Engineering

The COLLEGE OF ENGINEERING is committed to educate students so that they may acquire theoretical knowledge and technical competence in the design, development, and creation of components, systems, and processes to address the needs and problems of our society. The college offers an integrated and professionally oriented curriculum focused on developing engineering graduates who are solidly grounded and technically broad in perspective and capabilities, effective in group operations and communication, innovative, and aware of the world.

Resident education at the baccalaureate level is provided through thirteen majors available at University Park and three majors offered at other Penn State campuses. In addition, a number of associate degree programs are offered at campus college locations. All baccalaureate degree programs are of eight semesters' duration except Architectural Engineering, which requires ten semesters to complete. Each degree program provides basic elements of General Education consistent with the objectives of the program and institution as well as a professional component to prepare graduates for practice in the discipline. All College of Engineering baccalaureate majors at University Park, with the exception of Computer Science, are accredited by the Engineering Accreditation Commission of ABET, Inc., **www.abet.org**.

In each of the engineering disciplines, as designated by the majors, students acquire knowledge of mathematics and the sciences basic to engineering and computer science, and the ability to solve problems through experimentation and analysis. Students develop and exercise initiative, judgment, and creativity through the professional component and design experiences that are integrated across their baccalaureate study, culminating in a capstone design experience in the senior year. Emphasis is placed on application of the engineering method, the capability for critical thinking, teamwork, and the ability to communicate clearly, both orally and through written composition. The social-humanistic component of the curriculum extends throughout the baccalaureate study in all majors and provides students with knowledge of social and human relationships as well as an appreciation of cultural interests and contemporary issues. It includes elective courses in the arts, humanities, and social and behavioral sciences. Through these courses and their study in the majors, students learn to appreciate values and costs, the context of engineering in society, and the ethical characteristics of engineering practice.

With this knowledge and set of skills, graduates are positioned to enter technical and non-technical careers in the industrial, government and private sectors, and/or to pursue advanced study in a variety of disciplines. Their versatility and ability to learn independently enables graduates to acquire new skills and knowledge as required by their career choices. The college also administers several academic minors that permit students to broaden or supplement their technical training; obtain specialized training in leadership, entrepreneurship or product development; or expand their knowledge of the interrelationship of science and society. The Learning Factory, Center for Engineering Design and Entrepreneurship, and Student Activities Center collectively serve the needs of students by providing facilities for project work, computing, and organizational meetings.

The college provides, in addition to undergraduate education, programs in cooperative education, international study and internships, continuing education, research, and advanced study at the graduate level.

For additional information, refer to:
www.engr.psu.edu/CurrentStudents/Undergraduate.

ENGINEERING CAREER RESOURCES AND EMPLOYER RELATIONS -- Housed within the Engineering Career Resources office, the Engineering Co-op & Internship Program provides opportunities for students to obtain up to one full year of career-related experience while earning their degree. Students apply theories learned in the classroom to business, government, or industry settings while gaining valuable professional experience, confirming their choice of major, developing technical skills, enhancing communication and job search skills, and receiving compensation that can be used to offset the cost of their education. The program is available to engineering students at all Penn State campus locations. Participants also have access to the Professional Development Program, which arranges professional skills workshops for students on a variety of topics generated from student and employer evaluation feedback.

Students may choose to complete either a co-op or an internship. Co-op experiences are divided into three segments made up of various combinations of fall, spring, and summer sessions (excluding a three-summer option). These work assignments alternate with academic periods in school but are intentionally flexible in order to accommodate different academic course scheduling requirements. All co-op work experiences are paid and career-related, and students have increasing levels of responsibility over the course of multiple assignments with one or more employers. The internship option provides an opportunity for students to gain one semester—or more, if desired—of career-related experience. The work experience can be pursued during any semester, although the summer semester is the most common choice, and can begin an as early as the second semester of students' first year at Penn State.

For additional information, refer to: **www.engr.psu.edu/career**

GLOBAL ENGINEERING EDUCATION -- Through study and work abroad programs and opportunities, the College of Engineering provides students with opportunities to develop a global perspective, learn how engineering is practiced in other countries, make international contacts, and improve their potential for career advancement in order to help them prepare to become world-class engineers. Students in the college can earn Penn State credits and/or transfer credits for courses completed abroad. The University and college currently have agreements with numerous institutions in all parts of the world for study exchange programs, summer programs, and courses. In a program offered by the College of the Liberal Arts, qualified students can pursue both an engineering degree and, concurrently, a degree in French, Spanish, German, or other languages. In addition to the credit requirements of the selected engineering major, students pursuing a concurrent language major are required to complete courses in the language and to intern and/or study abroad. The college continues to expand the opportunities available for students to gain international exposure and experience, including a Certificate in International Engineering. Additional programs are being developed for students to gain global experience and exposure on campus through technology-enabled international programs and interactions with other students.

For additional information, refer to: **www.engr.psu.edu/global.**

CONCURRENT MAJORS PROGRAM IN ENGINEERING AND LIBERAL ARTS -- This program requires ten semesters of study, both in the College of Engineering and in the College of the Liberal Arts. Upon completion of the program, a B.S. in the selected College of Engineering major will be awarded by the College of Engineering and the B.A. in Letters, Arts, and Sciences (LAS) will be awarded by the College of the Liberal Arts.

To be eligible for the program, a student must be initially enrolled in either the College of Engineering or the College of the Liberal Arts. The student must file an application for entrance with the assistant dean for student services, College of Engineering, by the published deadline during the student's spring semester of the second year and with the associate dean for undergraduate studies, the College of the Liberal Arts. Concurrent major candidates are subject to the same criteria for admission to a participating major in the College of Engineering as all other students.

During the first six semesters, the student completes 70 credits of basic General Education and bachelor of arts degree requirements and 30 to 34 credits of basic engineering requirements. In the final four semesters, the student completes 12 LAS credits plus the remaining requirements for the selected College of Engineering major. The additional 24 major credits required for the LAS degree are double counted with credits required for the College of Engineering degree. The average concurrent major graduate completes 166 to 174 credits in order to qualify for both degrees. This program is available with all the majors in the College of Engineering with the exception of the ten-semester Architectural Engineering major.

INTEGRATED UNDERGRADUATE-GRADUATE DEGREE PROGRAMS--Qualified students who wish to develop deeper and/or more specialized knowledge and skills through graduate study in their major may have the option of participating in the Integrated Undergraduate-Graduate (IUG) Degree Program.

Integrated undergraduate-graduate study provides several advantages for qualifying students by permitting coherent planning of studies through the graduate degree, reducing the total time required to reach completion of the higher degree, providing earlier contact with the rigors of graduate study and with graduate faculty, and providing access to the resources of the Graduate School. Students who are admitted to the IUG Program may apply up to 12 credits to both undergraduate and graduate degrees. A minimum of 50 percent of the courses to be used for both degrees must be at the 500 or 800 level. Thesis and culminating capstone experience credits may not be double-counted.

The following College of Engineering majors have approved IUG Programs: Architectural Engineering, Engineering Science, and Mechanical Engineering. Qualified students may apply for admission to the IUG Program after they are admitted to these majors. All Schreyer Scholars are eligible to participate in the IUG Program, regardless of their major, if they qualify. For an up-to-date list of approved IUG programs, visit **www.senate.psu.edu/scca/iug_programs.htm**.

DUAL-DEGREE PROGRAM WITH OTHER INSTITUTIONS AND ENGINEERING -- In the Dual-Degree program (formerly known as the 3-2 program), the student completes three academic years of study at cooperating institutions (with which Penn State has signed agreements) and then transfers to Penn State for at least two additional academic years.

Upon completion of the program, the student is awarded a degree by the first institution and the B.S. degree by Penn State. The program makes it possible for students to spend the first three years at an institution near their home, thus reducing expenses. For information about the Dual-Degree program cooperating institutions, and available majors, see: **www.engr.psu.edu/future/transfer/DualDegree.aspx.**

CONTINUING AND DISTANCE EDUCATION -- The Engineering Continuing and Distance Education (C&DE) office offers a broad range of programs for practicing engineers, other technical professionals, Penn State students, and the public. Credit and noncredit programs for individuals or groups are available at the University Park campus, at other Penn State campuses, and through distance education. For distance education, the C&DE office makes programs and courses available to audiences anywhere in the world through a variety of technologies, including the Internet and interactive video. In providing these distance courses, C&DE interfaces with the college's academic units and Penn State World Campus and provides courses design, production, and delivery services. Undergraduate students often enroll in distance courses while they are on cooperative education or internship assignments, or on summer break, thereby continuing progress toward their degree requirements during those absences.

For additional information, refer to:
www.engr.psu.edu/ProspectiveStudents/ContinuingEd

CENTER FOR ENGINEERING OUTREACH AND INCLUSION -- The Center for Engineering Outreach and Inclusion is committed to creating and enhancing a welcoming learning environment for all students in the College of Engineering. Through pre-college and bridge programs and coordination of recruitment, retention, networking and other programming, the Office strives to enhance the representation of women and underrepresented students in the undergraduate and graduate programs, as well as in the faculty and administration. The Multicultural Engineering Program and the Women in Engineering Program have evolved over the past twenty years and currently offer fifteen to twenty programs annually that are designed to enhance diversity in the college.

For additional information, refer to: **http://psuengineeringdiversity.com/**

WOMEN IN ENGINEERING PROGRAM -- The Women in Engineering Program (WEP) is an award-winning academic support unit of the College of Engineering. WEP provides extensive programming to facilitate the college mission, vision, and goals in support of undergraduate and graduate women and alumnae. The Penn State Women in Engineering Program was selected in 2004 as a recipient of the National Science Foundation Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring. WEP provides services to facilitate its mission to recruit women into engineering, to engage women engineers through advocacy and action, and to promote an equitable learning environment within the College of Engineering. WEP programming is highlighted by an immersive first-year orientation complemented by year-long mentoring. Academic achievement, career development, leadership training, and active networking are emphasized in an effort to retain and advance women engineering students. Services feature academic assistance, career development, industry networking, community building, mentoring, leadership engagement, scholarship, engineering education gender research, and an external Advisory Board. WEP also offers an extensive program of K-12 STEM outreach, providing leadership opportunities for undergraduates as it engages future generations of engineers.

For additional information, refer to: **www.engr.psu.edu/wep**

MULTICULTURAL ENGINEERING PROGRAMS -- The nationally recognized Multicultural Engineering Program (MEP) focuses on fostering a sense of community in the college. In 2010, Penn State MEP received the highest honor awarded by the National Society of Black Engineers, The Golden Torch. MEP is responsible for the recruitment and retention of underrepresented graduate and undergraduate students throughout Penn State's campuses. To enhance recruitment and retention, the program provides services designed to nurture supportive and collaborative relationships among students, faculty, staff, alumni, and industrial partners. These services include tutoring programs, summer bridge programs, orientation programs, recruitment programs, employment workshops and scholarships, with emphasis on proactively seeking out, guiding and preparing students for future success from high school through graduate school or entrance to careers in engineering industry. The program promotes academic excellence, industrial and research experience, and personal and professional development.

For additional information, refer to: **www.engr.psu.edu/mep**

ENTRANCE TO MAJOR -- In addition to the minimum grade point average (GPA) requirements described by University Policies, the College of Engineering has course requirements for admission to all its majors. To be eligible for consideration for entrance to a major, a student must have completed the following requirements with a minimum grade of C: CHEM 110 GN (or CMPSC 122 for the Computer Science major), MATH 140 GQ, MATH 141 GQ, MATH 250 or 251 GQ (or MATH 230 for the Computer Science major), PHYS 211 GN, and PHYS 212 GN. These must be completed by the end of the semester during which the admission to major process is carried out. Because the Engineering Science major is an honors program, admission is limited to students who attain a cumulative GPA of 3.0.

For additional information, refer to: **http://www.engr.psu.edu/AdvisingCenter/ETM**

RECOMMENDED ACADEMIC PLANS

Recommended Academic Plans provide, in table form, the suggested courses that students schedule semester by semester for each beginning campus, as they pursue a specific College of Engineering undergraduate degree. Each college or campus maintains Recommended Academic Plans for its own majors/degree programs. Links to the College of Engineering plans are available through: **http://www.engr.psu.edu/AdvisingCenter/GraduationRequirements.** Questions concerning the Recommended Academic Plans should be directed to the college or campus involved or the Division of Undergraduate Studies.

ENROLLMENT CONTROLS

The Executive Vice President and Provost of the University approves administrative enrollment controls that limit the number of students who may be admitted to some majors in the College of Engineering. In each case, however, academic requirements are established that guarantee a student’s admission to those majors. For information on the majors for which enrollment is currently limited and their academic guarantees of

admission, contact the Engineering Advising Center, 208 Hammond Building, University Park, PA 16802 (814-863-1033).

COLLEGE OF ENGINEERING

JUSTIN SCHWARTZ, *Dean*

ANTHONY A. ATCHLEY, *Senior Associate Dean*

GEORGE LESIEUTRE, *Associate Dean for Research*

CHRISTOPHER D. RAHN, *Associate Dean for Innovation*

PETER J. BUTLER, *Associate Dean for Education*

CHRISTINE B. MASTERS, *Assistant Dean for Academic Support and Global Programs*

THOMAS A. LITZINGER, *Assistant Dean for Educational Innovation and Accreditation*

VACANT, *Assistant Dean for the Center for Engineering Outreach and Inclusion*

COLLEGE ORGANIZATION

Acoustics -- VICTOR SPARROW, *Director of Graduate Program*

Aerospace Engineering -- AMY R. PRITCHITT, *Head*

Architectural Engineering -- M. KEVIN PARFITT, *Interim Head*

Biomedical Engineering -- CHENG DONG, *Head*

Biological Engineering (College of Agricultural Sciences) -- PAUL H. HEINEMANN, *Head*

Chemical Engineering -- PHILLIP E. SAVAGE, *Head*

Civil and Environmental Engineering -- PATRICK J. FOX, *Head*

Computer Science and Engineering -- CHITARANJAN DAS, *Head*

Electrical Engineering -- KULTEGIN AYDIN, *Head*

Electrical Engineering and Computer Science, School of -- THOMAS F. LA PORTA, *Director*

Engineering Science and Mechanics -- JUDITH A. TODD, *Head*

Engineering Design, Technology, and Professional Programs, School of -- SVEN BILÉN, *Head*

Industrial and Manufacturing Engineering -- JANIS TERPENNY, *Head*

Mechanical and Nuclear Engineering --KAREN A. THOLE, *Head*

ACADEMIC PROGRAM SUPPORT

Academic Support and Global Programs -- CHRISTINE B. MASTERS, *Assistant Dean*

Office for Digital Learning -- CATHY HOLSING, *Director*

Engineering Assessment and Instructional Support -- SARAH E. ZAPPE, *Director*

Engineering Career Resources and Employer Relations -- RICK D. McCLINTIC, *Director*

Leonhard Center for the Enhancement of Engineering Education -- THOMAS A. LITZINGER, *Director*

Center for Engineering Outreach and Inclusion -- VACANT, *Assistant Dean*

Baccalaureate Degrees

Aerospace Engineering

University Park, College of Engineering (AERSP)

PROFESSOR AMY PRITCHETT, *Head, Department of Aerospace Engineering*

This major emphasizes the analysis, design, and operation of aircraft and spacecraft. Students learn the theories and practices in the fundamental subjects of aeronautics, astronautics, aerodynamics and fluid dynamics, aerospace materials and structures, dynamics and automatic control, aircraft stability and control and/or orbital and attitude dynamics and control, air-breathing and rocket propulsion, aircraft systems design and /or spacecraft systems design. All of these place significant weight on the development and use of teamwork and communications skills for effective problem-solving. Graduates in aerospace engineering find employment in the customary settings such as government laboratories, large and small aerospace firms, and in nontraditional positions that also require the use of systems-engineering approaches to problem-solving; they can also pursue graduate study in aerospace engineering and related fields.

Program Educational Objectives:

Two to three years after obtaining a B.S. in aerospace engineering, graduates will be

1. employed in the customary settings such as government laboratories, large and small aerospace firms, and nontraditional positions that also require the use of systems engineering approaches to problems-solving, or
2. pursuing graduate study in aerospace engineering and related fields.

Program Outcomes (Student Outcomes)

The undergraduate program will provide students with the

a.) ability to apply knowledge of mathematics, science and engineering to foundational subjects of aerospace engineering (aeronautics, astronautics, aerodynamics and fluid dynamics, aerospace materials and structures, dynamics and automatic control, stability and control of aircraft and/or spacecraft, air-breathing and rocket propulsion, and aircraft systems design and/or spacecraft systems design),

b.) ability to design and conduct experiments, analyze and interpret data in

aerodynamics, propulsion, structures, or control systems,

c.) ability to design a system, component or process, integrating knowledge from relevant topics in astronautics and aeronautics, to meet desired needs in aircraft systems and/or in spacecraft systems,

d.) ability to function on multi-disciplinary teams,

e.) ability to identify, formulate, and solve engineering problems,

f.) understanding of professional and ethical responsibility,

g.) ability to communicate effectively,

h.) broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context,

i.) recognition of the need for, and an ability to engage in life-long learning,

j.) knowledge of contemporary issues,

k.) ability to use the techniques, skills, and modern engineering tools necessary for engineering practice, and

l.) knowledge in all subjects in Category I or in Category II, and in some subjects in the other category:

(Category I. aerodynamics, aerospace materials, structures, propulsion, flight mechanics, and stability and control),
(Category II: orbital mechanics, space environment, attitude determination and control, telecommunications, space structures, and rocket propulsion).

The first two years of study are similar to those in other engineering majors and provide students with a basic education for the engineering profession. Students need to complete E MCH 212, CMPSC 201, MATH 220, MATH 230, and MATH 250 prior to the start of the junior year in order to meet graduation requirements in the following two years. Six of the nine technical-elective credits taken in the senior year must be aerospace engineering courses.

ENTRANCE TO MAJOR -- 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 PHSY 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.

*In the event that the major is under enrollment control, a higher minimum cumulative grade-point average is likely to be needed and students must be enrolled in the College of Engineering or Division of Undergraduate Studies at the time of confirming their major choice.

For the B.S. degree in Aerospace Engineering, a minimum of 131 credits is required. This baccalaureate program in Aerospace Engineering is accredited by the Engineering Accreditation Commission of ABET, Inc., **www.abet.org** .

Scheduling Recommendation by Semester Standing given like (Sem:1-2)

GENERAL EDUCATION: 45 credits
(27 of these 45 credits are included in the REQUIREMENTS FOR THE MAJOR)
(See description of General Education in this bulletin.)

FIRST-YEAR SEMINAR:
(Included in REQUIREMENTS FOR THE MAJOR)

UNITED STATES CULTURES AND INTERNATIONAL CULTURES:
(Included in GENERAL EDUCATION course selection)

WRITING ACROSS THE CURRICULUM:
(Included in REQUIREMENTS FOR THE MAJOR)

REQUIREMENTS FOR THE MAJOR: 113 credits
(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.)

PRESCRIBED COURSES (72 credits)
CHEM 110 GN(3)**[1]**, EDSGN 100(3), MATH 140 GQ(4)**[1]**, MATH 141 GQ(4)**[1]**, PHYS 211 GN(4)**[1]** (Sem: 1-2)
EMCH 212(3)**[1]**, ME 201(3), MATH 220 GQ(2-3), MATH 230(4), MATH 250(3)**[1]**, PHYS 212 GN(4)**[1]**, PHYS 214 GN(2) (Sem: 3-4)
AERSP 301(3)**[1]**, AERSP 304(3), AERSP 305(3), AERSP 306(3)**[1]**, AERSP 309(3)**[1]**, AERSP 311(3)**[1]**, AERSP 312(3), AERSP 313(3)**[1]**, EMCH 315(2), EMCH 316(1) (Sem: 5-6)
AERSP 410(3), ENGL 202C GWS(3) (Sem: 7-8)

ADDITIONAL COURSES (29 credits)
Select 1 credit of First-Year Seminar (Sem: 1-2)
ECON 102 GS(3), ECON 104 GS(3), or ECON 014 GS(3) (Sem: 1-2)
Select 5 credits from EMCH 210(5), EMCH 211(3), EMCH 213(3) (Sem: 3-4)
ENGL 015 GWS(3) or ENGL 030 GWS(3) (Sem: 1-2)
CAS 100A GWS(3) or CAS 100B GWS(3) (Sem: 3-4)
CMPSC 201 GQ(3) or CMPSC 202 GQ(3) (Sem: 3-4)
AERSP 401A(3), AERSP 401B(2); or AERSP 402A(3), AERSP 402B(2) (Sem: 7-8)
AERSP 413(3) or AERSP 450(3) (Sem: 7-8)
AERSP 440(3), EE 210(3), or EE 212(4) (Sem: 7-8)

SUPPORTING COURSES AND RELATED AREAS (12 credits)
Select 9 credits of Aerospace Technical Elective (ATE) courses from department list. (Sem: 7-8)

Select 3 credits of Limited Elective (LE) courses from department list. (Sem: 7-8)

(Students who complete Basic ROTC may substitute 6 of the ROTC credits for 3 credits of LE and 3 credits of GHA.)

