least 12 must be at the 500 level. Of the 12 credits at the 500 level, at least nine must be I E courses. A thesis is required, for which six credits of I E 600 or I E 610 must be taken. The M.S. degree with non-thesis track requires 27 credits of coursework, two credits of I E 590 (Colloquium). Out of the 27 credits of coursework, at least 18 must be I E courses, and at least 18 must be at the 500 level. Of the 18 credits at the 500 level, at least fifteen must be I E courses. A scholarly paper is required for the MS degree with non-thesis track for which three credits of I E 596 must be taken. For both tracks, a core curriculum is required that is composed of I E 505 (Linear Programming) (3 credits) and I E 511 (Experimental Design in Engineering) (3 credits), which all the students must satisfy. The thesis must demonstrate comprehensive and in-depth knowledge of a topic in industrial engineering, and it should be suitable for submission for publication in a refereed journal as approved by the committee. The paper should demonstrate the ability of the student to integrate and apply concepts and techniques learnt in the courses to solve an engineering problem.

The students seeking the Master of Science degree in Industrial Engineering with non-thesis track are expected to start their degree in the Fall semester of every year and complete their degree including all the required coursework and three credits of research resulting in a paper and graduate by the end of summer following the second semester. Students who cannot complete their research paper by this summer can graduate after the summer. The plan of study is as follows:

- Fall semester: Twelve credits of course work, one credit of colloquium and one credit of research (I E 596).
- Spring semester: Twelve credits of coursework, one credit of colloquium and one credit of research (I E 596).
- Summer semester: Three credits of coursework and one credit of research (I E 596).

For the M.S. degree, area options are available in Human Factors/Ergonomics Engineering, Manufacturing Engineering and Quality Engineering. M. S. dual-title degree program in Industrial Engineering and Operations Research is also offered.

The primary focus of the MEngIE degree will not be for the current students but will be for the thousands of IE alumni who are working as professional engineers and cannot easily take leave from their careers to return physically to the University Park campus for on-site courses and degrees. This degree will provide an opportunity for these professionals to seek further education in the form of a professional graduate degree.

The requirements for the online MEng degree program include:
1. Minimum of 30 course credits at the 400- or 500-level, of which 21 course credits must be earned at Penn State (i.e. only 9 credits can be transferred from other institutions).
2. All students must successfully complete three credits of IE 894, Capstone Design.
3. At least 18 credits in 500-level courses (including IE 894).
4. At least 15 credits in 500-level IE courses (including IE 894).
5. At least 21 credits of IE courses (including IE 894).
5. The culminating experience for professional degrees will be satisfied with IE 894, Capstone Design. Students will apply the analysis and design skills learned in their previous IE courses in order solve a problem in their workplace. This will be written up in a report to be submitted to the course instructor.

The Ph.D. program emphasizes scholarly research, and prepares students for research and development careers in industry, government, and academe. Students are admitted to candidacy after passing a written examination. The Ph.D. is awarded upon completion of a program of advanced study that includes a minimum period of residence, passing the English proficiency and comprehensive examinations, completing a satisfactory dissertation, and passing the final oral examination. The degree requirements consist of 45 credits of course work and four IE 590 (Colloquium) credits. Of the 45 credits of required course work, 36 must be prefixed IE, and at least 30 must be at the 500 level. Nine credits must be from outside the Department and must include a six-credit sequence, with at least three credits at the 500 level. A Ph.D. dual-title degree program in Industrial Engineering and Operations Research is also available.

Continuous registration is required for all graduate students until the paper, thesis, or dissertation is approved.

Master of Science (M.S.) Degree with thesis and non-thesis tracks- Human Factors/Ergonomics Engineering Option

To receive the M.S degree in Industrial Engineering with thesis track and with an Option in Human Factors/Ergonomics Engineering, a student must complete at least 32 credits beyond the bachelor's degree: 24 credits of course work, 2 credit of colloquium, and 6 credits of research leading to a thesis, as required for the M.S. degree in Industrial Engineering with thesis track. To receive the M.S degree in Industrial Engineering with non-thesis track and with an Option in Human Factors/Ergonomics Engineering, a student must complete at least 32 credits beyond the bachelor's degree: 27 credits of course work, 2 credit of colloquium, and 3 credits of research leading to a scholarly paper, as required for the M.S. degree in Industrial Engineering with non-thesis track.

The course credits for the Option in Human Factors/Ergonomics Engineering must include the following:

All the following three courses: (9 credits)
IE 549 Design Decision Making
IE 553 Engineering of Human Work
IE 558 Engineering of Cognitive Work
Master of Science (M.S.) Degree with thesis and non-thesis tracks- Quality Engineering Option

To receive the M.S degree in Industrial Engineering with thesis track and with an Option in Human Factors/Ergonomics Engineering, a student must complete at least 32 credits beyond the bachelor's degree: 24 credits of course work, 2 credit of colloquium, and 6 credits of research leading to a thesis, as required for the M.S. degree in Industrial Engineering with thesis track. To receive the M.S degree in Industrial Engineering with non-thesis track and with an Option in Human Factors/Ergonomics Engineering, a student must complete at least 32 credits beyond the bachelor's degree: 27 credits of course work, 2 credit of colloquium, and 3 credits of research leading to a scholarly paper, as required for the M.S. degree in Industrial Engineering with non-thesis track.

The course credits for the Option in Manufacturing Engineering must include the following:

All the following three courses: (9 credits)
I E 528 Metal Cutting Theory
I E 550 Manufacturing Systems
I E 563 Computer - Aided Design for Manufacturing

Master of Science (M.S.) Degree with thesis and non-thesis tracks- Quality Engineering Option

To receive the M.S degree in Industrial Engineering with thesis track and with an Option in Human Factors/Ergonomics Engineering, a student must complete at least 32 credits beyond the bachelor's degree: 24 credits of course work, 2 credit of colloquium, and 6 credits of research leading to a thesis, as required for the M.S. degree in Industrial Engineering with thesis track. To receive the M.S degree in Industrial Engineering with non-thesis track and with an Option in Human Factors/Ergonomics Engineering, a student must complete at least 32 credits beyond the bachelor's degree: 27 credits of course work, 2 credit of colloquium, and 3 credits of research leading to a scholarly paper, as required for the M.S. degree in Industrial Engineering with non-thesis track.