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

Last Revised by the Department: Summer Session 2006

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Architectural Engineering

University Park, College of Engineering (A E)

PROFESSOR M. KEVIN PARFITT, *Interim Head, Department of Architectural Engineering*

This major emphasizes the application of scientific and engineering principles to the planning, design, and construction of buildings and building systems. The goal of the program is to provide engineering graduates with the best education available for careers in the building professions. Graduates will have the ability to practice as registered professional engineers in a variety of areas, both public and private, related to the planning, design, construction, and operation of buildings and to assume a place of leadership in society.

Four options are available in the ten-semester major: the Construction option, which emphasizes building construction engineering and construction management; the Lighting/Electrical option, which emphasizes the design of lighting and electrical systems for buildings; the Mechanical option, which emphasizes the design of heating, ventilating and air-conditioning systems in buildings; and the Structural option, which emphasizes the analysis and design of building structural systems. Courses in architectural design are included in all options to give the engineering student an understanding of architectural design and its relation to engineering. Courses in engineering design are provided throughout the program. The design experience is culminated in a year-long capstone design course.

A limited number of undergraduate students in the B.A.E. program will be considered for admission to one of two integrated undergraduate-graduate degree programs. The first leads to the student earning both the B.A.E. and M.A.E. degrees and involves a graduate-level component in the capstone senior project. The second provides the student with the opportunity to earn both the B.A.E. and M.S. degrees and involves a research-oriented thesis in addition to the capstone undergraduate senior project. Students who are currently enrolled in the 7th semester of the B.A.E. degree program may apply to one of the two integrated programs and will be admitted following a positive review by the faculty committee on graduate admissions. To be considered for admission to either program, students must have attained a GPA of at least 3.0 and a grade of C or better in all classes listed as AE. A commitment from an AE graduate faculty member to serve as the student's M.S. thesis adviser is necessary for admission to the B.A.E./M.S. program. Students admitted to an integrated program must maintain a GPA in all classes used toward the M.A.E. or M.S. degree of at least 3.0. Students must complete a minimum of 172 credits for both the integrated B.A.E./M.A.E. and B.A.E./M.S. degree programs, 18 of which must be at the graduate level (500, 600 or 800-level). For the B.A.E./M.A.E. degree program, all of graduate credits are course credits. For the B.A.E./M.S. degree program, a thesis is required and six credits of thesis research (600 or 610) must be included in the candidate's academic course plan.

The professional degree, Bachelor of Architectural Engineering, is granted upon the satisfactory completion of the five-year program.

Program Educational Objectives:

The undergraduate program in Architectural Engineering is designed to produce graduates who will be:

- Engaged in a professional career in the building industry.

Qualified and competent to sit for the professional engineering exam.

Capable of meeting the challenges of the engineering work environment and assuming leadership responsibilities.

Capable of solving design and project related problems based on sound engineering principles as demanded by their work.

Successful in conducting multi-disciplinary/inter-disciplinary interactions as required by their work.

Engaged in service activities in the public and professional realms.

Program Outcomes (Student Outcomes):

The expected educational 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) 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
(l) a proficiency in mathematics through differential equations, probability and statistics, calculus based physics, and general chemistry
(m) proficiency in statics, strength of materials, thermodynamics, fluid mechanics, electric circuits, and engineering economics
(n) proficiency in a minimum of three (3) of the four (4) basic curriculum areas of structures, building mechanical and electrical systems, and construction/construction management
(o) Engineering design capabilities in at least two (2) of the three (3) basic curriculum areas of architectural engineering, and that design has been integrated across the breadth of the program
(p) An understanding of architectural design and history leading to architectural design that will permit communication, and interaction, with other design professionals in the execution of building projects

ENTRANCE TO MAJOR -- Minimum grade point average of 2.6, 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, PHYS 211 (GN) and PHSY 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.

*In the event that the major is under enrollment control, a higher minimum cumulative grade-point average is likely to be needed and students must be enrolled in the College of Engineering or Division of Undergraduate Studies at the time of confirming their major

choice.

For the B.A.E. degree in Architectural Engineering, a minimum of 160 credits is required. This baccalaureate program in Architectural Engineering is accredited by the Engineering Accreditation Commission of ABET, Inc., **www.abet.org** .

For the integrated B.A.E./M.A.E. degrees, a minimum of 172 credits of course work is required.

Scheduling Recommendation by Semester Standing given like (Sem:1-2)

GENERAL EDUCATION: 45 credits
(33 of these 45 credits are included in the REQUIREMENTS FOR THE MAJOR)
(See description of General Education in this bulletin.)

FIRST-YEAR SEMINAR:
(Included in REQUIREMENTS FOR THE MAJOR)

UNITED STATES CULTURES AND INTERNATIONAL CULTURES:
(Included in GENERAL EDUCATION course selection)

WRITING ACROSS THE CURRICULUM:
(Included in REQUIREMENTS FOR THE MAJOR)

REQUIREMENTS FOR THE MAJOR: 148 credits
(This includes 33 credits of General Education courses: 9 credits of GN courses; 6 credits of GA courses; 6 credits of GQ courses; 3 credits of GS courses; 9 credits of GWS courses.)

COMMON REQUIREMENTS FOR THE MAJOR (ALL OPTIONS): 112 credits

PRESCRIBED COURSES (102 credits)
CHEM 110 GN(3)**[1]**, CHEM 111 GN(1), EDSGN 130(3), MATH 140 GQ(4)**[1]**, MATH 141 GQ(4)**[1]**, PHYS 211 GN(4)**[1]** (Sem: 1-2)
AE 202(3), AE 221(3), AE 222(3), ARCH 130A(6), EMCH 211(3), EMCH 213(3), MATH 250(3**[1]**, PHYS 212 GN(4)**[1]**, PHYS 213 GN(2) (Sem: 3-4)
AE 308(4)**[1]**, AE 309(3), AE 310(3)**[1]**, AE 311(3)**[1]**, AE 372(3)**[1]**, AE 481(4), AE 482(4), ARCH 210 GA(3), ARCH 211 GA(3), EE 211(3), EMCH 212(3), ME 201(3), MATH 220 GQ(2-3), MATH 231(2), STAT 401(3) (Sem: 5-6)
ARCH 441(3), ARCH 443(1) (Sem: 7-8)
ENGL 202C GWS(3) (Sem: 9-10)

ADDITIONAL COURSES (10 credits)
Select AE 124(1) or 1 credit of another First-Year Seminar (Sem: 1-2)
ECON 102 GS(3), ECON 104 GS(3), or ECON 014 GS(3) (Sem: 1-2)
ENGL 015 GWS(3) or ENGL 030 GWS(3) (Sem: 1-2)
CAS 100A GWS(3) or CAS 100B GWS(3) (Sem: 3-4)

REQUIREMENTS FOR THE OPTION: 36 credits

CONSTRUCTION OPTION: (36 credits)

PRESCRIBED COURSES (24 credits)
AE 404(3), AE 475(3), AE 476(3), CE 336(3), CE 337(1), MGMT 326(3)**[19]** (Sem: 7-8)
AE 472(3), AE 473(3), CE 209(2) (Sem: 9-10)

SUPPORTING COURSES AND RELATED AREAS (12 credits)
Select 3 credits from technical courses on department list (Sem: 7-8)
Select 5 credits from technical courses on department list**[19]** (Sem: 9-10)
Select 4 credits of geotechnical courses (Sem: 9-10)

LIGHTING/ELECTRICAL OPTION: (36 credits)

PRESCRIBED COURSES (24 credits)
AE 404(3), AE 454(3), AE 461(3), AE 467(3), ARCH 442(3)**[19]** (Sem: 7-8)
AE 444(3), AE 464(3), AE 466(3) (Sem: 9-10)

SUPPORTING COURSES AND RELATED AREAS (12 credits)
Select 3 credits from technical courses on department option list (Sem: 7-8)
Select 9 credits from technical courses on department option list **[19]** (Sem: 9-10)

MECHANICAL OPTION: (36 credits)

PRESCRIBED COURSES (27 credits)
AE 404(3), AE 454(3), AE 455(3), AE 457(3), AE 467(3) ARCH 442(3)**[19]**, ME 320(3), ME 410(3) (Sem: 7-8)
AE 458(3) (Sem: 9-10)

SUPPORTING COURSES AND RELATED AREAS (9 credits)
Select 3 credits from technical courses on department option list**[19]** (Sem: 7-8)
Select 6 credits from technical courses on department option list (Sem: 9-10)

STRUCTURAL OPTION: (36 credits)

PRESCRIBED COURSES (23 credits)
AE 401(3), AE 402(3), AE 403(3), AE 430(3), ARCH 442(3)**[19]**, EMCH 315(2), EMCH 316(1) (Sem: 7-8)
AE 431(3), CE 209(2) (Sem: 9-10)

SUPPORTING COURSES AND RELATED AREAS (13 credits)
Select 9 credits from technical courses on department list**[19]** (Sem: 7-8)
Select 4 credits in Geotechnical (Sem: 7-8)

Note: The following substitutions are allowed for students attending campuses where the indicated course is not offered: ED&G 100(3) can be substituted for E G 130(3).

[1] A student enrolled in this major must receive a grade of C or better, as specified in Senate Policy 82-44.
[19] Students having successfully completed ROTC upon graduation, may apply 3 credits of ROTC to these courses. Additionally, 3 credits of ROTC may be applied to GHA.

Last Revised by the Department: Fall Semester 2016

Blue Sheet Item #: 45-01-060

Review Date: 8/23/2016

R & T: Approved 5/24/2013

UCA Revision #1: 8/2/06
UCA Revision #2: 7/26/07

EN

Biological Engineering

University Park, College of Agricultural Sciences
University Park, College of Engineering (B E)

PROFESSOR PAUL H. HEINEMANN, *Head of the Department of Agricultural and Biological Engineering*

This major helps prepare students for careers involving the application of engineering principles to agricultural and biological production systems, processing systems, and conservation of land and water resources. Education in mathematics, physics, and engineering sciences common to all engineering disciplines is provided along with specialized training in biological and agricultural sciences. The curriculum covers all areas of biological engineering, including development of machines for biological processing and agriculture, postharvest handling and processing, natural resource management and utilization, biological processes, food engineering, and structures and their environmental modifications. A student must select the Agricultural Engineering option, Food and Biological Processing Engineering option or the Natural Resources Engineering option.

Program Educational Objectives:

Early career Biological Engineering graduates will be expected to:

1. Demonstrate proficiency in basic and engineering sciences related to biological processing, natural resource, and agricultural engineering fields;
2. Effectively identify, analyze and design sustainable solutions to address issues and opportunities throughout the world;
3. Work in teams and effectively communicate within and outside the profession;
4. Demonstrate strong leadership skills, ethical integrity, and professional engagement

Program Outcomes (Student Outcomes):

Upon graduation Biological Engineering students will have:

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
d. an ability to function on multi-disciplinary teams
e. an ability to identify, forumulate, 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 and societal context
i. a recognition of the need for 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

Principles of engineering design experiences are integrated throughout the junior-year curriculum by having students solve problems typical of those encountered in the agricultural and biological engineering profession. A year-long major design experience in the senior year emphasizes that biological engineers must learn not only how to develop engineering solutions to unique, practical problems using the newest technology, but also to assess and integrate the social and ethical implications of their solutions.

Careers for graduates include design, development, and research engineering positions involving biological processes, machinery development, natural resources management, materials handling, biological product development, and structural systems for animals, plants, and crop storage. Biological engineers are employed in industry, consulting firms, and governmental agencies in the United States and abroad. Graduates deal with the various engineering aspects associated with production and processing of food, fiber, and other biological materials, within the constraints of environmental protection and natural resource conservation.

ENTRANCE TO MAJOR -- 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.

*In the event that the major is under enrollment control, a higher minimum cumulative grade-point average is likely to be needed and students must be enrolled in the College of Engineering or Division of Undergraduate Studies at the time of confirming their major choice.

For the B.S. degree in Biological Engineering, a minimum of 129 credits is required. The baccalaureate program in Biological Engineering at University Park is accredited by the Engineering Accreditation Commission of ABET, Inc., **www.abet.org**.

Scheduling Recommendation by Semester Standing given like (Sem: 1-2)

GENERAL EDUCATION: 45 credits
(27-28.5 of these 45 credits are included in the REQUIREMENTS FOR THE MAJOR)
(See description of General Education in front of *Bulletin.)*

FIRST-YEAR SEMINAR:
(Included in REQUIREMENTS FOR THE MAJOR)

UNITED STATES CULTURES AND INTERNATIONAL CULTURES:
(Included in GENERAL EDUCATION course selection)

WRITING ACROSS THE CURRICULUM:
(Included in REQUIREMENTS FOR THE MAJOR)

REQUIREMENTS FOR THE MAJOR: 111-112.5 credits
(This includes 27-28.5 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; and 1.5 credits of GHA courses.)

COMMON REQUIREMENTS FOR THE MAJOR (ALL OPTIONS): 75 credits

PRESCRIBED COURSES (68 credits)
CHEM 110 GN(3)**[1]**, CHEM 111 GN(1), EMCH 211(3)**[1]**, EDSGN 100(3), ENGL 015 GWS(3), MATH 140 GQ(4)**[1]**, MATH 141 GQ(4)**[1]**, PHYS 211 GN(4)**[1]** (Sem: 1-2)
EMCH 212(3)**[1]**, EMCH 213(3)**[1]**, ME 300(3)**[1]**, MATH 231(2), MATH 251(4)**[1]**, PHYS 212 GN(4)**[1]** (Sem: 3-4)
BE 301(3)**[1]**, BE 302(4)**[1]**, BE 304(3)**[1]**, BE 305(3)**[1]**, BE 308(3)**[1]**, BE 391 GWS(2) (Sem: 5-6)
BE 392 GWS(2), BE 460(1), BE 466(3) (Sem: 7-8)

ADDITIONAL COURSES (7 credits)
CAS 100A GWS(3) or CAS 100B GWS(3)
Select 1 credit of First-Year Seminar (Sem: 1-2)
AGBM 101 GS(3) or ECON 102 GS(3), or ECON 104 GS(3) (Sem: 3-4)

REQUIREMENTS FOR THE OPTIONS: 36-37.5 credits

AGRICULTURAL ENGINEERING OPTION: (36 credits)

ADDITIONAL COURSES (6 credits)
CE 360(3)**[1]** or ME 320(3) **[1]** (Sem: 5-6)

IE 424(3) or STAT 401(3) (Sem: 7-8)

SUPPORTING COURSES AND RELATED AREAS (30 credits)
Select 3 credits in math/basic science**[26]** (Sem: 3-6)
Select 6 credits from BE 303(3)**[1]**, BE 306(3)**[1]**, BE 307(3)**[1]** (Sem: 5-6)
Select 6 credits in engineering science/design**[26]** (Sem: 5-8)
Select 3 credits in agricultural/biological science**[26]** (Sem: 7-8)
Select 6 credits in biological engineering**[26]** (Sem: 7-8)
Select 6 credits in technical selection**[26]** (Sem: 7-8)
(Students may apply 3 credits of ROTC to the technical selection category and 3 credits to the GHA category upon completion of the ROTC program.)

FOOD AND BIOLOGICAL PROCESSING ENGINEERING OPTION: (37.5 credits)

PRESCRIBED COURSES (16.5 credits)
BMB 211(3), CHEM 202(3), NUTR 100 GHA(1.5) (Sem: 5-6)
BE 465(3), BE 468(3), IE 424(3) (Sem: 7-8)

ADDITIONAL COURSES (3 credits)
CE 360(3)**[1]** or ME 320(3)**[1]** (Sem: 5-6)

SUPPORTING COURSES AND RELATED AREAS (18 credits)
Select 6 credits in emphasis technical elective**[26]** (Sem: 7-8)
Select 6 credits in any engineering science/design**[26]** (Sem: 7-8)
Select 6 credits in technical selection**[26]** (Sem: 7-8)
(Students may apply 3 credits of ROTC to the technical selection category and 3 credits to the GHA category upon completion of the ROTC program.)

NATURAL RESOURCES ENGINEERING OPTION: (36 credits)

PRESCRIBED COURSES (21 credits)
SOILS 101 GN(3) (Sem: 1-4)
ASM 309 (3)**[1]**, BE 307(3)**[1]**, CE 360(3)**[1]** (Sem: 5-6)
BE 467(3), BE 477(3), BE 487(3) (Sem: 7-8)

ADDITIONAL COURSES (3 credits)
IE 424(3) or STAT 401(3) (Sem: 7-8)

SUPPORTING COURSES AND RELATED AREAS (12 credits)
Select 6 credits in engineering science/design**[26]** (Sem: 5-8)
Select 3 credits in biological/environmental sciences**[26]** (Sem: 7-8)
Select 3 credits in technical selection**[26]** (Sem: 7-8)
(Students may apply 3 credits of ROTC to the technical selection category and 3 credits to the GHA category upon completion of the ROTC program.)

[1] A student enrolled in this major must receive a grade of C or better, as specified in Senate Policy 82-44.
[26] Courses to be selected from a list approved by the Agricultural and Biological Engineering faculty. These courses must be chosen so that the engineering design and engineering science requirements for the major are met.

Last Revised by the Department: Spring Semester 2015

Blue Sheet Item #: 43-06-000

Review Date: 04/14/2015

R & T: Approved 5/24/2013

UCA Revision #1: 8/2/06
UCA Revision #2: 7/26/07

Comments

EN

Biomedical Engineering

University Park, College of Engineering (BME)

PROFESSOR CHENG DONG, *Head of the Department of Biomedical Engineering*

The Biomedical Engineering curriculum emphasizes the continuous integration of classical and modern engineering principles with the life sciences and health care. Biomedical Engineers apply these skills to innovation in the health care industry, basic biological sciences, and the underpinning of medical practice.

Consistent with the mission of Penn State University and the College of Engineering, the Penn State Bachelor of Science program in Biomedical Engineering aims to create world-class engineers who will, after graduation, contribute to social and economic development through the application of engineering to the solution of problems in medicine and biology.

Program Educational Objectives

Three to five years after graduation, we expect our graduates to be:

employed in industry and government positions which include, but are not limited to, research and development, regulation, manufacturing, quality assurance and sales and marketing, or,

enrolled in graduate school, continuing education, or other professional development programs related to biomedical sciences and engineering, or,

enrolled in medical school, dental school, or other health-related professional training programs.

Program Outcomes (Student Outcomes)

Upon graduation from the Biomedical Engineering program, students will have:

1. An ability to apply knowledge of advanced mathematics, (including differential equations and statistics), science, and engineering to solve problems at the interface of engineering and biology
2. An ability to design and conduct experiments, as well as to analyze and interpret data from living and non-living systems
3. 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
4. An ability to function on multi-disciplinary teams
5. An ability to identify, formulate, and solve engineering problems
6. An understanding of professional and ethical responsibility
7. An ability to communicate effectively
8. The broad education necessary to understand the impact of engineering solutions in

a global, economic, environmental, and societal context
9. A recognition of the need for, and an ability to engage in, life-long learning
10. A knowledge of contemporary issues
11. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
12. An understanding of physics, chemistry, and of physiology at molecular, cellular and organ levels
13. An ability to address problems associated with the interaction between living and non-living materials and systems

ENTRANCE TO MAJOR -- 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.

*In the event that the major is under enrollment control, a higher minimum cumulative grade-point average is likely to be needed and students must be enrolled in the College of Engineering or Division of Undergraduate Studies at the time of confirming their major choice.

For the B.S. degree in Biomedical Engineering, a minimum of 130-131 credits are required. The baccalaureate program in Biomedical Engineering at University Park is accredited by the Engineering Accreditation Commission of ABET, Inc., **www.abet.org.**

Students in residence at the Commonwealth campuses may satisfy the course requirements for semesters 1-3. They should then transfer to University Park to begin studies in their major beginning with semester 4.

Scheduling Recommendation by Semester Standing given like (Sem: 1-2)

GENERAL EDUCATION: 45 credits
(27 of these 45 credits are included in the REQUIREMENTS FOR THE MAJOR)
(See description of General Education in front of the *Bulletin*.)

FIRST-YEAR SEMINAR:
(Included in REQUIREMENTS FOR THE MAJOR)

UNITED STATES CULTURES AND INTERNATIONAL CULTURES:
(Included in GENERAL EDUCATION course selection)

WRITING ACROSS THE CURRICULUM:
(Included in REQUIREMENTS FOR THE MAJOR)

REQUIREMENTS FOR THE MAJOR: 112-113 credits
(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.)

COMMON REQUIREMENTS FOR THE MAJOR (ALL OPTIONS): 89 credits

PRESCRIBED COURSES (72 credits)
EDSGN 100(3) (Sem: 1-2)
CHEM 110 GN(3)**[1]**, CHEM 111 GN(1), CHEM 112 GN(3), CHEM 113 GN(1) (Sem: 1-2)
MATH 140 GQ(4)**[1]**, MATH 141 GQ(4)**[1]**, PHYS 211 GN(4)**[1]** (Sem: 1-2)
CMPSC 200 GQ(3), EMCH 210(5), MATH 230(4), MATH 251(4)**[1]**, PHYS 212 GN(4)**[1]** (Sem: 3-4)
BME 201(3)**[1]** (Sem: 4)

BME 301(4)[1], BME 303(3)[1], BME 313(3)[1], BME 401(3)[1], BME 402(3)[1], BME 403(1) (Sem: 5-6)
ENGL 202C GWS(3) (Sem: 5-6)
BME 429(2), BME 440(1), BME 450(3) (Sem: 7-8)

ADDITIONAL COURSES (14 credits)
Select 1 credit of First-Year Seminar (Sem: 1-2)
ENGL 015 GWS(3) or ENGL 030 GWS(3) (Sem: 1-2)
ECON 102 GS(3), or ECON 104 GS(3) (Sem: 1-2)
BIOL 141 GN(3)[1], BIOL 142(1)[1], or BIOL 240W(4)[1] (Sem: 3-4)
CAS 100A GWS(3) or CAS 100B GWS(3) (Sem: 4-8)

SUPPORTING COURSES AND RELATED AREAS (3 credits)
Select 3 credits of Science or Engineering Elective courses from departmental list (Sem: 7-8)

REQUIREMENTS FOR THE OPTION: 23-24 credits

BIOCHEMICAL OPTION: (24 credits)

PRESCRIBED COURSES (9 credits)
BME 409(3), BME 413(3) (Sem: 5-6)
BME 423(3) (Sem: 7-8)

ADDITIONAL COURSES (3 credits)
CHEM 202(3) or CHEM 210(3) (Sem: 4-6)

SUPPORTING COURSES AND RELATED AREAS (12 credits)
Select 9 credits from Biochemical Option department list (Sem: 6-8)
Select 3 credits from Related Electives department list (Sem: 6-8)

MEDICAL IMAGING AND DEVICES OPTION: (23 credits)

PRESCRIBED COURSES (7 credits)
EE 210(4) (Sem: 3-4)
BME 406(3) (Sem: 5-6)

ADDITIONAL COURSES (4 credits)
CMPEN 271(3) and CMPEN 275(1) or CMPEN 270(4) or EE 310(4) or EE 330(4) (Sem: 5-6)

SUPPORTING COURSES AND RELATED AREAS (12 credits)
Select 6 credits from the Related Electives department list (Sem: 6-8)
Select 6 credits from Medical Imaging and Device Option department list (Sem: 7-8)

BIOMATERIALS OPTION: (24 credits)

PRESCRIBED COURSES (12 credits)
MATSE 201(3), BME 409(3), BME 443(3) (Sem: 5-6)
BME 446(3) (Sem: 7-8)

ADDITIONAL COURSES (3 credits)
CHEM 202(3) OR CHEM 210(3) (Sem: 4-6)

SUPPORTING COURSES AND RELATED AREAS (9 credits)
Select 3 credits from Related Electives department list (Sem: 6-8)
Select 6 credits from Biomaterials Option department list (Sem: 7-8)

BIOMECHANICS OPTION: (24 credits)

PRESCRIBED COURSES (9 credits)

EMCH 212(3), EMCH 315(2), EMCH 316(1) (Sem: 4-6)
BME 409(3) (Sem: 5-6)

SUPPORTING COURSES AND RELATED AREAS (15 credits)
Select 9 credits from Biomechanics Option department list (Sem: 6-8)
Select 6 credits from Related Electives department list (Sem: 6-8)

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

Last Revised by the Department: Fall Semester 2013

Blue Sheet Item #: 42-03-040

Review Date: 11/19/2013

R & T: Approved 5/24/2013

UCA Revision #1: 8/2/06
UCA Revision #2: 7/26/07

EN

Chemical Engineering

University Park, College of Engineering (CH E)

Not all options are available at every campus. Contact the campus you are interested in attending to determine which options are offered.

PROFESSOR PHILLIP E. SAVAGE, *Head, Department of Chemical Engineering*

Chemical Engineering is one of the most versatile professions--you'll find Chemical Engineers employed in a broad array of industries ranging from pharmaceutical and biotechnical companies to semiconductor manufacturing to start-up companies converting the latest laboratory discoveries to large-scale commercial production. Chemical Engineers work with catalysts to develop new ways to manufacture medicines and plastics; they develop control systems that enable the safe production of products from semiconductors to household soap; they design chemical and petroleum plants; they research the effects of artificial organs on blood flow; and they develop the equipment and processes necessary for advances in biotechnology. While chemistry emphasizes the facts and principles of science, chemical engineering emphasizes its practical application for the development of new products and processes.

The undergraduate program in Chemical Engineering provides students with fundamental skills in problem solving, analysis, and design, along with hands-on experience in practical applications. The curriculum builds upon the traditional foundation in the chemical and energy-related industries and introduces new material in the life sciences, polymers, and environmental fields. Students have numerous opportunities to pursue more specialized areas including formal options in Bioprocess and Biomolecular Engineering, Energy and Fuels, and Polymer Engineering.

The program aims to produce graduates who will attain one or more of the following:

1. Careers as practicing chemical engineers in traditional chemical and energy-related industries as well as in expanding areas of materials, environmental, pharmaceutical, and biotechnology industries.

2. Advanced degrees in chemical engineering (or a related technical discipline), medicine, law, or business.
3. Positions that provide the technical, educational, business, and/or political leadership needed in today's rapidly changing, increasingly technological, global society.

ENTRANCE TO MAJOR -- 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 PHSY 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.

For the B.S. degree in Chemical Engineering, a minimum of 133 credits is required. This baccalaureate program in Chemical Engineering is accredited by the Engineering Accreditation Commission of ABET, Inc., **www.abet.org**.

Scheduling Recommendation by Semester Standing given like (Sem:1-2)

GENERAL EDUCATION: 45 credits
(27 of these 45 credits are included in the REQUIREMENTS FOR THE MAJOR)
(See description of General Education in this bulletin.)

FIRST-YEAR SEMINAR:
(Included in REQUIREMENTS FOR THE MAJOR)

UNITED STATES CULTURES AND INTERNATIONAL CULTURES:
(Included in GENERAL EDUCATION course selection)

WRITING ACROSS THE CURRICULUM:
(Included in REQUIREMENTS FOR THE MAJOR)

REQUIREMENTS FOR THE MAJOR: 115 credits
(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.)

COMMON REQUIREMENTS FOR THE MAJOR (ALL OPTIONS): 97 credits

PRESCRIBED COURSES (87 credits)
CHEM 110 GN(3)**[1]**, CHEM 111 GN(1), CHEM 112 GN(3), CHEM 113 GN(1), EDSGN 100(3), MATH 140 GQ(4)**[1]**, MATH 141 GQ(4)**[1]**, PHYS 211 GN(4)**[1]** (Sem: 1-2)
BMB 251(3), CHE 210(3)**[1]**, CHE 220(3)**[1]**, CHE 230(1), CHE 300(1), CHE 320(3)**[1]**, CHE 330(3)**[1]**, CHE 340(3), CHE 350(3)**[1]**, CHEM 210(3), CHEM 212(3), CHEM 213(2), CHEM 457(1-2), MATH 231(2), MATH 251(4)**[1]**, PHYS 212 GN(4)**[1]**, ENGL 202C GWS(3) (Sem: 3-6)
CHEM 466(3) (Sem: 6)
CHE 410(3)**[1]**, CHE 430(3)**[1]**, CHE 452(3), CHE 470(3), CHE 480W(3) (Sem: 7-8)

ADDITIONAL COURSES (10 credits)
Select 1 credit of First-Year Seminar (Sem: 1-2)
ENGL 015 GWS(3) or ENGL 030 GWS(3) (Sem: 1-2)
ECON 102 GS(3), ECON 104 GS(3), or ECON 014 GS(3) (Sem: 1-6)
CAS 100A GWS(3) or CAS 100B GWS(3) (Sem: 3-4)

REQUIREMENTS FOR THE OPTION: 18 credits

BIOPROCESS AND BIOMOLECULAR ENGINEERING OPTION: 18 credits

PRESCRIBED COURSES (9 credits)

BMB 442(3), CHE 438(3), CHE 449(3) (Sem: 5-8)

ADDTIONAL COURSES (3 credits)
BME 443/MATSE 403(3) or BME 444/MATSE 404 IL(3) (Sem: 5-8)

SUPPORTING COURSES AND RELATED AREAS (6 credits)
Select 3-6 credits from departmental list of BPBME Engineering Electives (Sem: 5-8)
Select 0-3 credits from departmental list of BPBME Science Electives (Sem: 5-8)

ENERGY AND FUELS OPTION: 18 credits

PRESCRIBED COURSES (6 credits)
EGEE 411W(3), EGEE 455(3) (Sem: 5-8)

ADDITIONAL COURSES (3 credits)
FSC 401(3) or ENVSE 400(3) (Sem: 5-8)

SUPPORTING COURSES AND RELATED AREAS (9 credits)
Select 9 credits from departmental list of Energy Electives (Sem: 5-8)

GENERAL OPTION: 18 credits

ADDITIONAL COURSES (3 credits)
MATSE 201(3) or MATSE 202(3) or EGEE 455(3) or BME 443/MATSE 403(3) (Sem: 5-8)

SUPPORTING COURSE ANDS RELATED AREAS (15 credits)
Select 6 credits in 400-level chemical engineering electives from departmental list (Sem: 5-8)
Select 3 credits of approved engineering electives from departmental list (Sem: 5-8)
Select 6 credits of approved professional electives from department list **[31]** (Sem: 5-8)

POLYMER ENGINEERING OPTION (18 credits)

PRESCRIBED COURSES (12 credits)
MATSE 202(3), MATSE 441(3), MATSE 446(3), MATSE 447(3) (Sem: 5-8)

ADDITIONAL COURSES (6 credits)
Select 6 credits from: CHE 443(3), MATSE 403/BME 443(3), MATSE 404/BME 444 IL(3), MATSE 445(3), ME 403(3) (Sem: 5-8)

RESEARCH INTENSIVE OPTION (18 credits)

PRESCRIBED COURSES (6 credits)
CHE 494(6)

ADDITIONAL COURSES (6 credits)
Select 3 credits from: CHE 446(3) or CHE 544(3) (Sem: 7-8)
Select 3 credits from: MATSE 201(3), MATSE 202(3), EGEE 455(3), MATSE 404/BME 444 IL(3), CHE 510(3) [91] (Sem: 5-8)

SUPPORTING COURSES AND RELATED AREAS (6 credits)
Select 6 credits of approved Research Electives from departmental list (Sem: 5-8)

[1] A student enrolled in this major must receive a grade of C or better, as specified in Senate Policy 82-44.
[31] Students may substitute 6 credits of ROTC for part of this requirement in consultation with department.
[91] "...senior, undergraduate students with an average of at least 3.5, and certain other students with averages of at least 3.00 who have been granted special permission to

enroll through the Office of Graduate Enrollment Services." Penn State University 2003-2004 Graduate Degree Programs Bulletin. Instructor approval is also required.

Last Revised by the Department: Fall Semester 2015

Blue Sheet Item #: 44-01-077

Review Date: 9/15/2015

R & T: Approved 5/24/2013

UCA Revision #1: 8/3/06
UCA Revision #2: 7/26/07

EN

Civil Engineering

University Park, College of Engineering (C E)

PROFESSOR PATRICK J. FOX, *Head, Department of Civil and Environmental Engineering*

The program in Civil and Environmental Engineering is designed to provide the basic undergraduate education required for private practice and public service in civil engineering, and/or continue formal education. Emphasis is placed on the fundamentals of civil engineering principles and design techniques. Students utilize basic engineering science concepts in several of the different specialty areas (e.g., construction/management, environmental, materials/pavement design/geotechnical, structures, transportation, and water resources). Finally the students are able to choose an area of specialization for professional practice or graduate studies.

Program Educational Objectives:

The educational objectives of our undergraduate program will prepare our graduates to:

begin and sustain a career in consulting, industry, or state and federal government agencies, such as the departments of transportation and departments of environmental protection;

lead and work in interdisciplinary teams needed to design sustainable and resilient infrastructure through knowledge and application of environmental, geotechnical, materials, structural, transportation, and water resources engineering;

engage in life-long learning opportunities, including graduate school; and

obtain and maintain professional licensure

Program Outcomes (Student Outcomes):

The undergraduate program will provide students with:

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. an understanding of 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. knowledge of contemporary issues in civil engineering;
k. an ability to use modern engineering techniques, skills, and tools necessary for engineering practice.

The program is broadened by courses in communication, arts, humanities, social and behavioral sciences, as well as other engineering disciplines. Students gain experience in working as members of a team and using interdisciplinary approaches to solve problems. These experiences, as well as those related to engineering principles and design, are provided through exercises in the classroom, laboratory, and field. The program culmination is a capstone design course wherein the students' knowledge and skills are applied to actual engineering problems.

ENTRANCE TO MAJOR -- 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.

*In the event that the major is under enrollment control, a higher minimum cumulative grade-point average is likely to be needed and students must be enrolled in the College of Engineering or Division of Undergraduate Studies at the time of confirming their major choice.

For the B.S. degree in Civil Engineering, a minimum of 127 credits is required. The baccalaureate program in Civil Engineering at University Park is accredited by the Engineering Accreditation Commission of ABET, Inc., **www.abet.org.**

Scheduling Recommendation by Semester Standing given like (Sem:1-2)

GENERAL EDUCATION: 45 credits
(27 of these 45 credits are included in the REQUIREMENTS FOR THE MAJOR)
(See description of General Education in this bulletin.)

FIRST-YEAR SEMINAR:
(Included in REQUIREMENTS FOR THE MAJOR)

UNITED STATES CULTURES AND INTERNATIONAL CULTURES:
(Included in GENERAL EDUCATION course selection)

WRITING ACROSS THE CURRICULUM:
(Included in REQUIREMENTS FOR THE MAJOR)

REQUIREMENTS FOR THE MAJOR: 112 credits
(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.)

PRESCRIBED COURSES (71 credits)
CHEM 110 GN(3)**[1]**, CHEM 111 GN(1), EMCH 211(3)**[1]**, EDSGN 100(3), MATH 140 GQ(4)**[1]**, MATH 141 GQ(4)**[1]**, PHYS 211 GN(4)**[1]** (Sem: 1-2)

EMCH 212(3)[1], EMCH 213(3)[1], STAT 401(3), GEOSC 001(3), MATH 220 GQ(2), MATH 251(4)[1], PHYS 212 GN(4)[1] (Sem: 3-4)
CE 310(3)[1], CE 321(3)[1], CE 332(3)[1], CE 335(3)[1], CE 336(3)[1], CE 340(3)[1], CE 360(3)[1], CE 370(3)[1], ENGL 202C GWS(3) (Sem: 5-6)

ADDITIONAL COURSES (29-32 credits)
CE 100S(1) or 1 credit of First-Year Seminar or elective (Sem: 1-2)
ENGL 015 GWS(3) or ENGL 030 GWS(3) (Sem: 1-2)
CAS 100A GWS(3) or CAS 100B GWS(3) (Sem: 3-4)
CMPSC 200 GQ(3) or CMPSC 201 GQ(3) (Sem: 3-4)
ECON 102 GS(3), ECON 104 GS(3), or ECON 014 GS(3) (Sem: 3-4)
ME 201(3) or CHE 220(3)[30] (Sem: 5-6)
CE 337(1) or CE 475(4) (Sem: 5-6)**[+]**
Select 9 credits from CE 341(3), CE 342(3), CE 371(3), CE 422(3), CE 423(3), CE 432(3), CE 435(3), CE 436(3), CE 437(3), CE 441(3), CE 447(3), CE 461(3), CE 462(3), CE 475(4), CE 476(3), CE 479(3) (Sem: 5-8)**[#]**
Select 3 credits of CE 400 level "W" courses (Sem: 5-8)

SUPPORTING COURSES AND RELATED AREAS: (9 credits)
Select 9 credits of technical elective from C E 300-level courses, CE 400-level courses, or department list. (Sem: 7-8)

[1] A student enrolled in this major must receive a grade of C or better, as specified in Senate Policy 82-44.
[30] Students may substitute 6 credits of ROTC for 3 credits of GHA courses and 3 credits of M E.
[+] If C E 475 is taken, one credit goes toward lab requirement and remaining three go towards C E or general technical electives.
[#] Two of those courses must be selected from at least 2 of the 3 remaining technical areas in the Civil Engineering program-- structures (x40), hydrosystems (x60), and environmental (x70).

Last Revised by the Department: Fall Semester 2015

Blue Sheet Item #: 44-03-040

Review Date: 11/17/15

R & T: Approved 5/24/2013

UCA Revision #1: 8/3/06
UCA Revision #2: 7/27/07

EN

Civil Engineering

Capital College (CE CA)

PROFESSOR SEROJ MACKERTICH, *Program Chair*

The program in Civil and Environmental Engineering is designed to provide the basic undergraduate education required for private practice and public service in civil engineering, and/or continue formal education. Emphasis is placed on the fundamentals

of civil engineering principles and design techniques. Students utilize basic engineering science concepts in several of the different specialty areas (e.g., construction/management, environmental, materials/pavement design/geotechnical, structures, transportation, and water resources). Finally the students are able to choose an area of specialization for professional practice or graduate studies.

The objective of the Civil Engineering program is to prepare students for a wide range of career paths that use civil engineering principles and methodologies. A curriculum is provided that prepares our recent graduates to:

begin and sustain a career in consulting, industry, or state and federal government agencies, such as the departments of transportation and departments of environmental protection;

lead and work in interdisciplinary teams needed to design sustainable and resilient infrastructure through knowledge and application of environmental, geotechnical, materials, structural, transportation, and water resources engineering;

engage in life-long learning opportunities, including graduate school; and

obtain and maintain professional licensure

Program Outcomes (Student Outcomes):

The undergraduate program will provide students with:

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 contraints 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. an understanding of 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. knowledge of contemporary issues in civil engineering;
k. an ability to use modern engineering techniques, skills, and tools necessary for engineering practice.

The program is broadened by courses in communication, arts, humanities, social and behavioral sciences, as well as other engineering disciplines. Students gain experience in working as members of a team and using interdisciplinary approaches to solve problems. These experiences, as well as those related to engineering principles and design, are provided through exercises in the classroom, laboratory, and field. The program culmination is a capstone design course wherein the students' knowledge and skills are applied to actual engineering problems.

ENTRANCE TO MAJOR -- 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) and PHYS 211 (GN). All of these courses must be completed by the end of the semester during which the admission to major process is carried out.

*In the event that the major is under enrollment control, a higher minimum cumulative grade-point average is likely to be needed and students must be enrolled in the College of Engineering or Division of Undergraduate Studies at the time of confirming their major choice.

For the B.S. degree in Civil Engineering, a minimum of 127 credits is required. The baccalaureate program in Civil Engineering at Harrisburg is accredited by the Engineering Accreditation Commission of ABET, Inc.,**www.abet.org.**

Scheduling Recommendation by Semester Standing given like (Sem:1-2)

GENERAL EDUCATION: 45 credits
(27 of these 45 credits are included in the REQUIREMENTS FOR THE MAJOR)
(See description of General Education in this bulletin.)

FIRST-YEAR SEMINAR:
(Included in REQUIREMENTS FOR THE MAJOR)

UNITED STATES CULTURES AND INTERNATIONAL CULTURES:
(Included in GENERAL EDUCATION course selection)

WRITING ACROSS THE CURRICULUM:
(Included in REQUIREMENTS FOR THE MAJOR)

REQUIREMENTS FOR THE MAJOR: 112 credits
(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.)