The course credits for the Option in Quality Engineering must include the following:

All the following three courses ( 9 credits)
I E 555 Statistical Process Monitoring and Analysis
I E 566 Quality Control
I E 583 Response Surface Methodology and Process Optimization

Other Relevant Information

Students in this program may elect the dual-title degree program in Operations Research for the Ph.D. and M.S. degrees.
Student Aid

In addition to the fellowships, traineeships, graduate assistantships, and other forms of financial aid described in the STUDENT AID section of the Graduate Bulletin, the following award typically has been available to graduate students in this program:

HAROLD & INGE MARCUS GRADUATE FELLOWSHIPS--Consideration for these fellowships shall be given to all students exhibiting academic excellence who have been admitted to Penn State as candidates for a graduate degree in the Department of Industrial and Manufacturing Engineering, College of Engineering.

BENJAMIN W. NIEBEL MANUFACTURING FELLOWSHIP
Consideration for this fellowship shall be given to all students exhibiting academic excellence who have been admitted to Penn State as candidates for a graduate degree in the Department of Industrial and Manufacturing Engineering, College of Engineering.

Courses

Graduate courses carry numbers from 500 to 699. Advanced undergraduate courses numbered between 400 and 499 may be used to meet some graduate degree requirements when taken by graduate students. Courses below the 400 level may not. A graduate student may register for or audit these courses in order to make up deficiencies or to fill in gaps in previous education but not to meet requirements for an advanced degree.

INDUSTRIAL ENGINEERING (I E) course list

Last Revised by the Department: Spring Semester 2015

Blue Sheet Item #: 43-06

Review Date: 04/14/2015

UCA Revision #2: 7/30/07

Faculty linked: 6/20/14
Appendix E: Consultation Responses for Proposed M.Eng. in IE Distance Degree Program

From: Karen Thole
Sent: Thursday, May 18, 2017 5:34 PM
To: Andris Freivalds <axf@engr.psu.edu>
Cc: Janis P. Terpenny <jpt5311@engr.psu.edu>; Mary Frecker <mxf36@engr.psu.edu>
Subject: RE: On-line MEng in IE

Dear Andris

Thank you very much for providing these helpful and detailed answers. I have no concerns and concur with the proposal. I wish you much success. The more online programs we have, the better it is for all of us.

Karen

Karen A. Thole
Distinguished Professor and Department Head
Department of Mechanical and Nuclear Engineering
The Pennsylvania State University
136 Reber Building, University Park, PA 16802-1412
(814)865-2519    FAX (814)865-1280
kthole@psu.edu  www.mne.psu.edu

From: Andris Freivalds
Sent: Thursday, May 18, 2017 9:39 AM
To: Karen Thole <kthole@engr.psu.edu>
Cc: Janis P. Terpenny <jpt5311@engr.psu.edu>
Subject: RE: On-line MEng in IE

Karen,

Thanks for your comments. To answer your concerns.

- Does the IE594 capstone design course involve team project(s)? If so, how will the course be done with online students?

No these were meant to be individual projects, most typically for the industrial practitioners using a work-related problem. For those, not having any workplace project, we will use existing ‘canned’ problems/data sets for them to use. Also, not fully explained in the proposal, eventually once the numbers get higher, we would probably have several sections of IE 594 geared toward the different concentrations: human factors, manufacturing and operations research type problems. I will indicate ‘individual’ in the proposal to clarify that.
The math on the number of students in section 5 is confusing, but graduating 25 students per year seems like an attainable goal. I am sure it will take quite a while to reach a steady state of 50 students per year. But I am basing that on my experience with the HFEE Certificate, which now has steady state numbers approaching 10 per year. Obviously, human factors is a small component of the IE discipline and extrapolating up based on departmental percentages would indicate at least 50 per year. But I will change the number to 25 in the proposal.

The program would be much stronger if it were not simply video capture but rather a program that embraces pedagogical methods for online delivery. Yes, that is probably true, but presently all the courses listed already exist and have been taught on-line. Most of those are in the video capture format. So rather than wait and see what happens with the COE CDE office, we wanted to proceed. Once things get settled down there and they have time and manpower, we can talk about converting courses. Also, by that time we might have some money in the system to pay for the conversion. The startup costs with the World Campus instructional design approach would be cost prohibitive, as I have learned with the slow start of the HFEE Certificate. We would never have gotten off the ground if we had to pay for the World Campus ID costs.

Even with the video capture, given the College’s closing of Continuing and Distance Ed and only two employees left, how will IME support the effort? (note Mr. Terry Reed listed on pg. 7 is no longer available). At the present, we are running about a dozen courses this summer (most are undergrad, three are graduate on the list for the on-line degree) with minimal help from CDE. I think once we have established the new procedures (as being proposed by Tom Litzinger), we should be able to move ahead mostly on our own.

Based on our experiences, the online students require significantly more advising than do resident students. Does IME have the resources to do so?

Again, based on our experiences, the two faculty involved with the steady state five (approaching 10) HFEE Certificate students have been able to take care of their academic advising needs. Since more faculty will be involved with the full degree, I think we should be able to handle it as other faculty join in. Also, our graduate staff support person helps in the admission process. Probably, with greater numbers, we may need to hire additional help for this staff person. I think she gets some such help during the admission crunch time and we obviously would get more help when needed.

I hope this answered your concerns. If not, we can talk a bit more. Or do you wish to meet with Janis and myself?

Andy
From: Andris Freivalds <axf@engr.psu.edu>
Date: Monday, May 22, 2017 at 9:28 AM
To: Paul Heinemann <hzh@PSU.EDU>
Subject: RE: On-line MEng in IE

Paul,

Thanks for the correction on the ‘typo’ (I guess I didn’t think of the implication as how you stated it).

Yes, we currently admit students to our on-site program with math or other science degrees (i.e. non engineering).

Thanks again, and I assume that it was a ‘yes’ to the program.

Thanks

Andy

From: Paul Heinemann-Forward
Sent: Friday, May 19, 2017 2:07 PM
To: Andris Freivalds <axf@engr.psu.edu>
Cc: Jeff Catchmark <JCatchmark@engr.psu.edu>
Subject: Re: On-line MEng in IE

Andy,

Our department has no concerns or issues related to the program.

A few minor notes:
It appears that the students entering the program do not need to have an engineering degree. I noted it states “engineering, physical sciences, and mathematics”. This presumes that none of the courses have engineering fundamentals as prerequisite, is this correct? Also, what else is included in the term “physical
Paul Heinemann
Professor and Head
Department of Agricultural and Biological Engineering
814-865-2633
hzh@psu.edu

From: Kultegin Aydin
Sent: Saturday, May 20, 2017 2:35 PM
To: Andris Freivalds <axf@engr.psu.edu>
Subject: RE: On-line MEng in IE

Dear Prof. Freivalds,

I support your proposal for the on-line MEng in IE. This is a well prepared proposal and the program has the potential to be very successful.