PRESCRIBED COURSES (71 credits)
CHEM 110 GN(3)**[1]**, CHEM 111 GN(1), EMCH 211(3)**[1]**, EDSGN 100(3), MATH 140 GQ(4)**[1]**, MATH 141 GQ(4)**[1]**, PHYS 211 GN(4)**[1]** (Sem: 1-2)
EMCH 212(3)**[1]**, EMCH 213(3)**[1]**, STAT 401(3), GEOSC 001(3), MATH 220 GQ(2), MATH 251(4)**[1]**, PHYS 212 GN(4)**[1]** (Sem: 3-4)
CE 310(3)**[1]**, CE 321(3)**[1]**, CE 332(3)**[1]**, CE 335(3)**[1]**, CE 336(3)**[1]**, CE 340(3)**[1]**, CE 360(3)**[1]**, CE 370(3)**[1]**, ENGL 202C GWS(3) (Sem: 5-6)

ADDITIONAL COURSES (29-32 credits)
CE 100(1) or 1 credit of First-Year Seminar or elective (Sem: 1-2)
ENGL 015 GWS(3) or ENGL 030 GWS(3) (Sem: 1-2)
CAS 100A GWS(3) or CAS 100B GWS(3) (Sem: 3-4)
CMPSC 200 GQ(3) or CMPSC 201 GQ(3) (Sem: 3-4)
ECON 102 GS(3), ECON 104 GS(3), or ECON 014 GS(3) (Sem: 3-4)
ME 201(3) or CHE 220(3)**[30]** (Sem: 5-6)
CE 337(1) or CE 475(4) (Sem: 5-6)**[+]**
Select 9 credits from CE 341(3), CE 342(3), CE 371(3), CE 422(3), CE 423(3), CE 432(3), CE 435(3), CE 436(3), CE 437(3), CE 441(3), CE 447(3), CE 461(3), CE 462(3), CE 475(4), CE 476(3), CE 479(3) (Sem: 5-8)**[#]**
Select 3 credits of CE level "W" courses (Sem: 5-8)

SUPPORTING COURSES AND RELATED AREAS: (9 credits)
Select 9 credits of technical elective from CE 300-level courses, CE 400-level courses, or department list. (Sem: 7-8)

Integrated B.S. in Civil Engineering/M.Eng. in Environmental Engineering Program

The Civil Engineering undergraduate and Environmental Engineering graduate program offers a limited number of academically superior Bachelor of Science candidates the opportunity to enroll in an integrated, continous program of study leading to both the

Bachelor of Science in Civil Engineering and the Master of Engineering in Environmental Engineering. The ability to coordinate as well as concurrently pursue the two degree programs enables the student to earn the two degrees in five years.

Students in the IUG program must satisfy the degree requirements for both Bachelor of Science and Master of Engineering degress. However, the total course load is reduced due to the maximum of 10 credits that can count towards both degress. A minimum of 7 credits proposed to count for both degrees must be at the 500 level. Master's paper credits may not be double counted. The first three years of the IUG program are identical to the first three years of the Bachelor of Science program. The fourth year of the IUG program differs from that of the Bachelor of Science program due to the courses that count toward the Master of Science degree requirements.

Students will be admitted on a provisional basis laste in their 6th semester so that they may be advised appropriately for the IUG 7th semester courses. Formal acceptance is contingent upon maintaining a 3.0 cumulative GPA through the 6th semester, and a collective GPA of 3.3 or better in courses designated MATH, CHEM, CE, or ENVE.

Student performance will be monitored on an on-going basis. In addition, a formal evaluation of student academic performance will be performed when the student has completed 114 to 115 credits, the end of the first semester of the senior year for a typical student in the program. Students who have not maintained a collective 3.3 GPA in courses designated MATH, CHEM, CE, or ENVE will be transferred to a probationary status. Students who have not maintained a collective GPA of 3.3 or better in courses designated MATH, CHEM, CE, or ENVE by end of their eighth semester will be **dropped** from the graduate program but will continue in the Bachelor of Science C E degree program.

If for any reason a student admitted to the IUG program is unable to complete the requirements for the Master of Engineering degree, the student will be permitted to receive the Bachelor of Science degree, assuming all the undergraduate degree requirements have been completed satisfactorily.

Students have the choice of receiving the B.S. degree at the end of the fouth year or waiting until the end of the fifth year to receive both degrees. Students who elect to receive the B.S. degree at the end of the fourth year will pay graduate tuition for courses taken in the fifth year; students opting to receive both degrees at the end of the fifth year will pay undergraduate tuition for all five years. Note that students who are awarded a graduate assistantship must elect to receive the B.S. degree at the end of the fourth year. If for any reason a student admitted to the IUG program is unable to complete the requirements for the Master of Science degree, the student will be permitted to receive the Bachelor of Science degree assumnig all the undergraduate degree requirements have been satisfactorily completed. Students who successfully complete the courses listed in the recommended schedule will satisfy the requirements for the Bachelor of Science degree by the end of their fourth year.

Admission Requirements

To apply, students must be enrolled in the PSH Civil Engineering B.S. program. To initiate the application process, students must submit an *Integrated Undergraduate-Graduate (IUG) Degree in Civil Engineering Application Form,* a transcript, and three faculty recommendations. If the student expresses interest early in their undergraduate career, their faculty adviser will help undergraduate candidates determine a sequence of courses that will prepare them for acceptance into the Integrated Undergraduate-Graduate (IUG) degree program. In order to apply for the IUG program, students must have completed a minimum of 82 credits. At the time of the application, students must have completed or be enrolled in CE 335, 336, 360, and 370.

A typical student would apply by the sixth semester and before the beginning of the seventh semester. For consideration for acceptance into the program, students must have earned a minimum cumulative grade-point average of 3.0, and a collective GPA of 3.3 or better in courses designated MATH, CHEM, CE, or ENVE.

To apply formally, students must submit a completed Graduate School application. The student should mention in the notes section that the application is for the IUG program in Civil Engineering/Environmental Engineering.

Students will be admitted on a provisional basis late in the spring semester of their application year so that they may be advised appropriately for the IUG 7th semester courses. Formal acceptance is contngent upon maintaining the 3.0 cumulative GPA through the 6th semester, and a collective GPA of 3.3 or better in courses designated MATH, CHEM, CE, or ENVE.

Degree Requirements

Studentsin the IUG program must satisfy the degree requirements for both Bachelor of Science and Master of Engineering degrees. The total course load is reduced due to a maximum of 10 credits that can count towards both degrees. The minimum of 7 credits double-counted must be at the 500 level. Master's paper credits may not be double counted.

[1] A student enrolled in this major must receive a grade of C or better, as specified in Senate Policy 82-44.
[30] Students may substitute 6 credits of ROTC for 3 credits of 400-level CE courses and 3 credits of ME or EE .
[+] If CE 475 is taken, one credit goes toward lab requirement and remaining three go towards CE or general technical electives.
[#] Those courses must be selected from at least 4 of the 5 technical areas in the Civil Engineering program--transportation (x20), construction (x30), structures (x40), hydrosystems (x60), and environmental (x70).

Last Revised by the Department: Fall 2016

Blue Sheet Item #: 44-01-046

Review Date: 8/25/15

UCA Revision #1: 8/3/06
UCA Revision #2: 7/27/07

EN

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.

ENTRANCE TO MAJOR -- 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.

*In the event that the major is under enrollment control, a higher minimum cumulative grade-point average is likely to be needed and students must be enrolled in the College of Engineering or Division of Undergraduate Studies at the time of confirming their major choice.

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**.

Scheduling Recommendation by Semester Standing given like (Sem:1-2)

GENERAL EDUCATION: 45 credits
(27 of these 45 credits are included in the REQUIREMENTS FOR THE MAJOR)
(See description of General Education in front of *Bulletin.)*

FIRST-YEAR SEMINAR:
(Included in REQUIREMENTS FOR THE MAJOR)

UNITED STATES CULTURES AND INTERNATIONAL CULTURES:
(Included in GENERAL EDUCATION course selection)

WRITING ACROSS THE CURRICULUM:
(Included in REQUIREMENTS FOR THE MAJOR)

REQUIREMENTS FOR THE MAJOR: 110 credits
(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.)

PRESCRIBED COURSES (78 credits)
CHEM 110 GN(3)**[1]**, CMPSC 121 GQ(3)**[1]**, MATH 140 GQ(4), MATH 141 GQ(4)**[1]**, PHYS 211 GN(4)**[1]**, PHYS 212 GN(4)**[1]** (Sem: 1-2)
CMPSC 122(3)**[1]**, 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)**[1]**, 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)**[1]**, ENGL 202C GWS(3), STAT 418(3) (Sem: 5-6)
CMPEN 482(3), CMPSC 473(3) (Sem: 7-8)

ADDITIONAL COURSES (26 credits)
Select 1 credit of First-Year Seminar (Sem: 1-2)
ENGL 015 GWS(3) or ENGL 030 GWS(3) (Sem: 1-2)
CAS 100A GWS(3) or CAS 100B GWS(3) (Sem: 3-4)
CMPEN 270(4)**[1]**; or CMPEN 271(3)**[1]** and CMPEN 275(1) (Sem: 3-4)
ECON 014 GS(3), ECON 102 GS(3), ECON 104 GS(3), or EBF 200 GS(3) (Sem: 3-4)
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 AND RELATED AREAS (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 major must receive a grade of C or better, as specified in Senate Policy 82-44.

Last Revised by the Department: Summer Session 2012

Blue Sheet Item #: 41-01-036

Review Date: 8/14/2012

R & T: Approved 5/24/2013

UCA Revision #1: 8/3/06
UCA Revision #2: 7/27/07

EN

Computer Science

University Park, College of Engineering (CMPSC)

PROFESSOR CHITA DAS, *Head, Department of Computer Science and Engineering*

Computer Science is concerned with the analysis, design, and applications of computing software and systems. It includes a core foundation in computer hardware and software with emphasis on the design of efficient, fault-free software. It includes programming languages, data structures, compilers, operating systems, databases, and artificial intelligence.

The major is designed to provide fundamental training in preparing graduates for positions in schools, commerce, industry, and government. Students should consult their advisers in formulating suitable programs.

ENTRANCE TO MAJOR -- 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: CMPSC 122, MATH 140 (GQ), MATH 141 (GQ), MATH 230 (GQ), 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.

*In the event that the major is under enrollment control, a higher minimum cumulative grade-point average is likely to be needed and students must be enrolled in the College of Engineering or Division of Undergraduate Studies at the time of confirming their major choice.

For the B.S. degree in Computer Science, a minimum of 126 credits is required.

Scheduling Recommendation by Semester Standing given like (Sem: 1-2)

GENERAL EDUCATION: 45 credits
(24 of these 45 credits are included in the REQUIREMENTS FOR THE MAJOR)
(See description of General Education in this bulletin.)

FIRST-YEAR SEMINAR:
(Included in REQUIREMENTS FOR THE MAJOR)

UNITED STATES CULTURES AND INTERNATIONAL CULTURES:
(Included in GENERAL EDUCATION course selection)

WRITING ACROSS THE CURRICULUM:
(Included in REQUIREMENTS FOR THE MAJOR)

REQUIREMENTS FOR THE MAJOR: 105-106 credits
(This includes 24 credits of General Education courses: 9 credits of GN courses; 6 credits of GQ courses; 9 credits of GWS courses.)

PRESCRIBED COURSES (64 credits)
CMPSC 121 GQ(3)[1], CMPSC 122(3)[1], CMPSC 360(3)[1], MATH 140 GQ(4)[1], MATH 141 GQ(4)[1], MATH 220 GQ(2), PHYS 211 GN(4)[1], PHYS 212 GN(4)[1] (Sem: 1-2)
CMPEN 271(3)[1], CMPEN 331(3)[1], CMPSC 221(3)[1], CMPSC 311(3)[1], MATH 230(4)[1], STAT 318(3) (Sem: 3-4)
CMPSC 461(3)[1], CMPSC 464(3), CMPSC 465(3)[1], CMPSC 473(3)[1], ENGL 202C GWS(3), STAT 319(3) (Sem: 5-6)

ADDITIONAL COURSES (19 credits)
Select 1 credit of First-Year Seminar (Sem: 1-2)
ENGL 015 GWS(3) or ENGL 030 GWS(3) (Sem: 1-2)
CAS 100A GWS(3) or CAS 100B GWS(3) (Sem: 3-4)
Select 6 credits from CMPEN 362(3), CMPEN 431(3), CMPEN 454(3), CMPSC 442(3), CMPSC 444(3), CMPSC 450(3), CMPSC 451(3), CMPSC 455(3), CMPSC 456(3), CMPSC 458(3), CMPSC 466(3), CMPSC 467(3), CMPSC 468(3), CMPSC 471(3), CMPSC 475(3), E E 456(3)

(Sem: 7-8)
Select 3 credits from any 400-level CMPEN or CMPSC course (Sem: 7-8)
Select 3 credits from CMPSC 431(3), or CMPSC 483(3) (Sem: 7-8)

SUPPORTING COURSES AND RELATED AREAS (22-23 credits)
Select 2-3 credits from PHYS 213 GN(2), PHYS 214 GN(2), or 3 credits from the approved list of natural sciences courses (Sem: 3-4)
Select 0-4 credits in a foreign language (second-semester proficiency) (Sem: 5-6)
Select 10-14 credits from department list (Students may apply up to 3 credits of ROTC as department list credits and 3 credits of ROTC as GHA credits) (Sem: 7-8)
Select 6 credits in 400-level non-CMPEN or CMPSC courses in consultation with adviser (Sem: 7-8)

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

Last Revised by the Department: Spring Semester 2013

Blue Sheet Item #: 41-05-089

Review Date: 02/19/2013

Retention and Transfer: #240 8/20/2013

UCA Revision #2: 7/27/07

EN

Data Sciences

University Park, College of Engineering (DATSC)
University Park, College of Information Sciences and Technology (DATSC)
University Park, Eberly College of Science (DATSC)

Mary Beth Rosson, Associate Dean, Information Sciences and Technology; Chita Das, Department Head, Computer Science and Engineering, College of Engineering

Not all options are available at all Colleges. Contact the College you are interested in entering to determine which options are offered.

The inter-college Data Sciences major will educate students on the technical fundamentals of data sciences, with a focus on developing the knowledge and skills needed to manage and analyze large scale unstructured data to address an expanding range of problems in industry, government, and academia. The underlying knowledge for data sciences derives from machine learning, data mining, computer science, statistics, and visualization, and the emerging science of managing and analyzing data at scale. Students will gain breadth of knowledge through common core classes, as well as depth in one of three options. After taking common courses during the pre-major stage, students will choose among options focused on application (College of IST), computation (College of Engineering) and science (College of Science). Students in all three options will come together in their junior and senior years for two shared capstone experiences. In combination the three options position Penn State to offer highly trained professionals who understand data science’s multiple dimensions for a growing segment of the U.S. economy.

Applied Data Sciences - This option focuses on the principles, methods, and tools for assembly, validation, organization, analysis, visualization, and interpretation of large and

heterogeneous data, to support data-driven discovery and decision making, with emphasis on addressing pressing scientific, organizational, and societal challenges. A combination of required and elective courses provides students with the training and skills needed to develop advanced tools and domain-specific analyses that yield actionable knowledge from data. This option also provides critical analytical skills needed to assess the benefits and limitations of data analytics across a broad range of applications.

Computational Data Sciences - This option focuses on the computational foundations of the data sciences, including the design, implementation and analysis of software that manages the volume, heterogeneity and dynamic characteristics of large data sets and that leverages the computational power of multicore hardware. Students in this option will take upper-level courses in computer science and related fields to develop the skills necessary to construct efficient solutions to computational problems involving Big Data.

Statistical Modeling Data Sciences - This option focuses on statistical models and methods that are needed to discover and validate patterns in Big Data. Students in this option will take upper-level statistics and mathematics courses, learning to apply the theoretical machinery of quantitative models to the solution of real-world problems involving Big Data.

Entrance Requirements
To be eligible for entrance into the Data Sciences major, a degree candidate must be enrolled in the College of Information Sciences and Technology, the College of Engineering, the Eberly College of Science, or the Division of Undergraduate Studies and satisfy requirements for entrance to the major.
Specific entrance requirements include:
1. The degree candidate must be taking, or have taken, a program appropriate for entry to the major as shown in the bulletin.
2. The degree candidate must complete the following entrance-to-major requirements: MATH 140 GQ (4) [1]; MATH 141 GQ (1) [1]; CMPSC 121 (3) [1]; CMPSC 122 (3); STAT 200 (GQ) (4)[1]; IST 210 (3)[1]. These courses must be completed by the end of the semester during which the entrance to major process is carried out.

For the B.S. degree in Data Sciences, a minimum of 125 credits is required (at least 18 credits must be taken at the 400 level).

GENERAL EDUCATION: 45 credits
(15 of these 45 credits are included in the REQUIREMENTS FOR THE MAJOR)
(See description of General Education in this bulletin.)

FIRST-YEAR SEMINAR:
(Included in ELECTIVES or GENERAL EDUCATION course selection)

UNITED STATES CULTURES AND INTERNATIONAL CULTURES:
(Included in GENERAL EDUCATION course selection, or REQUIREMENTS FOR THE MAJOR)

WRITING ACROSS THE CURRICULUM:
(Included in REQUIREMENTS FOR THE MAJOR)

ELECTIVES: 5-18 credits

REQUIREMENTS FOR THE MAJOR: 77-90 credits
(This includes 15 credits of General Education courses: 9 credits of GWS and 6 credits of GQ courses.)

COMMON REQUIREMENTS FOR THE MAJOR (ALL OPTIONS): 50 credits

PRESCRIBED COURSES (41 credits)

CMPSC 121 GQ(3)[1], CMPSC 122(3)[1], DS 220(3)[1], DS 300(3)[1], DS 340(3)[1], DS 440(3)[1], ENGL 202C GWS(3), IST 210(3)[1], MATH 140 GQ(4)[1], MATH 141 GQ(4)[1], MATH 220 GQ(2)[1], STAT 200 GQ(4)[1], STAT 380(3)[1]

ADDITIONAL COURSES (9 credits)
CAS 100 GWS(3), ENGL 015 GWS(3); ENGL 137/CAS 137 GWS(3), ENGL 138/CAS 138 GWS(3) (Sem: 1-6)
STAT 318/MATH 318(3)[1]; STAT 414/MATH 414(3)[1] (Sem: 3-4)

REQUIREMENTS FOR THE OPTION: 27-40

APPLIED DATA SCIENCES: 40 credits

PRESCRIBED COURSES (22 credits)
IST 110 GS(3)[1], IST 230(3)[1], DS 200(3)[1], DS 310(3)[1], DS 320(3)[1], DS 330(3)[1], DS 410(3)[1], IST 495(1)[1] (Sem: 5-6)

ADDITIONAL COURSES (6 credits)
SRA 231(3); IST 442 IL(3); SODA 308(3); IST 445(3) (Sem: 5-8)
IST 337(3); IST 441(3); DS 402(3); IST 462(3) (Sem: 5-8)

SUPPORTING COURSES AND RELATED AREAS (12 credits)
Select 6 credits from Applied Option List A (Sem: 5-8)
Select 6 credits from Applied Option List B (Sem: 5-8)
(Students may apply up to 3 credits of ROTC as option list credits and 3 credits of ROTC as GHA credits)

COMPUTATIONAL DATA SCIENCES: 38 credits

PRESCRIBED COURSES (25 credits)
MATH 230(4)[1], CMPSC 360(3)[1], CMPSC 448(3), CMPSC 465(3)[1], STAT 415/MATH 415(3)[1], CMPSC 461(3), DS 410(3)[1], CMPSC 442(3)

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

SUPPORTING COURSES AND RELATED AREAS (12 credits)
Select 6 credits from Option List A courses
Select 6 credits from Option List B courses
(Students may apply up to 3 credits of ROTC as option list credits and 3 credits of ROTC as GHA credits)

STATISTICAL MODELING DATA SCIENCES: 27 credits

PRESCRIBED COURSES (11 credits)
MATH 230(4), STAT 184(1), STAT 440(3), STAT 462(3)

ADDITIONAL COURSES (4 credits)
MATH 311W(3)[1]; CMPSC 360(3)[1] (Sem: 5-8)
1 credit of First-Year Seminar (Sem: 1-2)

SUPPORTING COURSES AND RELATED AREAS (12 credits)
Select 6 credits from Quantitative Modeling Option List A courses
Select 6 credits from Quantitative Modeling Option List B courses
(Students may apply up to 3 credits of ROTC as option list credits and 3 credits of ROTC as GHA credits)

List of Applied Data Sciences Option Courses

List of Computational Data Sciences Courses

List of Statistical Modeling Data Sciences Courses

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

Last Revised by the Department: Fall Semester 2015

Blue Sheet Item #: 44-02-038

Review Date: 10/13/2015

Electrical Engineering

University Park, College of Engineering (E E)

PROFESSOR KULTEGIN AYDIN, *Head of the Department of Electrical Engineering*

Electrical Engineering (E E) is one of the broadest of all engineering majors and is much more than just building electrical circuits. Electrical engineering is the application of electronics, electrical science and technology, and computer systems to the needs of society. An electrical engineer is responsible for designing and integrating electronic/electrical systems in diverse industries such as defense, communications, transportation, manufacturing, health care, construction, and entertainment.

The mission of our undergraduate program is to provide a high-quality education in electrical engineering for our students and to instill in them the attitudes, values, and vision that will prepare them for lifetimes of success, continued learning, and leadership in their chosen careers. A combination of required and elective courses ensures that students acquire a broad knowledge base in electrical circuits, digital systems, electronic devices, electromagnetics, and linear systems, as well as expertise in one or more areas of specialization. Additional problem-solving skills and practical experience are developed through design projects and laboratory assignments, which also provide opportunities for developing team-building and technical communication skills.

Program Educational Objectives:

The BSEE Program provides undergraduates with a broad technical education important for employment in the private or public sector, and it teaches them the fundamentals, current issues, and creative problem solving skills essential for future years of learning. At three to five years after graduation, we foresee our graduates able to accomplish the following:

1. Electrical engineering practice in technical assignments such as design, product development, research, manufacturing, consulting, testing, sales, and management;
2. Participation and leadership on teams comprised of individuals with diverse professional and cultural backgrounds;
3. Continued learning and professional development through such activities as graduate school, distance education, professional training, and membership in professional societies.

Program Outcomes (Student Outcomes):

The BSEE Program Student Outcomes mirror those articulated by ABET:
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.

ENTRANCE TO MAJOR -- 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.

Admission to the Electrical Engineering major also requires that the applicant have a cumulative GPA of 2.6 or higher by the end of the semester during which the admission to major process is carried out.

*In the event that the major is under enrollment control, a higher minimum cumulative grade-point average is likely to be needed and students must be enrolled in the College of Engineering or Division of Undergraduate Studies at the time of confirming their major choice.

For the B.S. degree in Electrical Engineering, a minimum of 130 credits is required. This baccalaureate program in Electrical Engineering is accredited by the Engineering Accreditation Commission of ABET, Inc., **www.abet.org**.

Scheduling Recommendation by Semester Standing given like (Sem: 1-2)

GENERAL EDUCATION: 45 credits
(27 of these 45 credits are included in the REQUIREMENTS FOR THE MAJOR)
(See description of General Education in this bulletin.)

FIRST-YEAR SEMINAR:
(Included in REQUIREMENTS FOR THE MAJOR)

UNITED STATES CULTURES AND INTERNATIONAL CULTURES:
(Included in GENERAL EDUCATION course selection)

WRITING ACROSS THE CURRICULUM:
(Included in REQUIREMENTS FOR THE MAJOR)

REQUIREMENTS FOR THE MAJOR: 112-113 credits
(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.)

PRESCRIBED COURSES (68 credits)
CHEM 110 GN(3)**[1]**, CHEM 111 GN(1), EDSGN 100(3), MATH 140 GQ(4)**[1]**, MATH 141 GQ(4)**[1]**, PHYS 211 GN(4)**[1]**, PHYS 212 GN(4)**[1]** (Sem: 1-2)
EE 200(3), EE 210(4)**[1]**, EE 310(4)**[1]**, MATH 220 GQ(2), MATH 230(4), MATH 250(3)**[1]**, PHYS 213 GN(2), PHYS 214 GN(2) (Sem: 3-4)
EE 300(3), EE 330(4)**[1]**, EE 340(4)**[1]**, EE 350(4)**[1]** (Sem: 5-6)

EE 403(3), ENGL 202C GWS(3) (Sem: 7-8)

ADDITIONAL COURSES (20-21 credits)
Select 1 credit of First-Year Seminar (Sem: 1-2)
ENGL 015 GWS(3) or ENGL 030 GWS(3) (Sem: 1-2)
CMPSC 201 GQ(3) or CMPSC 121 GQ(3) (Sem: 1-2)
CMPEN 270(4)**[1]**; or CMPEN 271(3)**[1]** and CMPEN 275(1) (Sem: 3-4)
CAS 100A GWS(3) or CAS 100B GWS(3) (Sem: 3-4)
ECON 102 GS(3) or ECON 104 GS(3) (Sem: 3-4)
Select 3-4 credits from IE 424(3), PHYS 410(3-4), STAT 401(3), STAT 414(3), or STAT 418(3) (Sem: 5-6)

SUPPORTING COURSES AND RELATED AREAS (24 credits)
Select 6 credits from program-approved list of 300-level courses (Sem: 5-6)
Select 3 credits from program-approved lists of 300-level or 400-level courses (Sem: 5-6)
Select 6 credits from program-approved list of 400-level courses (Sem: 7-8)
Select 3 credits of engineering /science courses from a program-approved list (Sem: 7-8)
Select 6 additional credits, which may include up to 6 credits of ROTC, up to 6 co-op credits, and others from a program-approved list (Sem: 7-8)

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

Last Revised by the Department: Spring Semester 2016

Blue Sheet Item #: 44-06-038

Review Date: 04/5/2016

R & T: Approved 5/24/2013 - Revised: 4/5/2016

UCA Revision #1: 8/16/06
UCA Revision #2: 7/27/07

EN

Electro-Mechanical Engineering Technology

Altoona College
Berks College
University College: Penn State New Kensington, Penn State York (EMET)

PROFESSOR SVEN BILÉN, Head, School of Engineering Design, Technology, and Professional Programs, College of Engineering, University Park
PROFESSOR IVAN E. ESPARRAGOZA, Director of Engineering Technology and Commonwealth Engineering, Penn State Brandywine
PROFESSOR JENNILYN VALLEJERA, Program Coordinator, Penn State Altoona
PROFESSOR TERRY SPEICHER, Program Coordinator, Penn State Berks
PROFESSOR KARL HARRIS, Program Coordinator, Penn State New Kensington
PROFESSOR CHARLES GASTON, Program Coordinator, Penn State York

The Electro-Mechanical Engineering Technology (B.S. EMET) degree program provides the basic undergraduate education required for a career as an electro-mechanical engineering technologist. The program emphasizes a breadth of knowledge in all fields of engineering technology related to typical, highly-automated manufacturing, production, or assembly plant processes. Basic coverage is provided in all major areas to

technology involved in the operation and control of manufacturing and production processes, including instrumentation and monitoring methods, principles of machine design, automated control techniques, thermal and fluid sciences, computerized manufacturing systems, principles of electrical and electronic circuit operation, computer-aided drafting and design, economics of production, and statistical analysis and quality control.

The primary aim of the EMET program is to provide graduates with the knowledge and skills necessary to apply current methods and technology to the development, design, operation, and management of electro-mechanical systems, particularly in those industries where automated systems are prevalent.

Program Educational Objectives:

Specific educational objectives of the program expect that graduates of the program, within five years of graduation will be:

1. Capable of and actively involved in the specification, procurement, or integration of electromechanical systems
2. Capable of and actively involved in the operation, testing, or maintenance of electromechanical systems
3. Capable of and actively participating in project team activities
4. Capable of and actively involved in the preparation and delivery of technical documentation and communication

Program Outcomes (Student Outcomes):

At graduation, EMET students should have:

a) An ability to select and apply the knowledge, techniques, skills, and modern tools of their disciplines to broadly-defined engineering technology activities,
b) An ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies,
c) An ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes,
d) An ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives,
e) An ability to function effectively as a member or leader on a technical team,
f) An ability to identify, analyze, and solve broadly-defined engineering technology problems,
g) An ability to communicate effectively regarding broadly-defined engineering technology activities,
h) An understanding of the need for and an ability to engage in self-directed continuing professional development,
i) An understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity,
j) A knowledge of the impact of engineering technology solutions in a societal and global context, and
k) A commitment to quality, timeliness, and continuous improvement.

In addition, EMET graduates must demonstrate the knowledge and technical competency to:

a) Use computer-aided drafting or design tools to prepare graphical representations of electromechanical systems.
b) Use circuit analysis, analog and digital electronics, basic instrumentation, and computers to aid in the characterization, analysis, and troubleshooting of

electromechanical systems.
c) Use statics, dynamics (or applied mechanics), strength of materials, engineering materials, engineering standards and manufacturing processes to aid in the characterization, analysis, and troubleshooting of electromechanical systems.
d) Use appropriate computer programming languages for operating electromechanical systems.
e) Use electrical/electronic devices such as amplifiers, motors, relays, power systems, and computer and instrumentation systems for applied design, operation, or troubleshooting electromechanical systems.
f) Use advanced topics in engineering mechanics, engineering materials, and fluid mechanics for applied design, operation, or troubleshooting of electromechanical systems.
g) Use basic knowledge of control systems for the applied design, operation. or troubleshooting of electromechanical systems.
h) Use differential and integral calculus, as a minimum, to characterize the static and dynamic performance of electromechanical systems.
i) Use appropriate management techniques in the investigation, analysis, and design of electromechanical systems.

The major is organized as a four-year baccalaureate program with the corresponding Penn State admission requirements. Graduates of an associate degree in either electrical or mechanical engineering technology from Penn State may re-enroll in the EMET program. The College of Engineering ENGR students may enroll through "Change of Major" procedures. Students from an engineering technology program at another institution or community college accredited by TAC of ABET may transfer into the program with advanced standing.

For the B.S. degree in Electro-Mechanical Engineering Technology, a minimum of 130 credits is required. This program is accredited at Penn State Altoona, Penn State Berks, Penn State New Kensington, and Penn State York of the University College by the Engineering Technology Accreditation Commission of ABET, www.abet.org.

Scheduling Recommendation by Semester Standing given like (Sem: 1-2)

GENERAL EDUCATION: 45 credits
(24 of these 45 credits are included in the REQUIREMENTS FOR THE MAJOR) (See description of General Education in front of Bulletin.)

FIRST-YEAR EXPERIENCE:
(Satisfied by the FYE program at the campus at which the student is enrolled in the EMET program)

UNITED STATES CULTURES AND INTERNATIONAL CULTURES:
(Included in GENERAL EDUCATION course selection)

WRITING ACROSS THE CURRICULUM:
(Included in REQUIREMENTS FOR THE MAJOR)

REQUIREMENTS FOR THE MAJOR: 109-114 credits
(This includes 24 credits of General Education courses: 6 credits of GQ courses; 9 credits of GN courses; 6 credits of GWS courses; 3 credits of GH or GS courses.)

PRESCRIBED COURSES (73 credits)
MCHT 111(3)[1] (Sem: 1-2)
CMPET 117(3)[1], CMPET 120(1)[1], CMPET 211(3), EDSGN 100(3), EET 105(3), EET 114(4)[1], EET 118(1)[1], EET 212(4)[1], EET 275(3), EGT 114(2), EMET 100(1), EMET 215(3), EMET 222(3)[1], EMET 225(2), EMET 230(3)[1], EMET 325(3), EMET 326(3), EMET 330(3)[1], EMET 350(3) EMET 403(1) (Sem: 5-6)
EMET 405(3), EMET 410(4), EMET 440(3), ENGL 202C GWS(3), IET 101(3), IET 333(2) (Sem:

7-8)

ADDITIONAL COURSES (27-31 credits**)**
Select 5-6 credits from MATH 40 GQ(5)[1]; or [MATH 22 GQ(3)[1] and MATH 26 GQ(3)[1]; or [MATH 81 GQ(3)[1] and MATH 82 GQ(3)[1] * (Sem: 1-2)

Select 3 credits of GH or GS from: ENGR 320Y GS;US;IL;WAC(3), STS 200 GS(3), STS 233 GH(3), or STS 245 GS;IL(3) (Sem: 2-8)

Select 10-11 credits from:
CAS 100A GWS(3); CAS 100B GWS(3) (Sem: 3-4)
MATH 83 GQ(4)[1]** or MATH 140 GQ(4)[1] (Sem: 3-4)_
MATH 210 GQ(3) or MATH 141 GQ(4) (Sem: 3-4)

Select 3 credits from MATH 211 GQ(3)[1] or MATH 250(3)*** (Sem: 4-5)

Select 6-8 credits of GN courses from two of the following groups:
CHEM 110 GN(3) and CHEM 111 GN(1) (Sem: 4-6)
PHYS 150 GN(3) or PHYS 211 GN(4) or PHYS 250 GN(4) (Sem: 4-6)
PHYS 151 GN(3) or PHYS 212 GN(4) or PHYS 251 GN(4) (Sem: 4-6)

SUPPORTING COURSES AND RELATED AREAS (9-10 credits)
Select 3-4 credits of science courses, in consultation with an adviser, from the approved department list (Sem: 4-6)
Select 6 credits of General Technical Elective courses, in consultation with an adviser, from the approved department list (Sem: 7-8)

[1] A student enrolled in this major must receive a grade of C or better, as specified in Senate Policy 82-44.
*students taking MATH 81 GQ(3) and MATH 82 GQ(3) must take MATH 83 GQ(4)
**students taking MATH 83(4) must take MATH 210(3) and MATH 211(3)
***Note that MATH 250 does not carry a C-requirement

Last Revised by the Department: Fall Semester 2017

Blue Sheet Item #: 46-01-040

Review Date: 8/22/2017

UCA Revision #1: 8/3/06 UCA Revision #2: 7/27/07

Comments

EN

Engineering (G E)

Abington College
University College, Penn State Brandywine, Penn State DuBois, Penn State Hazleton

PROFESSOR SVEN BILÉN, *Head of School of Engineering, Design, Technology and Professional Programs (SEDTAPP)*
PROFESSOR IVAN E. ESPARRAGOZA, *Director of Engineering Technology and Commonwealth Engineering*

PROFESSOR ROBERT AVANZATO, *Program Coordinator, Penn State Abington*

PROFESSOR ASAD AZEMI, *Program Coordinator, Penn State Brandywine*
PROFESSOR DAUDI WARYOBA, *Program Coordinator, Penn State DuBois*
PROFESSOR KATHRYN W. JABLOKOW, *Program Coordinator, Penn State Great Valley*
PROFESSOR WIESLAW GREBSKI, *Program Coordinator, Penn State Hazleton*

The Engineering program provides students with a broad foundation in engineering with specialization in a technically and professionally relevant topic. Students must choose the Multidisciplinary Engineering Design option at Abington, Brandywine and Great Valley campuses, Applied Materials option at the DuBois campus or the Alternative Energy and Power Generation option at the Hazleton campus. From this degree program, students will acquire the ability to work as members of a team toward successful attainment of a common goal, thus preparing them to work in for-profit or nonprofit organizations, or to further their studies in graduate school. Typical employment for General Engineering graduates includes positions such as engineer, product engineer, process engineer, manufacturing engineer, development engineer, and materials engineer. With employment opportunities such as these and others, graduates or the Engineering program can attain professional and economically sustaining employment in their desired regional area. This degree program develops written and oral communication skills, culminating in a two-semester senior design course sequence consisting of a project based largely on student interest and faculty input.

Program Educational Objectives:

The educational objectives of the Engineering program are designed to prepare graduates who, during the first few years of professional practice will

1. Be employed by industry or government in fields, such as design, research and development, experimentation and testing, manufacturing, and technical sales.
2. Assume an increasing level of responsibility and leadership within their respective organizations.
3. Communicate effectively and work collaboratively in multidisciplinary and multicultural work environments
4. Recognize and understand global, environmental, social, and ethical contexts of their work.
5. Progress to an advanced degree and certificate programs and be committeed to lifelong learning to enhance their careers and provide flexibility in responding to changing social and technical environments.

Program Outcomes (Student Outcomes):

Graduates of the Engineering program shall be able to:

a) Apply knowledge of mathematics, science, and engineering
b) Design and conduct experiments, as well as to analyze and interpret data
c) 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) Function on multidisciplinary teams
e) Identify, formulate, and solve engineering problems
f) Demonstrate an understanding of professional and ethical responsibility
g) Communicate effectively
h) Demonstrate the understanding of the impact of engineering solutions in a global, economic, environmental, and societal context
i) Recognize the need for, and an ability to engage in life-long learning
j) Demonstrate knowledge of contemporary issues
k) Use the techniques, skills, and modern engineering tools necessary for engineering practice.

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.

For the B.S. degree in Engineering, a minimum of 127 credits are required. This baccalaureate program in Engineering is accredited by the Engineering Accreditation Commission of ABET, **www.abet.org**.

Scheduling Recommendation by Semester Standing given like (Sem: 1-2)

GENERAL EDUCATION: 45 credits
(27 of these 45 credits are included in the REQUIREMENTS FOR THE MAJOR)
(See description of General Education in front of *Bulletin*.)

FIRST-YEAR SEMINAR:
(Included in REQUIREMENTS FOR THE MAJOR.)

UNITED STATES CULTURES AND INTERNATIONAL CULTURES:
(Included in GENERAL EDUCATION course selection.)

WRITING ACROSS THE CURRICULUM:
(Included in REQUIREMENTS FOR THE MAJOR.)

REQUIREMENTS FOR THE MAJOR: 109 credits
(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.)

COMMON REQUIREMENTS FOR THE MAJOR (ALL OPTIONS): 64 credits

PRESCRIBED COURSES: 41 credits
CHEM 110 GN(3)**[1]**, CHEM 111 GN(1), EDSGN 100(3), MATH 140 GQ(4)**[1]**, MATH 141 GQ(4)**[1]**, PHYS 211 GN(4)**[1]** (Sem: 1-2)
EMCH 211(3)**[1]**, EMCH 213(3), MATH 231(2), MATH 251(4)**[1]**, PHYS 212 GN(4)**[1]**, PHYS 214 GN(2) (Sem: 3-4)
ENGR 490(1), ENGR 491W(3) (Sem: 7-8)

ADDITIONAL COURSES: 19 credits
Select 1 credit of First-Year Seminar (Sem:1-2)
Select 3 credits from: CAS 100A GWS(3) or CAS 100B GWS(3) (Sem: 1-2)
Select 3 credits from: ENGL 15 GWS(3) or ENGL 30 GWS(3) (Sem: 1-2)
Select 3 credits from: CMPSC 121 GQ(3) or CMPSC 200 GQ(3) or CMPSC 201 GQ(3) (Sem: 3-4)
Select 3 credits from: ECON 102 GS(3) or ECON 104 GS(3) (Sem: 3-4)
Select 3 credits from: ENGL 202C GWS(3) or ENGL 202D GWS(3) (Sem: 3-4)
Select 3 credits from: ENGR 350(3)**[1]**, EMCH 407(3)**[1]**, or EMCH 461(3)**[1]** (Sem: 5-6)

SUPPORTING COURSES AND RELATED AREAS: 4 credits
Select 4 credits in General Technical Electives, in consultation with an advisor, from the program approved list.

REQUIREMENTS FOR THE OPTION: 45 credits

APPLIED MATERIALS OPTION: (45 credits)

PRESCRIBED COURSES: 42 credits

CHEM 112 GN(3), CHEM 113 GN(1) (Sem: 1-2)
EMCH 212(3), ENGR 320(3), MATSE 201(3)[1], MATSE 400(3), MATSE 413(3), STAT 200 GQ(4) (Sem: 5-6)
ENGR 421(4), ENGR 450(3), MATSE 402(3), MATSE 411(3), MATSE 417(3), MATSE 430(3) (Sem: 7-8)

ADDITIONAL COURSES: 3 credits
ME 300(3)[1]; EME 301(3)[1] (Sem: 3-4)

ALTERNATIVE ENERGY AND POWER GENERATION OPTION: (45 credits)

PRESCRIBED COURSES: 27 credits
CHEM 112 GN(3), CHEM 113 GN(1) (Sem: 1-2)
EE 210(4)[1] (Sem: 3-4)
EE 314(3), EGEE 302(3), EME 303(3), ME 345(4) (Sem: 5-6)
EE 485(3), EGEE 420(3) (Sem: 7-8)

ADDITIONAL COURSES: 12 credits
ME 300(3)[1]; EME 301(3)[1] (Sem: 3-4)
Select 9 credits from NUCE 401(3); EE 488(3); EGEE 437(3); EGEE 438(3); EGEE 441(3) (Sem: 5-8)

SUPPORTING COURSES AND RELATED AREAS 6 credits
Select 6 credits in Engineering Technical Elective courses, any 400-level courses in the College of Engineering or any 400-level courses with the Energy and Geoenvironmental Engineering (EGEE) abbreviation. Other substitutions outside the approved list must be approved by petition. (Sem: 5-8)

MULTIDISCIPLINARY ENGINEERING DESIGN OPTION (45 credits)

PRESCRIBED COURSES: 35 credits
CMPEN 271(3), EE 210(4), EMCH 212(3)[1] (Sem: 3-4)
EDSGN 402(4), EE 310(4)[1], EE 316(3) (Sem: 5-6)
EDSGN 401(3), EDSGN 403(3), EDSGN 410(4)[1], EDSGN 495(1), ENGR 407(3) (Sem: 7-8)

ADDITIONAL COURSES 7 credits
CHEM 112 GN(3); or any GN(3) (Sem: 1-2)
CHEM 113 GN(1); or any GN(1) (Sem: 1-2)
ME 201(3)[1]; ME 300(3)[1]; EME 301(3)[1] (Sem: 5-6)

SUPPORTING COURSES AND RELATED AREAS 3 credits
Select 3 credits in Engineering Technical Elective courses, in consultation with an advisor, from department list (Sem: 7-8)

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

Last Revised by the Department: Fall Semester 2017

Blue Sheet Item #: 46-01-041

Review Date: 8/22/2017

R & T: Approved 5/24/2013

Engineering Science

University Park, College of Engineering (E SC)

PROFESSOR JUDITH A. TODD, *Department Head; P. B. Breneman Chair and Professor of Engineering Science and Mechanics*

Engineering Science is a multidisciplinary honors program that emphasizes enhanced understanding and integrated application of engineering, scientific, and mathematical principles. The program is unique because it provides a broad foundation in the sciences and associated mathematics that underlie engineering and provides students the opportunity to obtain a depth of knowledge in an area of their choosing through technical electives and a research and design honors thesis. The curriculum is designed for students who seek to link the engineering disciplines with science. In addition to taking core courses in mathematics, physics and chemistry - (and biology for students in premedicine), students study thermodynamics, heat transfer, electromagnetics, solid and fluid mechanics, electrical devices, materials science, and topics selected as foundational and technical electives. During the junior year, students investigate a variety of research fields and identify a topic for their honor thesis research and design project. During the senior year, all students complete a capstone project on their chosen topic by writing a thesis that applies the scientific principles of research, design and analysis to engineering. Focus areas of study include, but are not limited to: electrical, mechanical, civil, biomedical, and materials engineering and are expected to be interdisciplinary. Hence, Engineering Science students achieve both depth and breadth in engineering and science, are able to function across disciplines, and graduate well prepared for advanced studies as well as professional employment.