Best regards,

Kultegin

Kultegin Aydin
Professor and Head
Department of Electrical Engineering
School of Electrical Engineering and Computer Science
The Pennsylvania State University
129 EE East, University Park, PA 16802
Phone: (814) 863-2788
From: Phillip Savage
Sent: Saturday, May 20, 2017 9:28 PM
To: Andris Freivalds <axf@engr.psu.edu>
Subject: Re: On-line MEng in IE

Andy

I scanned the documents you had attached. ChE has no objections. Good luck launching the new on-line degree.
Phil

Phillip E. Savage | Department Head, Chemical Engineering | Penn State

From: Patrick J. Fox
Sent: Wednesday, May 17, 2017 11:43 AM
To: Andris Freivalds <axf@engr.psu.edu>
Subject: Re: On-line MEng in IE

Hi Any - CEE supports this proposal. Please proceed from our standpoint.
Thanks for inquiring.
Pat
-----
Patrick J. Fox, Ph.D., P.E., D.GE, F.ASCE
Department Head
John A. and Harriette K. Shaw Professor
Department of Civil and Environmental Engineering
212 Sackett
Pennsylvania State University
University Park, PA 16802
Tel: (814) 863-3084
pjfox@engr.psu.edu
Board of Governors, ASCE Geo-Institute
Appendix F:

Graduate Council Subcommittee On New And Revised Programs And Courses

COURSE SUBMISSION AND CONSULTATION FORM

Principal Faculty Member Proposing Course: ANDRIS FREIVALDS
College: ENGINEERING
Department or Instructional Area: INDUSTRIAL AND MANUFACTURING ENGINEERING
College/Academic Unit With Curriculum Responsibility: ENGINEERING
Type of Proposal: ☑ Add ☐ Change ☐ Drop
Type of Review: ☑ Full ☐ Expedited
(See Guide to Curricular Procedure for definitions of a full or expedited review.)
Course Designation: (IE 894) Capstone Design

<table>
<thead>
<tr>
<th>Proposed Bulletin Listing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abbreviation</td>
</tr>
<tr>
<td>Number</td>
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<tr>
<td>Title</td>
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<td>Abbreviated Title</td>
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<td>Credits</td>
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<td>Repeatable</td>
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<tr>
<td>Description</td>
</tr>
</tbody>
</table>

Prerequisites
Concurrent Courses
Cross Listings
Does this Course have a Travel Component: No

Course Outline
A brief outline or overview of the course content
Students will apply the analytical and design skills learned in previous courses to solve an industrial problem.

A listing of the major topics to be covered with an approximate length of time allotted for their discussion

Prepare a proposal describing the problem and the approach used to solve it (2 weeks)

Work on solving the problem and prepare progress report (5 weeks)

Continue working and write report (8 weeks)
Long Course Description:
A succinct stand-alone course description (up to 400 words) to be made available to students through the on-line Bulletin and Schedule of Courses.
Students will apply the analytical and design skills learned in previous courses to solve an industrial problem based on their workplace or industrial partner. They will start with writing a proposal to clearly identify the problem and procedures to be used in solving the problem. The instructor will provide feedback on the approach and allow the students to proceed. Mid-way the students will write a progress report. Again based on the instructor feedback, the students will continue working and then summarizing the work in a final report. This will be submitted both to the instructor for a course grades, as well as to the sponsor of the project. Those students that do not have an identifiable work-related problem, will be able to choose among several case studies with data. This is an individual project.

The name(s) of the faculty member(s) responsible for the development of the course
Dr. Andris Freivalds, Lucas Professor of Industrial Engineering

Justification Statement
Instructional, Educational, and Course Objectives
This course is the culminating experience for the on-line Master of Engineering in Industrial Engineering degree. It will demonstrate whether the students can apply the analytical and design skills learned in the courses leading up to this point to an industrial problem of their choosing. After successfully completing this course, a student should be able to do similar work at their workplace.

Evaluation Methods:
Proposal: 10%
Progress Report: 20%
Final Report: 70%

Relationship/Linkage of Course to Other Courses
This course is meant for Industrial Engineering students to complete their MEng degree. A prior course in industrial engineering is necessary for this class.

Relationship of Course to Major, Option, Minor, or General Education
This course is the culminating experience for industrial engineering students to complete their MEng degree.
Dr. Motta:

The Graduate Studies and Research Committee has completed review the proposal for Nuclear Security Option - Masters of Science and Masters of Engineering Degrees in Nuclear Engineering, and is requesting revisions based on the following Committee comments:

- This sounds like a great opportunity for the students and the foundation courses have been well-supported. I am concerned about how the Lab (which required the development of a new facility) will be taught online.

For now Nuc E 543 is for resident student only. We plan to study later how to make a version available online.

- I would vote to approve the proposed option. However, I do have a couple of questions/concerns:
  - First, how would NUC E 543 be offered online?

See above

- Second, since this is proposed as an option to two existing degrees, not as a certificate program, won't the Graduate School and GCJCC require that the proposal include the revised Bulletin listings for those programs?
  - See Graduate Program Proposal Procedures website under Changes in Programs, Options, and Minors for additional guidance.
  - as this is a change to add a degree option to an existing program, copy and paste the existing NUC E program Bulletin into a word document, and use track changes to show any changes or additions to the current Bulletin; the Table of Contents would need to be modified to reflect the addition of the Bulletin as part of the proposal as well.

See attached document

Please respond to the Committee comments using a Word document or issuing your response via replying to this email. In your reply, and when resubmitting your proposal, please indicate where within the proposal you have made any changes.

Thank you.

Lori
Proposal for Creating a Nuclear Security Option for the

Masters of Science and Masters of Engineering Degrees in Nuclear Engineering

Arthur T. Motta.
Chair of Nuclear Engineering
Professor of Nuclear Engineering and Materials Science and Engineering
Department of Mechanical and Nuclear Engineering
138 Reber Bldg.,
atm2@psu.edu

Penn State University, University Park Pa 16802
Phone (814) 865-0036
(Program Office: 814-863-6383) fax: 814-865-1280

July 24, 2017
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b) Objectives of the Program ........................................................................................................................ 4
c) List of new Courses .................................................................................................................................. 4
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e) Consultations ........................................................................................................................................... 6

   d1) With Prof. Alexander Siedschlag, Chair, Intercollege Master of Professional Studies Program in Homeland Security (iMPS-HLS) ................................................................................................................. 6
   d2) with Patria de Lancer Julnes, Ph.D. Director, School of Public Affairs, Penn State Harrisburg ........... 9
a) Justification for the New Program:

Educating the next generation of technical experts in nuclear security practices is a critical element in order to ensure the successful long-term operational security of nuclear and radiological material worldwide. The National Nuclear Security Administration’s (NNSA) directs the Department of Energy’s nuclear security goal to prevent the acquisition of illicit radioactive material for use in weapons of mass destruction (WMD) and other acts of terrorism. As a part of that effort, DOE-NNSA has recognized a national need for university-level nuclear security education. To achieve this goal, DOE selected the Pennsylvania State University (PSU), Massachusetts Institute of Technology (MIT), and Texas A&M University (TAMU) to design and implement a nuclear security education program (NSEP) in 2010. This initiative establishes a nuclear security curriculum within the nuclear engineering graduate programs at the partner universities. This collaborative, multi-year effort formed the basis of specific courses designed to educate the next generation of students who plan on careers in nuclear engineering/nuclear security.

The possibility that nuclear materials (fissile or radioactive materials) could be used in a terrorist attack is one of the most pressing security questions of the present times. Attention is also increasingly being given to the protection of existing nuclear facilities from internal and external threats. These threats fall under the umbrella of nuclear security, and significant resources have been directed to enable the U.S. and the international community to cope with these concerns. In this scenario, the role of the university nuclear engineering research and education programs is both to perform the research that will enable the development of novel technologies that can protect the country from such threats, and to educate the new generations of scientists and engineers for the field.

The Nuclear Security Education Program was developed with funding from the Department of Energy, National Nuclear Security Administration. Five core graduate courses for nuclear security were jointly developed with PSU, MIT and TAMU and being taught at PSU since 2011. A state-of-the-art nuclear security education laboratory was created and located at the Penn State Radiation Science and Engineering Center (RSEC). The program will benefit from the Radiation Science and Engineering Center, which houses the Penn State Breazeale Nuclear Reactor, radiochemistry laboratories and the state-of-the-art Radiation Detection and Nuclear Security Laboratory. The full suite of courses is aimed at educating the next generation of technical experts in security practices, global nuclear security policies and technological developments in special nuclear materials detection, to ensure the successful long-term operational security of nuclear and radiological material located at civilian sites. The curriculum consists of a five-course suite specified below. Students who pass all these five courses would be eligible to receive the designation MS or MEng with a Nuclear Security Option.

The Nuclear Engineering Program has been very successful in offering an online Masters of Engineering in Nuclear Engineering degree program. We currently have over 70 students in degree-seeking status and have graduated over 160 students since 2001. We envision that many of the online students will be attracted to this program, which will be the first in the nation. The Nuclear Engineering Program, the Mechanical and Nuclear Engineering Department, and the College of Engineering are anxious to further expand the offering of this program given the potential and interest. It is in the near term plans that this program will also be offered through Penn State’s World Campus, which is the organization that manages all online program delivery.
b) Objectives of the Program
The objective of the program is to provide students with the theoretical and experimental background to work in the development and analysis of radiation detection technologies for special nuclear materials and other radioactive sources, to design and implement security systems, and to understand the global impact of nuclear threats and domestic/international nuclear security policies. The new option will significantly expand the range of interest in the current Penn State’s graduate program in nuclear engineering by providing a new option for students to focus on nuclear security. As such, it is expected such option will attract a wider audience compared to the existing program. Students who go through the program will be able to work in technical and policy related nuclear security areas, and design nuclear security and radiation detection systems.

The proposed program focuses on the technical background needed to implement radiation detection, nuclear security systems, nuclear threat analysis and assessment, and nuclear policies as such it complements the existing Intercollege Program in Homeland Security, while not duplicating it. We believe this program is unique in the country, and possibly in the World, it would be very straightforward to implement due to existing laboratories and Penn State courses, and as such it should be very attractive both to resident and online students.

c) List of new Courses
Nuclear Security suite of courses (all these courses have been developed and have been taught to resident students)

**Nuc E 441:** Nuclear Security Threat Analysis and Assessment; Credits: 3; Nuclear threat assessment and analysis for non-state actors to nuclear and radiological facilities and supply lines.

**Nuc E 442:** Nuclear Security System Design; Credits: 3; Science and engineering associated with the design, evaluation, and implementation of systems to secure nuclear and radiological materials. Prereq Nuc E 301, or Nuc E 497A

**NUC E 542:** Source and Detector Technologies for Nuclear Security: Credits: 3; Theory and technology behind detectors, sensors, and source technologies including portal monitors and field deployable radiation detection systems; Prerequisite(s) NUC E 450

**NUC E 543:** Nuclear Security Education Laboratory: Credits: 3; Hands-on experiences on the radiation detection systems, sensors, devices and source technologies for nuclear security applications. Prerequisite(s) NUC E 450 and Nuc E 541

**NUC E 544:** Global Nuclear Security Policies: Credits: 3; Introduce students to global policies and laws for nuclear security that are intended to provide a secure environment for the pursuit of legitimate nuclear activities. Prerequisite(s) Graduate Standing.
d) Bulletin

Nuclear Engineering (NUC E)

[Program Home Page (Opens New Window)]

ARTHUR T. MOTTA, Chair of Nuclear Engineering
138 Reber Building
814-863-6384 865-0036

Degrees Conferred:

Ph.D., M.S., M.Eng.

The Graduate Faculty

The Programs

Graduate programs and research facilities are available in thermal-hydraulics, neutronics, computational methods, advanced controls with applications of artificial intelligence, materials, radiation monitoring and effects, fuel management, and radioactive waste management and nonproliferation/nuclear security. Application areas include advanced reactor design, safety analysis, radiation instrumentation development, neutron imaging, neutron activation analysis, and plant life extension.

Admission Requirements

Scores from the Graduate Record Examinations (GRE), or from a comparable substitute examination accepted by a graduate program and authorized by the dean of the Graduate School, are required for admission. At the discretion of a graduate program, a student may be admitted provisionally for graduate study in a program without these scores. Requirements listed here are in addition to general Graduate School requirements stated in the GENERAL INFORMATION section of the Graduate Bulletin.

Students with a 3.00 junior/senior grade-point average and with appropriate course backgrounds will be considered for admission. General aptitude GRE test results are required. The best-qualified applicants will be accepted up to the number of spaces that are available for new students. Exceptions to the minimum 3.00 grade-point average may be made for students with special backgrounds, abilities, and interests.