The specific program objectives are tied to the mission of the program as described above. They target the major outcomes expected of Engineering Science students and are flexible and readily adaptable to meet changing constituent needs.

Program Educational Objectives

The expected accomplishments of Engineering Science graduates in the first several years following graduation are:

1. participate in lifelong learning activities including, but not limited to, masters, doctorate, medical, and law degrees, continuing education, leadership development, management training, and global involvement/awareness;
2. engage in practice in a wide variety of fields including, but not limited to, electrical systems, electronics, mechanical systems, materials development, forensics, biomaterials, medicine, law, and business;
3. research, develop, design and/or utilize new products, processes, materials, devices, systems, and/or tools;
4. communicate findings and best practices at conferences and meetings, and to the general public through presentations, technical publications (journals, reports, memoranda), and patents;
5. use state-of-the-art tools for the benefit of society;
6. participate in and promote the values of diversity and sustainability in society; and
7. encourage and foster future generations of engineers through mentoring, service, and outreach.

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.

Enrollment is limited to students who have demonstrated that they can benefit from the advanced courses of the curriculum; therefore a minimum grade-point average of 3.0 is required. Qualified students can participate in the integrated undergraduate graduate (IUG) program to streamline the process of earning B.S. and M.S. degrees.

ENTRANCE TO MAJOR -- 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.

*Since Engineering Science is an honors program, admission is limited to students who attain a cumulative GPA of at least 3.0 by the end of the entrance to major semester. In the event that the major is under enrollment control, a higher minimum cumulative grade-point average is likely to be needed and students must be enrolled in the College of Engineering or Division of Undergraduate Studies at the time of confirming their major choice.

For the non-Honors B.S. degree in Engineering Science, 131 credits and a 2.50 grade-point average are required. The Honors degree requires the same number of total credits but a minimum of 16 honors Jr./Sr. year credits and a higher grad-point average as determined by the faculty. The baccalaureate program in Engineering Science is accredited by the Engineering Accreditation Commission of ABET, Inc., **www.abet.org**.

Scheduling Recommendation by Semester Standing given like (Sem:1-2)

GENERAL EDUCATION: 45 credits
(27 of these 45 credits are included in the REQUIREMENTS FOR THE MAJOR)
(See description of General Education in this bulletin.)

FIRST-YEAR SEMINAR:
(Included in REQUIREMENTS FOR THE MAJOR)

UNITED STATES CULTURES AND INTERNATIONAL CULTURES:
(Included in GENERAL EDUCATION course selection)

WRITING ACROSS THE CURRICULUM:
(Included in REQUIREMENTS FOR THE MAJOR)

REQUIREMENTS FOR THE MAJOR: 113 credits

(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.)

PRESCRIBED COURSES (65 credits)
CHEM 110 GN(3)**[1]**, CHEM 111 GN(1), EDSGN 100(3), MATH 140 GQ(4)**[1]**, MATH 141 GQ(4)**[1]**, PHYS 211 GN(4)**[1]** (Sem: 1-2)
MATH 220 GQ(2-3), MATH 230(4), MATH 251(4)**[1]**, ME 302(4), PHYS 212 GN(4)**[1]**, PHYS 214 GN(2) (Sem: 3-4)
EE 210(4), ESC 312(3), ESC 407(3)**[1]**, ESC 409(1), ESC 414(3)**[1]**, ESC 433(1) (Sem: 5-6)
ESC 404(3)**[1]**, ESC 410(3), ESC 411(2), ENGL 202C GWS(3) (Sem: 7-8)

ADDITIONAL COURSES (21 credits)
Select 1 credit of First-Year Seminar (Sem: 1-2)
ENGL 015 GWS(3) or ENGL 030 GWS(3) (Sem: 1-2)
ESC 261(3) or CMPSC 201 GQ(3) or CMPSC 202 GQ(3) (Sem: 1-2)
ECON 102 GS(3), ECON 104 GS(3), or ECON 014 GS(3) (Sem: 1-2)
CAS 100A GWS(3) or CAS 100B GWS(3) (Sem: 3-4)
EMCH 210H(5)**[1]** or EMCH 210(5)**[1]**; EMCH 212H(3)**[1]** or EMCH 212(3)**[1]** (Sem: 3-4)

SUPPORTING COURSES AND RELATED AREAS (27 credits)
Select 15 credits from the department Foundational Elective List (Sem:5-6)
Select 12 credits from the department Technical Elective List (Students may apply 3 credits of ROTC or 3 credits of co-op experience.) (Sem: 7-8)

Integrated Undergraduate/Graduate Study - B.S. Engineering Science - M.S. Engineering Science and Mechanics

The flexibility and strength in fundamentals of the Engineering Science curriculum provides an opportunity for Engineering Science undergraduate students to participate in the ESM Integrated Undergraduate/Graduate (IUG) program. Application for IUG status may be made in the fifth or subsequent semesters.

The IUG program promotes the interchange of ideas across all branches of the scientific and engineering disciplines from both theoretical and experimental perspectives. Students in the composite degree program are expected to pursue interdisciplinary studies in areas that encompass nano- and bionanotechnology, advanced materials, electromagnetic, mechanics, microelectronics, nanoelectronics and bioelectronics, neural engineering, photonics and photovoltaics (among others) and they are expected to embrace multidisciplinary perspectives across departmental, College, and University boundaries.

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

Last Revised by the Department: Summer Session 2006 (E SC); Spring Semester 2012 (Integrated B.S./E.Sc.-M.S./E.Mch. & Integrated B.S./E.Sc.-M.S./E.Sc. AND Program Description)

Blue Sheet Item #: 42-04-021 (E SC); 33-04-176, 40-05-034 (Add Integrated B.S./E.Sc.-M.S./E.Mch. & Integrated B.S./E.Sc.-M.S./E. Sc.)

Last Revised by the Department: Fall Semester 2013

Review Date: 01/14/2014

R & T: Approved 5/24/2013

UCA Revision #1: 8/3/06
UCA Revision #2: 7/27/07

EN

Industrial Engineering

University Park, College of Engineering (I E)

PROFESSOR JANIS TERPENNY, *Head, Harold and Inge Marcus Department of Industrial and Manufacturing Engineering*

The undergraduate program in industrial engineering, being the first established in the world, has a long tradition of providing a strong, technical, hands-on education in design, control, and operation of manufacturing processes and systems. The curriculum provides a broad-based education in manufacturing, operations research and ergonomics through a base of mathematics, physical and engineering sciences, and laboratory and industrial experiences. It builds a strong foundation for the development of a professionally competent and versatile industrial engineer, able to function in a traditional manufacturing environment as well as in a much broader economy, including careers in financial services, communication, information technology, transportation, health care, consulting, or academia.

Program Educational Objectives:

We expect our graduates to:

Participate in and lead cross-functionally defined project teams, designing, implementing and improving processes and systems in the manufacturing, service, or government sectors, using state-of-the- art tools and methodologies;

Work effectively in managerial and leadership positions, to establish and execute engineering and business strategies;

Work and communicate effectively with internal and external stakeholders in the global environment, while satisfying engineering, business and financial goals and the end customers; and

Engage in continuous learning through varied work assignments, graduate school, professional training programs and independent study.

Program Outcomes (Student Outcomes):

These are the specific competencies that our students are taught through the curriculum offered by the department. Our students are expected to know and be able to demonstrate these outcomes by the time they graduate. These relate to the skills, knowledge and behaviors that students acquire as they progress through the program. These are related to the ABET Outcomes (a) through (k). They are listed below.

1.1 Analyze and design both the job and the worksite in a cost-effective manner, as well as measure the resulting output.
1.2 Understand and apply cognitive systems engineering: identify visual, auditory, cognitive, perceptual and environmental aspects of human performance; Perform task analysis and evaluate human-computer interfaces.
1.3 Understand information contained in typical specifications and methods of

product verification and conformance to specifications.
1.4 Program flexible manufacturing equipment and system controllers; design logical manufacturing layouts and implement contemporary systems issues.
1.5 Perform work measurement: develop an MTM analysis and carry out a work sampling study.
1.6 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.
1.7 Understand and apply principles of effective human/interface design to address improved human performance, visual displays and software design.

2.1 Ability to apply time value of money and select cost-effective engineering solutions; understand cost-accounting principles.
2.2 Ability to apply probability concepts to solve engineering problems, including reliability issues.
2.3 Ability to apply statistical concepts to solve real life problems, such as hypotheses testing, design of experiments and statistical quality control methods such as process capability and control charts.

2.4 Formulate, solve and analyze the results of linear programming models of real-world applications.
2.5 Formulate, solve and analyze real problems using Markov chains, network models, dynamic programming, queuing theory and inventory models.
2.6 Gain in-depth knowledge of data storage, analysis and visualization related to manufacturing and service domains.
2.7 Ability to create simulation models of manufacturing and service systems and analyze simulation output.
2.8 Ability to apply mathematical models to optimally design and control service systems.

3.1 Present engineering study results in technical reports and orally.
3.2 Demonstrate life-long learning by synthesizing information from several sources.

4.1 Work effectively in groups on case studies and projects.
4.2 Demonstrate knowledge of contemporary issues.
4.3 Understand professional and ethical responsibility.
4.4 Understand the impact of engineering decisions in a global and societal context.

After completing courses required for the core and fundamental competencies in the major, students can choose two technical elective courses from the department list, out of which must be an I E course. In addition, the students must also complete the three-credit capstone design course.

ENTRANCE TO MAJOR -- 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.
*In the event that the major is under enrollment control, a higher minimum cumulative grade-point average is likely to be needed and students must be enrolled in the College of Engineering or Division of Undergraduate Studies at the time of confirming their major choice.

For the B.S. degree in Industrial Engineering, a minimum of 129 credits is required. This baccalaureate program in Industrial Engineering is accredited by the Engineering Accreditation Commission of ABET, Inc., **www.abet.org** .

Scheduling Recommendation by Semester Standing given like (Sem:1-2)

GENERAL EDUCATION: 45 credits
(27 of these 45 credits are included in the REQUIREMENTS FOR THE MAJOR)
(See description of General Education in this bulletin.)

FIRST-YEAR SEMINAR:
(Included in REQUIREMENTS FOR THE MAJOR)

UNITED STATES CULTURES AND INTERNATIONAL CULTURES:
(Included in GENERAL EDUCATION course selection)

WRITING ACROSS THE CURRICULUM:
(Included in REQUIREMENTS FOR THE MAJOR)

REQUIREMENTS FOR THE MAJOR: 111 credits
(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.)

PRESCRIBED COURSES (77 credits)
CHEM 110 GN(3)**[1]**, CHEM 111 GN(1), EDSGN 100(3), MATH 140 GQ(4)**[1]**, MATH 141 GQ(4)**[1]**, PHYS 211 GN(4)**[1]** (Sem: 1-2)
EMCH 210(5)**[1]**, ENGL 202C GWS(3), MATH 220 GQ(2), MATH 231(2), MATH 250(3)**[1]**, PHYS 212 GN(4)**[1]** (Sem: 3-4)
IE 302(3)**[1]**, IE 305(3)**[1],** IE 322(3)**[1]**, IE 323(3)**[1],** IE 327(3)**[1],** IE 330(3)**[1],** IE 405(3)**[1],** MATSE 259(3) (Sem: 5-6)
IE 425(3), IE 453(3), IE 460(3), IE 470(3), IE 480(3) (Sem: 7-8)

ADDITIONAL COURSES (16 credits)
Select 1 credit of First-Year Seminar (Sem: 1-2)
ENGL 15 GWS(3) or ENGL 30 GWS(3) (Sem: 1-2)
CAS 100A GWS(3) or CAS 100B GWS(3) (Sem: 3-4)
CMPSC 201 GQ(3) or CMPSC 202 GQ(3) (Sem: 1-2)
ECON 102 GS(3) or ECON 104 GS(3) (Sem: 1-2)
IE 408(3), IE 418(3), or IE 419(3) (Sem: 7-8) (*The courses not taken to satisfy this requirement can be taken as a track elective. Please see the department list*)

SUPPORTING COURSES AND RELATED AREAS (18 credits)
Select 3 credits as a science selection from department list (Sem: 3-4)
Select 6 credits as non-major electives from department list (Sem: 3-8)
Select 3 credits in manufacturing processes from department list. (Sem: 5-6) (*The course not taken to satisfy this requirement can be taken as a technical elective. Please see the department list)*
Select 6 credits of technical electives from the department list, out of which at least 3 credits must be I E credits.

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

Last Revised by the Department: Spring Semester 2013

Blue Sheet Item #: 41-05-090

Review Date: 02/19/2013

R & T: Approved 5/24/2013

UCA Revision #1: 8/8/06
UCA Revision #2: 7/27/07

EN

Liberal Arts and Earth and Mineral Sciences Concurrent Degree Program

Liberal Arts and Engineering Concurrent Degree Program

These programs require ten semesters of study, concurrently in the College of the Liberal Arts (during which the student completes 70 credits in General Education and Bachelor of Arts requirements and 33 to 37 basic engineering or science requirements), and in either the College of Earth and Mineral Sciences or the College of Engineering (during which the student completes the credits required in the selected major in Earth and Mineral Sciences or Engineering).

Upon completion of the program, the B.A. in General Arts and Sciences will be awarded by the College of the Liberal Arts and the B.S. by the College of Earth and Mineral Sciences or the College of Engineering. The majors available in the College of Earth and Mineral Sciences are Environmental Systems Engineering, Geosciences, Mining Engineering, Polymer Science, Mineral Economics, Petroleum and Natural Gas Engineering, Ceramic Science and Engineering, Metals Science and Engineering, or Meteorology. The majors available in the College of Engineering are Aerospace, Agricultural, Chemical, Civil, Electrical, Environmental, Industrial and Management Systems, Mechanical, or Nuclear Engineering, or Engineering Science**[44]**

To be eligible for this program, a student must file an application for entrance with the associate dean for undergraduate studies, College of the Liberal Arts, not later than the third semester. Entrance to the program requires that the student satisfy all regular requirements of the College of the Liberal Arts and the College of Earth and Mineral Sciences or the College of Engineering. In addition, special requirements may need to be satisfied when enrollment controls are imposed on programs in any of the colleges because of space limitations. Once a student has met all the requirements for entrance to this program, transfer from the College of the Liberal Arts to the College of Earth and Mineral Sciences or the College of Engineering, with enrollment in one of the majors listed, will be approved automatically at the end of the sixth semester if the student continues to make normal progress toward the concurrent degree and has maintained a cumulative average of 2.00 or higher. Students entering majors in the College of Engineering must complete the following courses with a grade of C or higher: CHEM 110 GN(3) and CHEM 111 GN(1), MATH 140 GQ(4), MATH 141 GQ(4), and PHYS 201 GN(4), and meet the required cumulative grade-point average for the requested engineering major.

Students are advised of the absolute necessity for scheduling classes in exact sequence during the first six semesters of Concurrent Degree study. It is imperative that students obtain, from the Liberal Arts Undergraduate Studies Office, 101 Sparks Building, a copy of the Concurrent Degree requirements worksheet that enumerates the specific course requirements for the two programs for semesters one through six.

Scheduling Recommendation by Semester Standing given like (Sem:1-2)

GENERAL EDUCATION: 45 credits
(15 of these 45 credits are included in the REQUIREMENTS FOR THE MAJOR)
(See description for General Education in this bulletin.)

FIRST-YEAR SEMINAR:
(Included in GENERAL EDUCATION course selection or REQUIREMENTS FOR THE MAJOR)

UNITED STATES CULTURES AND INTERNATIONAL CULTURES:
(Included in GENERAL EDUCATION course selection or REQUIREMENTS FOR THE MAJOR)

WRITING ACROSS THE CURRICULUM:
(Included in GENERAL EDUCATION course selection or REQUIREMENTS FOR THE MAJOR)

BACHELOR OF ARTS DEGREE REQUIREMENTS: 24 credits
(3 of these 24 credits are included in the REQUIREMENTS FOR THE MAJOR, GENERAL EDUCATION, or ELECTIVES and 0-12 credits are included in ELECTIVES if foreign language proficiency is demonstrated by examination.)
(See description of Bachelor of Arts Degree Requirements in this bulletin.)

REQUIREMENTS FOR THE MAJOR: 12 credits

EARTH AND MINERAL SCIENCES OR ENGINEERING COMPONENT: 89-91 credits
(This includes 15 credits of General Education courses: 6 credits of GQ courses and 9 credits of GN courses.)

SEMESTERS ONE THROUGH SIX (33-34 credits)**[45]**

PRESCRIBED COURSES (27 credits)
CHEM 111 GN(1), CHEM 113 GN(1), MATH 220 GQ(2-3), MATH 230(4), MATH 250(3) (Sem: 1-4)
EG 10(1), EG 11(1) (Sem: 3-4)
PHYS 201 GN(4), PHYS 202 GN(4) (Sem: 3-6)
EMCH 211(3), EMCH 212(3) (Sem: 5-8)

ADDITIONAL COURSES (6-7 credits)
PHYS 203 GN(3) or PHYS 204 GN(4) (Sem: 3-6)
B.S. requirements**[46]**(3) (Sem: 5-6)

SEMESTERS SEVEN THROUGH TEN (56-57 credits)
Credits required in the selected major in Earth and Mineral Sciences or Engineering (56-57) (Sem: 7-10)

SUPPORTING COURSES AND RELATED AREAS (12 credits)
Select 3 credits from each of the following areas: arts, humanities, science/mathematics, social and behavioral sciences. (Sem: 9-10)

[44] Enrollment in the Engineering Science program is limited to those students attaining an average of B or higher during their first six semesters and to those specially chosen by the College of Engineering faculty on the basis of evidence that they will benefit from the advanced courses.
[45] Concurrent Degree candidates should consult the individual program requirements in the College of Engineering and the College of Earth and Mineral Sciences to ascertain which combinations of CHEM, E G, E MCH, MATH, and PHYS are required.
[46] Concurrent Degree candidates should select a course in this category appropriate for the requirements for their program in either Earth and Mineral Sciences or Engineering.

Last Revised by the Department: Summer Session 1991

Blue Sheet Item #: 16-10-030

Review Date: 5/22/08

UCA Revision #1: 8/8/06

Mechanical Engineering

University Park, College of Engineering (M E)

PROFESSOR KAREN A. THOLE, *Head, Department of Mechanical and Nuclear Engineering*

Mechanical Engineering is one of the broadest engineering disciplines and is central in many new technological developments. Mechanical engineers create things that help improve the health, happiness and safety of our everyday lives such as biomedical devices, aircraft propulsion, and ways to store renewable energies. Mechanical engineering is divided into two broad areas: mechanical systems and thermal systems. Mechanical systems include the design of mechanisms and the analysis of the strength and wear of materials. Thermal systems include methods of energy conversions, heat transfer and fluid flow.

Program Educational Objectives:

The overall educatinal objective of the Mechanical Engineering program is to help prepare our graduates to succeed and provide leadership in a range of career paths. To that end we endeavor to maintain and continuously improve a curriculum that prepares our graduates to: :

1. Apply foundational knowledge, critical thinking, problem solving, and creativity in engineering practice or in other fields.
2. Grow as leaders while maintaining the highest societal responsibility and ethical standards in the global workplace.
3. Develop innovative solutions through effective communication, collaboration, and teamwork.
4. Seek advancement in their knowledge and careers through continuing technical and/or professional studies.