To qualify for admission, an international student must achieve a minimum score on the Test of English as a Foreign Lanaguage (TOEFL) of 550 on the paper-based test, 213 on the computer-based test, and 80 on the Internet-based test with a 19 in the speaking section. This requirement is waived if the student's native language is English or if the student received a baccalaurate or master's degree from an institution in which the language of instruction was English. Letters of recommendation and a statement of purpose written by the applicant are also required to complete the application package.

Degree Requirements
The M.Eng. degree is a nonthesis professional master's degree. In the M.Eng. degree program, 30 course credits are required. Twelve of those credits must be in Nuclear Engineering with at least 18 credits at the 500 level. No thesis is required for the M.Eng. degree. Instead, the student must take 3 credits of NUC E 597C Professional Topics in Nuclear Engineering, which represents formal recognition of the student's effort spent on writing a paper about an engineering subject. It must be approved by the adviser, a faculty reader, and the program chair.

The M.S. degree program is designed for students to gain advanced knowledge for research, analysis, and design in nuclear engineering. Student pursuing an M.S. degree must complete 24 course credits and submit an acceptable thesis (6 research credits) to the Graduate School. An option exists to earn a nuclear security option for either the M.S. or M.Eng. degree by completing the five courses of the nuclear security option (NucE441, NucE442, NucE542, NucE543, NucE544), a total of 15 credits.

Continuous registration is required of all Ph.D. students until the thesis is approved.

The Ph.D. program emphasizes scholarly research and helps students prepare for research and related careers in industry, government, and academe. Students are admitted to candidacy after passing written and oral examinations. The Ph.D. program is quite flexible, with minimal formal requirements. The Ph.D. degree is awarded upon completion of a program of advanced study that includes a minimum period of residence, a satisfactory thesis, and the passing of comprehensive and final oral examinations as determined by the student's doctoral committee.

Generally, a Ph.D. student must have 30 credits above a master's degree before taking a comprehensive examination.

**Student Aid**

In addition to the fellowships, traineeships, graduate assistantships, and other forms of financial aid described in the Student Aid section of the [Graduate Bulletin](#), the following awards typically have been available to graduate students in this program:

- **NATIONAL ACADEMY FOR NUCLEAR TRAINING FELLOWSHIPS**- Available to graduate students in nuclear engineering; stipend plus tuition.
- **U.S. Nuclear Regulatory Commission Fellowships**- available to graduate students interested in working in nuclear engineering, covering stipend and tuition.
- **U.S. DEPARTMENT OF ENERGY-NUCLEAR SCIENCE AND ENGINEERING FELLOWSHIPS**- Available to graduate students interested in engineering and engineering support related to nuclear technology; stipend plus tuition.

**Courses**

Graduate courses carry numbers from 500 to 599 and 800 to 899. Advanced undergraduate courses numbered between 400 and 499 may be used to meet some graduate degree requirements when taken by graduate students. Courses below the 400 level will not count. A graduate student may register for or audit these courses in order to make up deficiencies or to fill in gaps in previous education but not to meet requirements for an advanced degree.

e) Consultations

**d1) With Prof. Alexander Siedschlag, Chair, Intercollege Master of Professional Studies Program in Homeland Security (iMPS-HLS)**

**From:** ALEXANDER SIEDELSCHLAG [mailto:aus50@psu.edu]

**Sent:** Tuesday, July 25, 2017 11:36 AM
To: Arthur Motta  
Cc: vlh16@psu.edu; ARTHUR MOTTA  
Subject: RE: Consultation on Nuclear Security Option

Arthur,

Many thanks for the opportunity to comment on your proposal for a Nuclear Security Option.

I thought this proposal was very timely and relevant from the security, studies, homeland security, and iMPS-HLS program point of view. Also, I was excited to read that the plan is to also offer this Option online in the future. We would be interested in offering some of the new Option's courses as electives to our iMPS-HLS students.

Best regards,

Alexander

--

Alexander Siedschlag, Ph.D., M.A.  
Professor of Homeland Security and Public Health Sciences  
Chair, Intercollege Master of Professional Studies Program in Homeland Security (iMPS-HLS)  
The Pennsylvania State University  
Penn State Harrisburg  
School of Public Affairs  
160W Olmsted Building  
777 West Harrisburg Pike  
Middletown, PA 17057  
U.S.A.

Phone (717) 948-4326 (Program Office: 6050) -- Fax (717) 948-6484

Professional Website http://sites.psu.edu/homelandsecurity  
Program Website https://harrisburg.psu.edu/public-affairs/homeland-security/master-homeland-security  
Program Website https://harrisburg.psu.edu/public-affairs/political-science-and-public-policy/bachelor-arts-political-science
Dear Dr. Siedschlag

I am attaching to this message the proposal for a Nuclear Security Option in the existing M.SC. and M.Eng. degrees in Nuclear Engineering. As we discussed on the phone I think this proposal is very complementary to your own program on Homeland Security by focusing on the technical aspects of special nuclear material detection and threat assessment. I also see a potential for students from one program to take classes in the other.

Please review and send me a message as to your evaluation at your earliest convenience

Best regards

Arthur Motta
Dear Arthur,

Thank you for the opportunity to review the proposal for creating a Nuclear Security Option for the MS and ME degrees in Nuclear Engineering.

I found the arguments for creating the option compelling. I also believe that this option will enhance the opportunities currently available to our students as it introduces an area of study of increasing critical importance. I’m particularly excited for the opportunity that this program will provide Homeland Security Students, specially because of the additional courses addressing threat assessment and policy.

Sincerely,

Patria

Dr. Patria Julnes

==============================================

Patria de Lancer Julnes, Ph.D.
Director, School of Public Affairs
Penn State Harrisburg

Mailing Address:
777 W. Harrisburg Pike
Middletown, PA 17057

Office Address:
153 W Olmsted

Phone: 717-948-6693
E-mail: pdd10@psu.edu or patriajulnes@psu.edu
Patria

Just noticed I called you by an incorrect name in my previous message, my apologies.

At your convenience, could you send us your comments? I am only awaiting those to send the proposal on to the graduate school.

Thank you for your attention to this matter

Regards

Arthur Motta

******************************************************************************

Arthur T. Motta
Professor of Nuclear Engineering and
    Materials Science and Engineering
Chair of Nuclear Engineering
Department of Mechanical and Nuclear Engineering
138A Reber Building
Penn State University, University Park, PA, 16802
http://www.mne.psu.edu/motta/
Dear Arthur,

Thank you. Will send comments soon.