Program Outcomes (Student Outcomes):

The Program outcomes are knowledge, skills, and/or behavior that are derived from the program educational objectives.

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 braod 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.

ENTRANCE TO MAJOR -- 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.

*In the event that the major is under enrollment control, a higher minimum cumulative grade-point average is likely to be needed and students must be enrolled in the College of Engineering or Division of Undergraduate Studies at the time of confirming their major choice.

For the B.S. degree in Mechanical Engineering, a minimum of 131 credits is required. This baccalaureate program in Mechanical Engineering is accredited by the Engineering Accreditation Commission of ABET, Inc., **www.abet.org**.

Scheduling Recommendation by Semester Standing given like (Sem:1-2)

GENERAL EDUCATION: 45 credits
(27 of these 45 credits are included in the REQUIREMENTS FOR THE MAJOR)
(See description of General Education in front of *Bulletin*.)

FIRST-YEAR SEMINAR:
(Included in REQUIREMENTS FOR THE MAJOR)

UNITED STATES CULTURES AND INTERNATIONAL CULTURES:
(Included in GENERAL EDUCATION course selection)

WRITING ACROSS THE CURRICULUM:
(Included in REQUIREMENTS FOR THE MAJOR)

REQUIREMENTS FOR THE MAJOR: 113 credits
(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.)

PRESCRIBED COURSES (83 credits)
CHEM 110 GN(3)**[1]**, EDSGN 100(3), MATH 140 GQ(4)**[1]**, MATH 141 GQ(4)**[1]**, PHYS 211 GN(4)**[1]** (Sem: 1-2)
CMPSC 200 GQ(3), EMCH 211(3)**[1]**, EMCH 212(3)**[1]**, EMCH 213(3)**[1]**, ME 300(3)**[1]**, MATH 220 GQ(2-3), MATH 231(2), MATH 251(4)**[1]**, PHYS 212 GN(4), PHYS 214 GN(2) (Sem: 3-4)
EE 212(3), EMCH 315(2), ENGL 202C GWS(3), ME 320(3)**[1]**, ME 340(3)**[1]**, ME 345(4)**[1]**, ME 360(3)**[1]**, ME 370(3)**[1]**, ME 410(3)**[1]**, MATSE 259(3) (Sem: 5-6)
IE 312(3), ME 450(3)**[1]** (Sem: 7-8)

ADDITIONAL COURSES (18 credits)
Select 1 credit of First-Year Seminar (Sem: 1-2)
CHEM 112 GN(3), or BIOL 141 GN(3) (Sem: 1-2)
ENGL 15 GWS(3) or ENGL 30 GWS(3) (Sem: 1-2)
ECON 102 GS(3), ECON 104 GS(3), ECON 14 GS(3), or ENNEC 100 GS(3) (Sem: 1-2)
CAS 100A GWS(3) or CAS 100B GWS(3) (Sem: 3-4)
ME 440(3); ME 442 WAC(2), ME 443 WAC(1) or ME 441(3) (Sem: 7-8)
Select 2 credits from ME 325(1), ME 315(1), ME 375(1), ME 355(1), or EMCH 316(1) (Sem: 7-8)

SUPPORTING COURSES AND RELATED AREAS (12 credits)

Select 3 credits in a 400-level ME Technical Elective course from department list excluding ME 410(3), ME 440(3), ME 441(3), ME 442(2), ME 443(1), ME 450(3), ME 494(1-9), and ME 496(1-18) (Sem: 5-8)
Select 6 credits in Engineering Technical Elective courses from department list
Select 3 credits in General Technical Elective courses from department list (Sem: 7-8)
(Students who complete Basic ROTC may substitute 6 of the ROTC credits for 3 credits of GTE and 3 credits of GHA.)
Three rotations of Engr Co-op (ENGR 295, ENGR 395, and ENGR 495) can be used as 3 credits of GTE.

Integrated B.S. and M.S. in Mechanical Engineering

A limited number of undergraduate students in the B.S.M.E. program will be considered for admission to the integrated undergraduate/graduate program leading to the B.S.M.E. and the M.S.M.E. degrees. Students with a junior standing in the B.S.M.E. degree program may be admitted to the integrated B.S.M.E./M.S.M.E. program, following a positive review of an application specific to this program by the faculty committee on graduate admissions. Students must have attained a GPA of at least 3.0. Students admitted to the integrated program must maintain a GPA in all classes used toward the M.S.M.E. degree of at least 3.0.

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

Last Revised by the Department: Fall Semester 2017

Blue Sheet Item #: 46-01-042

Review Date: 8/22/2017

R & T: Approved 5/24/2013

UCA Revision #1: 8/9/06
UCA Revision #2: 7/30/07

Comments

EN

Nuclear Engineering

University Park, College of Engineering (NUC E)

PROFESSOR KAREN A. THOLE, *Head, Department of Mechanical and Nuclear Engineering*
PROFESSOR ARTHUR T. MOTTA, *Program Chair, Nuclear Engineering Program*

The overall educational objective of the Nuclear Engineering program is to help prepare our graduates to function effectively in the marketplace in a wide range of career paths in Nuclear Engineering. The technical part of the curriculum, emphasizes nuclear power engineering, which refers to complex systems used to generate electricity. Because of our strong educational and research emphasis in nuclear power engineering, and because a shortage for this expertise exists in the industry, generally the industry values our graduates highly. We recognize that nuclear science, including nuclear security and

non-proliferation, is an important growth area. We constantly assess and review the needs of our undergraduate students and their most frequent employers and use this feedback to consider revisions to our curriculum so that it is responsive to the needs of our constituents.

Program Educational Objectives:

Accordingly, we will endeavor to maintain and provide a curriculum that prepares our graduates such that:

Within two to three years of graduation, we expect the majority of our B.S. graduates to:

be working in industry, especially related to nuclear power engineering,

be working in government agencies or national laboratories,

be pursuing advanced degrees.

We expect that our students will continue to develop professionally and establish themselves in their careers and in this way may take the opportunity to further their education and training by attending graduate school or by pursuing other professional development.

Program Outcomes (Student Outcomes):

The Program outcomes are knowledge, skills, and/or behavior that are derived from the program educational objectives.

a. Students will demonstrate a knowledge of the fundamentals in mathematics, physics, chemistry and the engineering sciences necessary to the nuclear engineering profession.
b. Students will demonstrate an ability to apply the fundamentals to understand, analyze and design nuclear systems; demonstrate knowledge of the contemporary issues affecting the nuclear engineering profession.
c. Students will demonstrate the ability to use appropriate methods and technology for detection and measurement of radiation and for nuclear science.
d. Students will be proficient in the oral and written communication of their work and ideas; show the ability to learn independently using appropriate technology; show ability to work well in teams.
e. Students will demonstrate the ability to operate in a modern, diverse work environment; understand their professional and ethical responsibilities; and be aware of the safety, environmental, and societal consequences of their work in a global contexts

The first two years of the program stress fundamentals in mathematics, chemistry, physics, computer programming, and engineering sciences such as mechanics, materials, and thermodynamics. The last two years provide the breadth and depth in nuclear science, behavior of heat and fluids, reactor theory and engineering, and radiation measurement. The laboratory work includes experiments using the University's 1,000-kilowatt research reactor. Engineering design is incorporated in many courses from the freshman year to the senior year, but is particularly emphasized in the senior capstone design course, which integrates the critical elements of reactor theory, reactor engineering, safety considerations and economic optimization into a reactor design.

Many graduates are employed by electric power companies that use nuclear power plants, or by companies that help service and maintain those plants. They use their knowledge of engineering principles, radioactive decay, interactions of radiation with matter, and

nuclear reactor behavior to help assure that the power plants meet the demand for reliable, economic electricity while ensuring a safe environment. To do this, graduates must be problem solvers who can develop and use complex computer models and sophisticated monitoring systems, design systems to handle radioactive waste, determine if the materials in the plant are becoming brittle or corroded, or manage the fuel in the reactor to get the maximum energy from it. Other graduates work in industries that use radioactivity or radiation to detect problems or monitor processes. Jobs are also found in branches of the government as designers of the next generation of reactors for submarines, aircraft carriers, or space probes, or to manage and clean up contaminated wastes. They could also be involved with regulation of nuclear power or radiation uses, or in research to develop advanced technologies that will be used in next-generation power plants. Graduates who want to further their education in the fields of health physics, radiation biology, or nuclear medical applications find this degree to be a useful preparation.

ENTRANCE TO MAJOR -- 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.

*In the event that the major is under enrollment control, a higher minimum cumulative grade-point average is likely to be needed and students must be enrolled in the College of Engineering or Division of Undergraduate Studies at the time of confirming their major choice.

For the B.S. degree in Nuclear Engineering, a minimum of 129 credits is required. This baccalaureate program in Nuclear Engineering is accredited by the Engineering Accreditation Commission of ABET, Inc., **www.abet.org**.

Scheduling Recommendation by Semester Standing given like (Sem:1-2)

GENERAL EDUCATION: 45 credits
(27 of these 45 credits are included in the REQUIREMENTS FOR THE MAJOR)
(See description of General Education in front of *Bulletin.*)

FIRST-YEAR SEMINAR:
(Included in REQUIREMENTS FOR THE MAJOR)

UNITED STATES CULTURES AND INTERNATIONAL CULTURES:
(Included in GENERAL EDUCATION course selection)

WRITING ACROSS THE CURRICULUM:
(Included in REQUIREMENTS FOR THE MAJOR)

REQUIREMENTS FOR THE MAJOR: 111 credits
(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.)

PRESCRIBED COURSES (89 credits)
CHEM 110 GN(3)**[1]**, CHEM 111 GN(1), EDSGN 100(3), MATH 140 GQ(4)**[1]**, MATH 141 GQ(4)**[1]**, PHYS 211 GN(4)**[1]**, PHYS 212 GN(4)**[1]** (Sem: 1-2)
EMCH 211(3), EMCH 212(3), EMCH 213(3), ME 300(3), MATH 230(4), MATH 251(4)**[1]**, PHYS 214 GN(2) (Sem: 3-4)
EE 212(3), EMCH 315(2), EMCH 316(1), ME 320(3), ME 410(3), NUCE 301(4)**[1]**, NUCE 302(4)**[1]**, NUCE 309(3)**[1]**, NUCE 450(3)**[1]** (Sem: 5-6)
ENGL 202C GWS(3), NUCE 310(2), NUCE 403(3), NUCE 430(3)**[1]**, NUCE 431(4), NUCE

451(3) (Sem: 7-8)

ADDITIONAL COURSES (19 credits)
Select 1 credit of First-Year Seminar (Sem: 1-2)
ECON 102 GS(3), ECON 104 GS(3) or EBF 200 GS(3) (Sem: 1-2)
ENGL 15 GWS(3) or ENGL 30 GWS(3) (Sem: 1-2)
CAS 100A GWS(3) or CAS 100B GWS(3) (Sem: 3-4)
CMPSC 200 GQ(3) or CMPSC 201 GQ(3) (Sem: 3-4)
Select 6 credits, of which 3 credits must be designated as design, from BME 406(3), NUCE 405(3), NUCE 407(3), NUCE 408(3), NUCE 409(3), NUCE 420(3), NUCE 428(3), NUCE 444(3), NUCE 445(3), NUCE 460(3), NUCE 470(3), NUCE 490(3), NUCE 496(1-18), NUCE 497(1-9) or 500-level NUC E courses with approval of adviser (Sem: 7-8)

SUPPORTING COURSES AND RELATED AREAS (3 credits)
(These courses may have to be chosen so that the engineering design or engineering science requirements for the major are met.)
Select 3 credits in General Technical Elective (GTE) courses from department list. (Sem: 7-8)
(Students who complete Basic ROTC may substitute 6 of the ROTC credits for 3 credits of GTE and 3 credits of GHA.)

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

Last Revised by the Department: Fall Semester 2017

Blue Sheet Item #: 46-01-037

Review Date: 8/22/17

R & T: Approved 5/24/2013

UCA Revision #1: 8/9/06
UCA Revision #2: 7/30/07

Comments

EN

Surveying Engineering

University College, Penn State Wilkes-Barre (SUR E)

PROFESSOR FRANK DERBY, *Program Coordinator, Penn State Wilkes-Barre*
PROFESSOR IVAN E. ESPARRAGOZA, *Director of Engineering Technology and Commonwealth Engineering, Penn State Brandywine*
PROFESSOR SVEN BILÉN, *Head, School of Engineering Design, Technology, and Professional Programs, Penn State University Park*

The Surveying Engineering major provides a basic undergraduate education required for private and public service in the profession of surveying. Particular emphasis is placed on fundamental surveying principles required in all areas of surveying. Instruction is provided in the main divisions of surveying, including land surveying, mapping, photogrammetry, data analysis and adjustment, geodesy and map projection coordinate

systems, remote sensing, geographic information systems, and land development. Students study various data collection techniques using surveying tools including total stations, levels, softcopy photogrammetry, satellite imagery, and the global navigation satellite system (GNSS). They also study legal principles related to land surveying, professional ethics, applications for Geographic Information Systems (GIS) in surveying, and data management techniques. Through the use of projects and capstone courses students will design measurement systems, alignments, land information systems, and land development.

Program Educational Objectives:

1. Proficiently use mathematics, science, measurement methods, and modern surveying tools to collect, analyze, and reduce spatial data in professional applications or advanced study in surveying engineering or a related field.
2. Proficiently apply basic principles of land surveying, professional practice, and professional ethics to design and conduct surveys, and to analyze and interpret data in surveying engineering applications.
3. Effectively convey technical and professional information in written, verbal, and graphic forms, as an individual and as a member of a professional team.
4. Demonstrate their recognition of the importance of professional organizations for advancement toward professional licensure, development of leadership skills, and maintaining a broad understanding of contemporary societal issues by participating in activities of professional organizations in capacities ultimately leading to leadership positions.
5. Demonstrate their recognition of the need for continuous, life-long learning by participating in continuing education as students or as instructors.

Program Outcomes (Student Outcomes):

The SUR E program has adopted for its program student outcomes the following outcomes as listed in the general criteria of the EAC of ABET “Criteria for AccreditingEngineering Programs, 2012-2013.” Engineering programs must demonstrate that their students attain:

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 a minimum of 132 credits is required. The baccalaureate program in Surveying Engineering is accredited by the Engineering Accreditation Commission of ABET, Inc., **www.abet.org.**

Scheduling Recommendation by Semester Standing given like (Sem: 1-2)

GENERAL EDUCATION: 45 credits

(27 of these 45 credits are included in the REQUIREMENTS FOR THE MAJOR)
(See description of General Education in this bulletin.)

FIRST-YEAR SEMINAR:
(Included as part of the First-Year Experience as specified by individual campus or college)

UNITED STATES CULTURES AND INTERNATIONAL CULTURES:
(Included in GENERAL EDUCATION course selection)

WRITING ACROSS THE CURRICULUM:
(Included in REQUIREMENTS FOR THE MAJOR)

REQUIREMENTS FOR THE MAJOR: 114 credits
(This includes 27 credits of General Education courses: 9 credits of GWS courses; 6 credits of GQ courses; 9 credits of GN courses; 3 credits of GS courses.)

PRESCRIBED COURSES (93 credits)
EDSGN 100(3), MATH 140 GQ(4)**[1]**, MATH 141 GQ(4)**[1]**, MATH 220 GQ(2-3), PHYS 211 GN(4), SUR 111(4)**[1]**, SUR 162(3)**[1]** (Sem: 1-2)
CMPSC 201 GQ(3), MATH 230(4), MATH 251(4), PHYS 212 GN(4), PHYS 213 GN(2), PHYS 214 GN(2), STAT 401(3), SUR 212(4), SUR 222(3), SUR 241(3)**[1]**, SUR 262(2) (Sem: 3-4)
IE 302(3), SUR 272(3)**[1]**, SUR 341(3), SUR 351(3), SUR 362(3), SUR 372(3)**[1]**, SUR 381(4) (Sem: 5-6)
SUR 441(3), SUR 455(3), SUR 462(3), SUR 471(3), SUR 490(1) (Sem: 7-8)

ADDITIONAL COURSES (15 credits)
CAS 100A GWS(3) or CAS 100B GWS(3) (Sem: 1-2)
ENGL 15 GWS(3) or ENGL 30 GWS(3) (Sem: 1-2)
ECON 102 GS(3), ECON 104 GS(3), or ECON 14 GS(3) (Sem: 3-6)
ENGL 202C GWS(3) or ENGL 202D GWS(3) (Sem: 5-6)
CE 410(3) or SUR 482(3) (Sem: 7-10)

SUPPORTING COURSES AND RELATED AREAS (6 credits)
Select 6 credits from C E 300-level courses **[2]**, CE 400-level courses**[2]**, SUR 313(3), SUR 422(3), SUR 496(1-6) or SUR 497(1-6) (Sem: 7-10)

[1] A student enrolled in this major must receive a grade of C or better, as specified in Senate Policy 82-44.
[2] These courses are not offered at Wilkes-Barre campus. They are provided to accommodate concurrent degree students in CE and SURE.

Last Revised by the Department: Spring Semester 2011

Blue Sheet Item #: 39-06-069

Review Date: 04/12/2011

UCA Revision #1: 8/14/06
UCA Revision #2: 7/30/07

EN

Program objectives updated with editorial changes, per COE: 5/21/12

Associate Degrees

Biomedical Engineering Technology

University College: Penn State New Kensington (2 BET)

PROFESSOR JOIE MARHEFKA, *Program Coordinator, Penn State New Kensington*
PROFESSOR IVAN E. ESPARRAGOZA, *Director of Engineering Technology and Commonwealth Engineering, Penn State Brandywine*
PROFESSOR SVEN BILÉN, *Head, School of Engineering Design, Technology, and Professional Programs, Penn State University Park*

The medical community has grown to depend on medical devices and systems to diagnose, treat and monitor patients in health care. These medical devices have become very complex systems, as they are becoming microprocessor controlled, PC based, and networked to share information. Biomedical Equipment Technicians (BETs) are specialized individuals who are educated and trained on the methods of: physiological measurement; equipment application and operation; safety, performance and preventive maintenance testing; calibration; problem solving; and troubleshooting. In addition, BETs may be involved in equipment and technology management programs, selection and installation of medical equipment, manufacturer and FDA recalls of medical devices, quality improvement programs, and training programs for hospital personnel in the safe and proper use of medical equipment. The classroom and laboratory portions of this major focus on electronically and PC based medical devices for patient monitoring and life-support equipment. The student is exposed to a much broader spectrum of medical equipment through a 400-hour (ten-week) practical internship in an approved health care facility.

Program Educational Objectives

The BET major prepares graduates who, during the first few years of professional practice, will be able to:

1. Apply knowledge of medical devices to install, perform acceptance testing and preventive maintenance (PMs) inspections, troubleshoot, and repair a wide variety of medical devices.
2. Be employed in the healthcare technology management (HTM) profession, and advance their careers by engaging in continuous learning through CBET certification and/or other professional tranining programs and independent study.
3. Identify and apply standards, regulations, and quality improvement plans regarding medical equipment.
4. Work both independently and collaboratively in multi-disciplinary teams, communicating effectively with relevant healthcare related professionals.

Program Outcomes (Student Outcomes)

The BET program outcomes are as follows:

1. Understand use, application, operation, installation, acceptance testing, preventive maintenance, performance assurance and safety inspections (PMs) on select medical devices.
2. Understand and apply a fundamental knowledge of electrical and electronic engineering technology fundamentals, components, circuits and networking fundamentals.
3. Apply basic mathematical and scientific principles to identify, analyze and solve technical problems.
4. Be aware of and understand diversity, professional and ethical responsibilities, applicable standards and regulations regarding medical equipment support.
5. Work with fellow technicians, clinical professionals and other related professionals by

functioning effectively on teams and by independent work.
6. Communicate effectively with fellow technicians, clinical professionals and other related professionals.
7. Recognize and understand the need for continued professional development, including formal and informal study.
8. Recognize, observe and participate when possible in quality improvement programs, timeliness and commitment to continuous improvement that support medical equipment and systems.

Students completing the 2 BET degree need only complete several additional courses to obtain the Associate in Engineering Technology degree in Electrical Engineering Technology. Graduates of the program may qualify for admission to the baccalaureate degree major in Electrical Engineering Technology offered at Penn State Harrisburg, Electrical and Computer Engineering Technology offered at Penn State Erie, and Electro-Mechanical Engineering Technology offered at Penn State Altoona, Berks, New Kensington and York.

ENTRANCE REQUIREMENTS: Students must have a minimum 2.0 GPA to change to this Associate degree after admission to the University.

For the Associate in Engineering Technology degree in Biomedical Engineering Technology, a minimum of 71 credits is required. This program is accredited by the Engineering Technology Accreditation Commission of ABET, **www.abet.org**.