Regards

Dr. Patria Julnes

Patria de Lancer Julnes, Ph.D.
Director, School of Public Affairs
Penn State Harrisburg

Mailing Address:

777 W. Harrisburg Pike
Middletown, PA 17057

Office Address:

153 W Olmsted

Phone: 717-948-6693
E-mail: pdd10@psu.edu or patriajulnes@psu.edu
Dear Dr. Julnes

I am contacting you at the behest of Vicki Hewitt at the Graduate School for a consultation on a new Nuclear Security Option we are proposing in our MS and MEng in Nuclear Engineering. It consists of 5 courses we created where students learn the principles of detection of special nuclear materials, perform threat assessment and study global nuclear policies.

I am enclosing it to this message for your review. Your support for this proposal would be greatly appreciated

Thank you for considering this request

Arthur Motta
Graduate Council Subcommittee On New And Revised Programs and Courses

COURSE SUBMISSION AND CONSULTATION FORM

Principal Faculty Member(s) Proposing Course

<table>
<thead>
<tr>
<th>Name</th>
<th>User ID</th>
<th>College</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>YANXI LIU</td>
<td>yul11</td>
<td>Engineering (EN)</td>
<td>Not Available</td>
</tr>
</tbody>
</table>

Academic Home: Engineering (EN)
Type of Proposal: [ ] Add [X] Change [ ] Drop

Course Designation
(CSE 583) Pattern Recognition and Machine Learning

Justification of Course Number:
This course deals with advanced research topics in the fields of pattern recognition and machine learning. Therefore a 5xx course number is appropriate.

Course Information
Cross-Listed Courses:
EE 552(EN)

Prerequisites:

Corequisites:

Concurrents:

Recommended Preparations:
Multivariate calculus, linear algebra, probability

Abbreviated Title: Ptn Rcn & Mchn Lrn

This course will be delivered:
[X] in residence
[ ] off-site
[ ] online

Bulletin Listing
Minimum Credits: 3
Maximum Credits: 3
Repeatable: NO
Department with Curricular Responsibility: Computer Science And Engineering (UPEN_CSE)

Effective Semester: After approval, the Faculty Senate will notify proposers of the effective date for this course change. Please be aware that the course change may not be effective until between 12 to 18 months following approval.

Travel Component: NO

Campuses That Have Offered (CSE 583) Over The Past 4 Years

| semester | AB | AL | BK | BR | BW | CR | DS | ER | FE | GA | GV | HB | HN | HY | LV | MA | NK | PC | SH | SL | SL | UP | WB | WC | WS | XC | XP | XS | YK |
|----------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Spring 2018 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Spring 2017 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Spring 2016 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
Course Outline

A brief outline or overview of the course content:
This course begins with a review of pertinent mathematical and statistical tools needed to perform pattern recognition and machine learning. Theory and applications involving pattern recognition and machine learning are presented next. The course concludes with student presentations of semester-long projects.

A listing of the major topics to be covered with an approximate length of time allotted for their discussion:
Introduction - 1 week
Probability theory review - 1/2 week
Curve fitting -- 1/2 week
Linear regression - 1/2 week
Decision theory -- 1/2 week
Linear classification models - 1 1/2 weeks
Dimension reduction -- 1 1/2 weeks
Feature selection -- 1 1/2 weeks
Ensemble learning -- 1/2 week
Student project proposal presentations -- 1 week
Support vector machines -- 1 week
Graphical models -- 1 week
Student project update presentations - 2 week
Neural networks and deep learning -- 1 week
Student project presentations - 1 week

Course Description:
This course is a comprehensive introduction to the fields of pattern recognition and machine learning. The content covers both classification and recursion, model selection, decision theory, information theory, linear and non-linear models, graphical models, kernel methods, mixture models and EM as well as neural networks. It assumes no previous knowledge of pattern recognition or machine learning concepts. Knowledge of multivariate calculus and basic linear algebra is required, and some familiarity with probability would be helpful.

The name(s) of the faculty member(s) responsible for the development of the course:

Name: YANXI LIU (yu11)
Title:
Phone:
Address:
Campus: UP
City:
Fax:

Course Justification

Instructional, Educational, and Course Objectives:
This section should define what the student is expected to learn and what skills the student will develop.
2. Provide graduate students with the skills needed to do research in pattern recognition and machine learning.

Evaluation Methods:
Include a statement that explains how the achievement of the educational objective identified above will be assessed.
The procedures for determining students’ grades should be specifically identified.
Homework assignments
Computer projects
Presentation of semester-long research project

Relationship/Linkage of Course to Other Courses:
This statement should relate the course to existing or proposed new courses. It should provide a rationale for the level of instruction, for any prerequisites that may be specified, or for the course’s role as a prerequisite for other courses.
This is an elective course intended for graduate students in computer science and engineering, electrical engineering, and related fields. This course is loosely linked to other graduate-level courses in computer vision, image processing, neural networks, and machine learning.

Relationship of Course to Major, Option, Minor, or General Education:
This statement should explain how the course will contribute to the major, option, or minor and indicate how it may function as a service course for other departments.
This is an elective course in the Computer Science and Engineering graduate program and the Electrical Engineering graduate program.

A description of any special facilities:
None

Frequency of Offering and Enrollment:
Course is taught every Spring. Typical enrollment is 50 students.

Justification for Changing The Proposal:
Include a justification for each change to the course. Particular attention should be paid to the effects of the course change within the discipline and in other disciplines where the course may be required within a major or used as a service course. When a unit submits several course changes, with or without new course proposals, a general statement covering the programmatic effects of the changes should be submitted.
The only change is the course title. The old title "Pattern Recognition -- Principles and Applications" is a historic one inherited from a course taught before 2006 and a name-change is long overdue. The phrase "Machine learning" is a modern term commonly accepted in state-of-the-art technical literature in this field, so adding this phrase to the title better reflects the content of the course.

Review History
This section represents all consultation history that has occurred on this proposal

Legend
Approve  Rejected  Waiting Review  User Action Required
Pending Action(s)  Moved to Rejected Status  Approved  (#) · Review Order Sequence Number

Consultation

Recipient Name: AB Shafaye  Department: Science, Engineering And Technology
Position: Consultation  Campus: PENN STATE HARRISBURG, THE CAPITAL COLLEGE
Title: EE/EET Programs Chair

Request sent: 12/19/2017 at 10:09 AM
Concur: Yes
Comments:  Reviewed On: 12/30/2017 at 2:06 PM

Recipient Name: THOMAS HEMMINGER  Department: Engineering
Position: Consultation  Campus: PENN STATE ERIE, THE BEHREND COLLEGE
Title: PROFESSOR ELEC & COMP ENG

Request sent: 12/19/2017 at 10:09 AM
Last sent: 1/15/2018 at 7:31 AM
Concur: Yes
Comments: (Completed By Default - Exceeded Time Limit)  Reviewed On: 1/23/2018 at 7:15 AM
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<tr>
<td>CHITARANJAN DAS</td>
<td>(Not Available)</td>
<td>Head of Department</td>
</tr>
<tr>
<td>KULTEGIN AYDIN</td>
<td>(Not Available)</td>
<td>Head of Department</td>
</tr>
<tr>
<td>MATTHEW PARKINSON</td>
<td>(Not Available)</td>
<td>College/School Representative to the Graduate Council Subcommittee on New and Revised Programs and Courses</td>
</tr>
<tr>
<td>GEORGE LESIEUTRE</td>
<td>(Not Available)</td>
<td>Dean of the College</td>
</tr>
<tr>
<td>VICKI HEWITT</td>
<td>(Not Available)</td>
<td>Review on Behalf of the Dean of the Graduate School</td>
</tr>
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</table>
Feedback from the Graduate Council Joint Curricular Committee

Recipient Name: ROBERT BANNON
Position: Feedback from the Graduate Council Joint Curricular Committee
Campus: UNIVERSITY PARK CAMPUS

Concur: [Not Yet Reviewed]
Comments: [Not Yet Reviewed]
Reviewed On: [Not Yet Reviewed]

Final Confirmation

Recipient Name: ALLISON ALBINSKI
Position: Final Confirmation
Campus: UNIVERSITY PARK CAMPUS

Concur: [Not Yet Reviewed]
Comments: [Not Yet Reviewed]
Reviewed On: [Not Yet Reviewed]

Recipient Name: KADI CORTER
Position: Final Confirmation
Campus: UNIVERSITY PARK CAMPUS

Concur: [Not Yet Reviewed]
Comments: [Not Yet Reviewed]
Reviewed On: [Not Yet Reviewed]

Recipient Name: JOY ROBERTSON
Position: Final Confirmation
Campus: UNIVERSITY PARK CAMPUS

Concur: [Not Yet Reviewed]
Comments: [Not Yet Reviewed]
Reviewed On: [Not Yet Reviewed]

Request sent: 11/9/2017 at 1:51 PM
Concur: [Not Yet Reviewed]
Comments: [Not Yet Reviewed]
Reviewed On: [Not Yet Reviewed]
Curricular Information
Blue Sheet Item #: 
Review Date: 

**SCRID Numbers**
(CSE 583): 
(EE 552): 
Proposal ID: 5552 created on 3/7/2018 3:21 PM
Graduate Council Subcommittee On New And Revised Programs and Courses

COURSE SUBMISSION AND CONSULTATION FORM

Principal Faculty Member(s) Proposing Course

<table>
<thead>
<tr>
<th>Name</th>
<th>User ID</th>
<th>College</th>
<th>Department</th>
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<tbody>
<tr>
<td>TIMOTHY SIMPSON</td>
<td>tws8</td>
<td>Engineering (EN)</td>
<td>Not Available</td>
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</table>

Academic Home: Engineering (EN)

Type of Proposal: [ ] Add [ ] Change [ ] Drop

Course Designation

(AMD 600) Thesis Research

Justification of Course Number:
Additive Manufacturing and Design Research Credit

Course Information

Cross-Listed Courses:

Prerequisites:

Corequisites:

Concurrents:

Recommended Preparations:

Abbreviated Title: Thesis Research

This course will be delivered:

[ ] in residence
[ ] off-site
[ ] online

Bulletin Listing

Minimum Credits: 1
Maximum Credits: 6
Repeatable: YES
Maximum Total Credits: 6

Department with Curricular Responsibility: Mechanical Engineering (UPEN_ME)
Effective Semester: FA 2018
Travel Component: NO

Campuses That Have Offered ( ) Over The Past 4 Years

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<th>CR</th>
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<th>XS</th>
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</thead>
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Course Outline

A brief outline or overview of the course content:
N/A

A listing of the major topics to be covered with an approximate length of time allotted for their discussion:
N/A

Course Description:
Thesis research.
The name(s) of the faculty member(s) responsible for the development of the course:

- Name: TIMOTHY SIMPSON (tws8)
- Title:
- Phone:
- Address:
- Campus: UP
- City:
- Fax:

CIP Code: 149999

Course Justification

Instructional, Educational, and Course Objectives:
This section should define what the student is expected to learn and what skills the student will develop.
N/A

Evaluation Methods:
Include a statement that explains how the achievement of the educational objective identified above will be assessed.
The procedures for determining students’ grades should be specifically identified.
N/A

Relationship/Linkage of Course to Other Courses:
This statement should relate the course to existing or proposed new courses. It should provide a rationale for the level of instruction, for any prerequisites that may be specified, or for the course’s role as a prerequisite for other courses.
N/A

Relationship of Course to Major, Option, Minor, or General Education:
This statement should explain how the course will contribute to the major, option, or minor and indicate how it may function as a service course for other departments.
N/A

A description of any special facilities:
N/A

Frequency of Offering and Enrollment:
N/A

Review History

This section represents all consultation history that has occurred on this proposal

Legend

- Approve
- Rejected
- Waiting Review
- User Action Required
- Pending Action(s)
- Moved to Rejected Status
- Approved
- (#) - Review Order Sequence Number

Head of Department

Recipient Name: Karen Ann Thole
Department: (Not Available)
Position: Head of Department
Campus: UNIVERSITY PARK CAMPUS
Title:
College/School Representative to the Graduate Council Subcommittee on New and Revised Programs and Courses

Recipient Name: Matt Parkinson
Department: (Not Available)
Position: College/School Representative to the Graduate Council Subcommittee on New and Revised Programs and Courses
Campus: UNIVERSITY PARK CAMPUS
Title:

Dean of the College

Recipient Name: GEORGE LESIEUTRE
Department: (Not Available)
Position: Dean of the College
Campus: UNIVERSITY PARK CAMPUS
Title:

Review on Behalf of the Dean of the Graduate School

Recipient Name: VICKI HEWITT
Department: (Not Available)
Position: Review on Behalf of the Dean of the Graduate School
Campus: UNIVERSITY PARK CAMPUS
Title:

Feedback from the Graduate Council Joint Curricular Committee

Recipient Name: ROBERT BANNON
Department: (Not Available)
Position: Feedback from the Graduate Council Joint Curricular Committee
Campus: UNIVERSITY PARK CAMPUS
Title:

Concur: [Not Yet Reviewed]
Comments: [Not Yet Reviewed]
Reviewed On: [Not Yet Reviewed]
## Final Confirmation

<table>
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<tr>
<th>Recipient Name</th>
<th>Department</th>
<th>Position</th>
<th>Campus</th>
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<tbody>
<tr>
<td>ALLISON ALBINSKI</td>
<td>(Not Available)</td>
<td>Final Confirmation</td>
<td>UNIVERSITY PARK CAMPUS</td>
</tr>
<tr>
<td>Joy Robertson</td>
<td>(Not Available)</td>
<td>Final Confirmation</td>
<td>UNIVERSITY PARK CAMPUS</td>
</tr>
<tr>
<td>Kadi Corter</td>
<td>(Not Available)</td>
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## Curricular Information

<table>
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## SCRID Numbers

(AMD 600):

Proposal ID: 6376 created on 3/7/2018 2:13 PM
Graduate Council Subcommittee On New And Revised Programs and Courses

COURSE SUBMISSION AND CONSULTATION FORM

Principal Faculty Member(s) Proposing Course

<table>
<thead>
<tr>
<th>Name</th>
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<th>College</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIMOTHY SIMPSON</td>
<td>tws8</td>
<td>Engineering (EN)</td>
<td>Not Available</td>
</tr>
</tbody>
</table>

Academic Home: Engineering (EN)
Type of Proposal: [X] Add  [ ] Change  [ ] Drop

Course Designation
(AMD 596) Individual Studies

Justification of Course Number:
Additive Manufacturing and Design Individual Study course credit for students to complete culminating experience project and paper.

Course Information

Cross-Listed Courses:

Prerequisites:

Corequisites:

Concurrents:

Recommended Preparations:

Abbreviated Title: Individual Studies

This course will be delivered:
[X] in residence
[ ] off-site
[X] online

Bulletin Listing

Minimum Credits: 1
Maximum Credits: 9
Repeatable: YES
Maximum Total Credits: 9
Department with Curricular Responsibility: Mechanical Engineering (UPEN_ME)
Effective Semester: SU1 2018
Travel Component: NO

Campuses That Have Offered () Over The Past 4 Years

Course Outline

A brief outline or overview of the course content:
N/A

A listing of the major topics to be covered with an approximate length of time allotted for their discussion:
N/A

Course Description:
Creative projects, including non-thesis research, which are supervised on an individual basis and which fall outside the scope
formal courses.

The name(s) of the faculty member(s) responsible for the development of the course:

- Name: TIMOTHY SIMPSON (tws8)
- Title:
- Phone:
- Address:
- Campus: UP
- City:
- Fax:

CIP Code: 149999

Course Justification

Instructional, Educational, and Course Objectives:
This section should define what the student is expected to learn and what skills the student will develop.
N/A

Evaluation Methods:
Include a statement that explains how the achievement of the educational objective identified above will be assessed. The procedures for determining students' grades should be specifically identified.
N/A

Relationship/Linkage of Course to Other Courses:
This statement should relate the course to existing or proposed new courses. It should provide a rationale for the level of instruction, for any prerequisites that may be specified, or for the course's role as a prerequisite for other courses.
N/A

Relationship of Course to Major, Option, Minor, or General Education:
This statement should explain how the course will contribute to the major, option, or minor and indicate how it may function as a service course for other departments.
N/A

A description of any special facilities:
N/A

Frequency of Offering and Enrollment:
N/A

Review History
This section represents all consultation history that has occurred on this proposal

Legend

![Approve](image)
Approve

![Rejected](image)
Rejected

![Waiting Review](image)
Waiting Review

![User Action Required](image)
User Action Required

![Pending Action(s)](image)
Pending Action(s)

![Moved to Rejected Status](image)
Moved to Rejected Status

![Approved](image)
Approved

(#{Review Order Sequence Number})

Head of Department

Recipient Name: Karen Ann Thole
Department: (Not Available)

Position: Head of Department
Campus: UNIVERSITY PARK CAMPUS
Title:
College/School Representative to the Graduate Council Subcommittee on New and Revised Programs and Courses

Recipient Name: Matt Parkinson  Department: (Not Available)
Position: College/School Representative to the Graduate Council Subcommittee on New and Revised Programs and Courses
Campus: UNIVERSITY PARK CAMPUS
Title:


Dean of the College

Recipient Name: GEORGE LESIEUTRE  Department: (Not Available)
Position: Dean of the College
Campus: UNIVERSITY PARK CAMPUS
Title:


Review on Behalf of the Dean of the Graduate School

Recipient Name: VICKI HEWITT  Department: (Not Available)
Position: Review on Behalf of the Dean of the Graduate School
Campus: UNIVERSITY PARK CAMPUS
Title:


Feedback from the Graduate Council Joint Curricular Committee

Recipient Name: ROBERT BANNON  Department: (Not Available)
Position: Feedback from the Graduate Council Joint Curricular Committee
Campus: UNIVERSITY PARK CAMPUS
Title:

Final Confirmation

**Recipient Name:** ALLISON ALBINSKI  
**Department:** (Not Available)  
**Position:** Final Confirmation  
**Campus:** UNIVERSITY PARK CAMPUS

Concur: [Not Yet Reviewed]  
Comments: [Not Yet Reviewed]  
Reviewed On: [Not Yet Reviewed]

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**Recipient Name:** JOY ROBERTSON  
**Department:** (Not Available)  
**Position:** Final Confirmation  
**Campus:** UNIVERSITY PARK CAMPUS

Concur: [Not Yet Reviewed]  
Comments: [Not Yet Reviewed]  
Reviewed On: [Not Yet Reviewed]

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**Recipient Name:** KADI CORTER  
**Department:** (Not Available)  
**Position:** Final Confirmation  
**Campus:** UNIVERSITY PARK CAMPUS

Concur: [Not Yet Reviewed]  
Comments: [Not Yet Reviewed]  
Reviewed On: [Not Yet Reviewed]

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Curricular Information

Blue Sheet Item #:  
Review Date:

**SCRID Numbers**  
(AMD 596):  
Proposal ID: 6373 created on 3/7/2018 2:21 PM