Scheduling Recommendation by Semester Standing given like (Sem: 1-2)

GENERAL EDUCATION: 21 credits
(12 of these 21 credits are included in the REQUIREMENTS FOR THE MAJOR) (See description of General Education in front of *Bulletin*.)

REQUIREMENTS FOR THE MAJOR: 62-63 credits
(This includes 12 credits of General Education courses: 3 credits of GN courses; 3 credits of GQ courses; 6 credits of GWS courses.)

PRESCRIBED COURSES (47 credits)
BE_T 101(1), CHEM 101 GN(3), EET 105(3), CMPET 117(3), CMPET 120(1), ENGL 015 GWS(3), IST 110 GS(3)**[1]**, IST 220(3) (Sem: 1-2)
BE_T 201(5)**[1]**, BE_T 204(5)**[1]**, BE_T 205(4)**[1]**, CAS 100 GWS(3), PHYS 150 GN(3), RADSC 230(3) (Sem: 3-4)
BE_T 203 (4)**[1]****[2]** (Sem: 5)

ADDITIONAL COURSES (15-16 credits)
MATH 022 GQ(3) and MATH 026 GQ(3) or MATH 040 GQ(5) (Sem: 1-2)
BE_T 202(4)**[1]** or BE_T 206(4)**[1]** (Sem: 3-4)
BISC 004 GN(3) or BIOL 141 GN(3) (Sem: 3-4)
Select 3 credits from the following technical courses: BE_T 210(3), BE_T 296(1-18), BE_T 297(1-9), BIOL 129 GN(4), CMPET 211(3), CMPSC 101 GQ(3), EDSGN 100(3), EET 213(5), EET 297(1-3), EGT 201(2) or MCHT 111(3) (Sem: 3-4)

[1] A student enrolled in this major must receive a grade of C or better, as specified in Senate Policy 82-44.
[2] BE T 203(4) Internship must be the last course taken for the degree.

Last Revised by the Department: Summer Semester 2017

Blue Sheet Item #: 45-04-048A

Review Date: 01/10/2017

UCA Revision #1: 8/2/06
UCA Revision #2: 7/26/07

Comments

EN

Electrical Engineering Technology

Penn State Erie, The Behrend College
University College: Penn State Fayette, Penn State York (2 EET)

PROFESSOR DAVID LOKER, *Program Coordinator, Penn State Erie, The Behrend College*
PROFESSOR ANDRZEJ GAPINSKI, *Program Coordinator, Penn State Fayette*
PROFESSOR MICHAEL MARCUS, *Program Coordinator, Penn State York*
PROFESSOR IVAN E. ESPARRAGOZA, *Director of Engineering Technology and Commonwealth Engineering, Penn State Brandywine*
PROFESSOR SVEN BILÉN, *Head, School of Engineering Design, Technology, and Professional Programs, Penn State University Park*

The Electrical Engineering Technology (2 EET) major helps prepare graduates for technical positions in the expanding fields of electronics, computers and microprocessors, instrumentation, and electrical equipment. The primary objective is to provide a broad foundation of theoretical and practical knowledge in the areas of electrical and electronic circuits, digital circuits, computers, electrical machinery, and programmable logic controls.

Program Educational Objectives

To produce graduates who, during the first few years of professional practice, will:

1. Demonstrate broad knowledge of electrical/electronics engineering technology practices to support design, application, installation, manufacturing, operation, and maintenance as required by their employer,
2. Apply basic mathematical and scientific principles for technical problem solving in areas which may include circuit analysis of both analog and digital electronics, microprocessors, programmable logic control, and electrical machines,
3. Utilize computers and software in a technical environment,
4. Demonstrate competence in written and oral communication,
5. Work effectively as an individual and as a member of a multidisciplinary team,
6. Show awareness of social concerns and ethical/professional responsibilities in the workplace, and
7. Matriculate into a baccalaureate degree and/or continue their professional training and adapt to changes in the workplace, through additional formal or informal education.

Program Outcomes (Student Outcomes)

Students should possess

a) an ability to apply the knowledge, techniques, skills and modern tools of the disciplines to electrical engineering technology activities,
b) an ability to apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require limited application of principles but extensive practical knowledge,

c) an ability to conduct standard tests and measurements, and to conduct, analyze and interpret experiments,
d) an ability to function effectively as a member of a technical team,
e) an ability to identify, analyze and solve narrowly defined engineering technology problems,
f) an ability to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature,
g) an understanding of the need for and an ability to engage in self-directed continued professional development, including engineering standards,
h) an understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity,
i) a commitment to quality, timeliness and continuous improvement.

In addition, 2EET graduates must demonstrate knowledge and hands-on competence appropriate to the objectives of the program in:

A. the application of circuit analysis and design, computer programming, associated software, analog and digital electronics, and microcomputers, and engineering standards to the building, testing, operation, and maintenance of electrical/electronic(s) systems; and

B. the application of natural sciences and mathematics at or above the level of algebra and trigonometry to the building, testing, operation, and maintenance of electrical/electronic systems.

Graduates of the Electrical Engineering Technology major may qualify for admission to the baccalaureate degree majors in Electrical Engineering Technology offered at Penn State Harrisburg, Capital College; the baccalaureate degree major in Electrical and Computer Engineering Technology at Penn State Erie, The Behrend College; or the baccalaureate degree major in Electro-Mechanical Engineering Technology offered at Penn State Altoona, Penn State Berks, Penn State New Kensington or Penn State York. Two baccalaureate tracks are available to streamline the transition to these degree programs. Students interested in pursuing the baccalaureate degree major of Electrical Engineering Technology at Penn State Harrisburg should follow track c. A general track is also provided for students who decide not to continue their engineering technology education at the baccalaureate level.

ENTRANCE REQUIREMENTS: Students must have a minimum 2.0 GPA to change to this Associate degree after admission to the University.

For the Associate in Engineering Technology degree in Electrical Engineering Technology, a minimum of 66 credits is required. This program is accredited by the Engineering Technology Accreditation Commission of ABET, **www.abet.org**.

Scheduling Recommendation by Semester Standing given like (Sem: 1-2)

GENERAL EDUCATION: 21 credits
(12-15 of these 21 credits are included in the REQUIREMENTS FOR THE MAJOR)
(See General Education description in front of *Bulletin*.)

REQUIREMENTS FOR THE MAJOR: 57-62 credits
(This includes 12-15 credits of General Education courses: 3 credits of GN courses; 3 credits of GQ courses; 6 credits of GWS courses, 0-3 credits of GH or GS)

PRESCRIBED COURSES (23 credits)
CMPET 117(3)**[1]**, CMPET 120(1)**[1]** (Sem: 1-2)
CAS 100 GWS(3), CMPET 211(3), EE_T 114(4)**[1]**, EE_T 118(1)**[1]**, EET 212(4), EET 214(3),

EET 215(1) (Sem: 3-4)

ADDITIONAL COURSES (34-39 credits)
ENGL 015 GWS(3); ENGL 030 GWS(3) (Sem: 1-2)
MATH 022 GQ(3)[2] and MATH 026 GQ(3)[2]; or MATH 040 GQ(5)[2]; or MATH 081 GQ(3)[2] and MATH 082 GQ(3)[2] (Sem: 1-2)
PHYS 150 GN(3); PHYS 211 GN(4); PHYS 250 GN(4) (Sem:3-4)

Select at least 22-26 credits from one of the following three tracks: a. General Track, b. Baccalaureate Electrical and Computer Engineering Technology (ECET) Track or c. Baccalaureate Electro-Mechanical Engineering Technology (EMET) Track.

a**.** General Track:
(This includes 3 credits of General Education courses: 3 credits of GH or GS)
EDSGN 100(3); EET 105(3), IET 101(3), MCHT 111(3) (Sem: 1-2)
EET 275(3); EMET 230(3) (Sem: 3-4)
PHYS 151 GN(3); PHYS 212 GN(4); PHYS 251 GN(4); CHEM 110 GN(3), CHEM 111 GN(1) (Sem: 3-4)
STS 200 GS(3); STS 233/PHIL 233 GH(3); STS 245 GS;IL(3) (Sem: 3-4)
Select 3-4 credits in consultation with your adviser from the approved program list. (Sem: 3-4)

b. Baccalaureate Electrical and Computer Engineering Technology (ECET) Track:
CMPET 005(1), EET 002(1), EET 101(3), EET 109(1) (Sem: 1-2)
CHEM 110 GN(3), CHEM 111 GN(1), EET 275(3), EGT 119(2) (Sem: 3-4)
MATH 083 GQ(4) or MATH 140 GQ(4) (Sem: 3-4)
Select 3 credits of General Education natural science GN or MATH 210 GQ(3) (Sem: 3-4)

c. Baccalaureate Electro-Mechanical Engineering Technology (EMET) Track [3]:
((This includes 3 credits of General Education courses: 3 credits of GH or GS)
EDSGN 100(3); EET 105(3), IET 101(3), MCHT 111(3) (Sem: 1-2)
EET 275(3); EMET 230(3) (Sem: 3-4)
MATH 083 GQ(4) or MATH 140 GQ(4) (Sem: 3-4)
PHYS 151 GN(3); PHYS 212 GN(4); PHYS 251 GN(4); CHEM 110 GN(3), CHEM 111 GN(1) (Sem: 3-4)
STS 200 GS(3); STS 233/PHIL 233 GH(3); STS 245 GS;IL(3) (Sem: 3-4)

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

[2] A student planning to re-enoll into the baccalaureate degree major of Electro-Mechanical Engineering Technology (EMET), after graduation from the 2 EET program, must receive a grade of C or better in order to meet requirements of the EMET degree.

[3] A student planning to re-enroll into the baccalaureate degree major of Electrical Engineering Technology at Penn State Harrisburg, after graduation from the 2 EET program, should follow Track c. They should select MATH 140 GQ(4) instead of MATH 083 GQ(4).

Last Revised by the Department: Spring Semester 2017

Blue Sheet Item #: 45-04-048B

Review Date: 1/10/2017

UCA Revision #1: 8/3/06
UCA Revision #2: 7/27/07

Comments

EN

Mechanical Engineering Technology

Penn State Erie, The Behrend College
University College: Penn State DuBois, Penn State York (2 MET)

PROFESSOR SVEN BILÉN, *Head, School of Engineering Design, Technology, and Professional Programs, Penn State University Park*
PROFESSOR IVAN ESPARRAGOZA, *Director of Engineering Technology and Commonwealth Engineering, Penn State University Park*
PROFESSOR FREDRICK NITTERRIGHT, *Program Coordinator, Penn State Erie, The Behrend College*
PROFESSOR DOUGLAS MILLER, *Program Coordinator, Penn State DuBois*
PROFESSOR MARSHALL COYLE, *Program Coordinator, Penn State York*

This major helps graduates prepare for technical positions in manufacturing, machine and tool design, computer drafting and design, computer integrated manufacturing, materials selection and processes, technical sales, and other related industries in mechanical applications. The primary objective of the program is to provide a broad foundation in mechanical systems and applications; computer systems in drafting (CAD), manufacturing (CAM), and automation and robotics (CIM); production and product design; mechanics, dynamics, and strength of materials. Graduates of the Associate Degree in Mechanical Engineering Technology program will:

Practice in the areas of applied design, manufacturing, testing, evaluation, technical sales, or 2D and 3D modeling.

Communicate effectively and work collaboratively in multi-disciplinary teams.

Learn and adapt to changes in a professional work environment.

Demonstrate a high standard of professional ethics and be cognizant of social concerns as they relate to the practice of engineering technology.

Graduates of this major may qualify for admission to the baccalaureate degree majors in Mechanical Engineering Technology and Structural Design and Construction Engineering Technology programs at Penn State Harrisburg; the Mechanical Engineering Technology and the Plastics Engineering Technology programs at Penn State Erie, The Behrend College; or the baccalaureate degree major in Electro-Mechanical Engineering Technology offered at Penn State Altoona, Penn State Berks, Penn State New Kensington, or Penn State York. Two tracks are available to streamline the transition to these baccalaureate degree programs. A general track is provided for students who do not plan to continue their engineering technology education at the baccalaureate level.

ENTRANCE REQUIREMENTS: Students must have a minimum 2.0 GPA to change to this Associate degree after admission to the University.

For the Associate in Engineering Technology degree in Mechanical Engineering Technology, a minimum of 65 credits is required. This program is accredited by the

Engineering Technology Accreditation Commission of ABET, **www.abet.org**.

Scheduling Recommendation by Semester Standing given like (Sem: 1-2)

GENERAL EDUCATION: 21 credits
(12-15 of these 21 credits are included in the REQUIREMENTS FOR THE MAJOR)
(See description of General Education in front of *Bulletin*.)

REQUIREMENTS FOR THE MAJOR: 54-64 credits
(This includes 12-15 credits of General Education courses: 3 credits of GN courses; 3 credits of GQ courses; 6 credits of GWS courses, 0-3 credits of GH or GS.) A First-Year Seminar is required for students at Penn State Behrend.

PRESCRIBED COURSES (23 credits)
CAS 100 GWS(3), IET 101(3)**[1]**, MCHT 111(3)**[1]** (Sem: 1-2)
IET 215(2), IET 216(2), MCHT 213(3), MCHT 214(1)[2], MET 206(3)**[1]**, MET 210(3), (Sem: 3-4)

ADDITIONAL COURSES (31-41 credits)
ENGL 015 GWS(3); ENGL 030 GWS(3) (Sem: 1-2)
MATH 022 GQ(3), MATH 026 GQ(3); MATH 040 GQ(5)[2][3]; MATH 081 GQ(3)**[2][3]**, MATH 082 GQ(3)**[2][3]**(Sem: 1-2)
PHYS 150 GN(3); PHYS 211 GN(4); PHYS 250 GN(4) (Sem: 1-2)
PHYS 151 GN(3); PHYS 212 GN(4); PHYS 251 GN(4) (Sem: 1-2)

Select at least 19-24 credits from one of the following three tracks: a. General Track, b. Baccalaureate Electro-Mechanical Engineering Technology (EMET) Track, or c. Baccalaureate Mechanical Engineering Technology (METBD or M E T) Track.

a) General Track
EDSGN 100(3), EET 105(3), MET 107(3) (Sem: 1-2)
EDSGN 110(2); EGT 114(2) (Sem: 1-2)
STS 200 GS(3); STS 233 GH(3); STS 245 GS;IL(3) (Sem: 3-4)
Select at least 6 credits from the approved supporting course list for Track a.

b) Baccalaureate Electro-Mechanical Engineering Technology (EMET) Track
CMPET 117(3)[2], CMPET 120(1)[2], EDSGN 100(3), EET 105(3) (Sem: 1-2)
EDSGN 110(2); EGT 114(2) (Sem: 1-2)
EET 114(4)[2], EET 118(1)[2] (Sem: 3-4)
MATH 083 GQ(4)[2][3] or MATH 140 GQ(4)[2][3] (Sem: 3-4)
STS 200 GS(3); STS 233/PHIL 233 GH(3); STS 245 GS;IL(3) (Sem: 3-4)

c) Baccalaureate Mechanical Engineering Technology (METBD or M E T) Track
EGT 120(3), EGT 121(3), MET 107(3) (Sem: 1-2)
EET 100(3) (Sem: 3-4)
Select 1 credit of First-Year Seminar (Sem: 1-2)
Select 6 credits from the approved supporting course list for Track c (Sem: 3-4)

[1] A student enrolled in this major must receive a grade of C or better, as specified in Senate Policy 82-44.
[2] Students pursuing the baccalaureate track must take MATH 022 and MATH 026
[3] Students who choose to take MATH 081 and MATH 082 must select MATH 083. Students who choose to take MATH 022 and MATH 026 must select MATH 140.

Last Revised by the Department: Spring Semester 2017

Blue Sheet Item #: 45-04-048C

Review Date: 1/10/2017

UCA Revision #1: 8/3/06
UCA Revision #2: 7/30/07

Comments

EN

Surveying Engineering Technology

University College: Penn State Wilkes-Barre (2 SRT)

PROFESSOR FRANK DERBY, Program Coordinator, Penn State Wilkes-Barre
PROFESSOR IVAN E. ESPARRAGOZA, *Director of Engineering Technology and Commonwealth Engineering, Penn State Brandywine*
PROFESSOR SVEN BILÉN, *Head, School of Engineering Design, Technology, and Professional Programs, Penn State University Park*

The Surveying Engineering Technology major provides the basic undergraduate education required for private and public service as a technician in the surveying profession. Basic knowledge is provided in the areas of boundary, construction, topographic, and photogrammetric surveying. The curriculum is designed to develop an individual understanding of the skills and equipment needed to make precise surveying measurements.

Program Educational Objectives

Specific educational objectives of the program are to prepare graduates who, after the first few years of their surveying careers:

1. Proficiently apply basic principles and methods of surveying practice to perform surveys and analyze results
2. Effectively convey technical and professional information in written, verbal, and graphic forms, as individuals and as members of a professional team
3. Demonstrate their recognition of the importance of professional organizations for their development as surveying technologists
4. Demonstrate their recognition of the need for continuous, life-long learning

Program Outcomes (Students Outcomes)

The SRT program has adopted for its program student outcomes the following outcomes as listed in the general criteria of the TAC of ABET “Criteria for Accrediting Engineering Technology Programs, 2012-2013.” Each program must demonstrate that graduates have:

a) an ability to apply the knowledge, techniques, skills, and modern tools of the discipline to narrowly defined engineering technology activities;
b) an ability to apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require limited application of principles but extensive practical knowledge;
c) an ability to conduct standard tests and measurements, and to conduct, analyze, and interpret experiments;
d) an ability to function effectively as a member of a technical team;

e) an ability to identify, analyze, and solve narrowly defined engineering technology problems;
f) an ability to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature;
g) an understanding of the need for and an ability to engage in self-directed continuing professional development;
h) an understanding of and a commitment to address professional and ethical responsibilities, including a respect for diversity; and
i) a commitment to quality, timeliness, and continuous improvement.

Also adopted are the following TAC of ABET's Program Criteria for Surveying/Geomatics Engineering Technology Programs, 2012-2013. Associate degree programs must demonstrate that graduates are capable of:

a) Utilizing modern measurement technologies to acquire spatial data;
b) Employing industry-standard software to solve technical problems.

Graduates of the Surveying Engineering Technology major may qualify for admission to the baccalaureate degree majors in Surveying Engineering at Penn State Wilkes-Barre or Structural Design and Construction Engineering Technology at Penn State Harrisburg.

ENTRANCE REQUIREMENTS: Students must have a minimum 2.0 GPA to change to this Associate degree after admission to the University.

For the Associate in Engineering Technology degree in Surveying Engineering Technology, a minimum of 67 to 70 credits is required. This program is accredited by the Engineering Technology Accreditation Commission of ABET, **www.abet.org**.

Scheduling Recommendation by Semester Standing given like (Sem: 1-2)

GENERAL EDUCATION: 21 credits
(12 of these 21 credits are included in the REQUIREMENTS FOR THE MAJOR)
(See description of General Education in this bulletin.)

REQUIREMENTS FOR THE MAJOR: 58-61credits
(This includes 12 credits of General Education courses: 3 credits of GN courses; 3 credits of GQ courses; 6 credits of GWS courses.)

PRESCRIBED COURSES (31 credits)
SUR 111(4)**[1]**, SUR 162(3)**[1]** (Sem: 1-2)
SUR 212(4), SUR 222(3), SUR 241(3), SUR 262(2), SUR 272(3)**[1]**, SUR 313(3), SUR 362(3), SUR 372(3) (Sem: 3-4)

ADDITIONAL COURSES (27-30 credits)
CAS 100A GWS(3) or CAS 100B GWS(3) (Sem: 1-2)
EDSGN 100(3); or EGT 101(1), EGT 102(1) and ET 002(1) (Sem: 1-2)
ENGL 015 GWS(3) or ENGL 030 GWS(3) (Sem: 1-2)
ENGL 202C GWS(3) or ENGL 202D GWS(3) (Sem: 3-4)
MATH 022 GQ(3) and MATH 026 GQ(3); or MATH 040 GQ(5) (Sem: 1-2)
MATH 110 GQ(4) or MATH 140 GQ(4) (Sem: 3-4)
PHYS 150 GN(3) or PHYS 211 GN(4) or PHYS 250 GN(4) (Sem: 1-2)
PHYS 151(3) or PHYS 212 GN(4) or PHYS 251 GN(4) (Sem: 3-4)

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

Last Revised by the Department: Spring Semester 2017

Blue Sheet Item #: 45-04-048D

Review Date: 1/10/2017

UCA Revision #2: 7/30/07

EN

Minors

Biological Engineering Minor

University Park, College of Agricultural Sciences
University Park, College of Engineering (B E)

This minor provides students with an opportunity to apply engineering principles to agricultural and biological production and processing systems and to the management of our natural resources. Courses may be selected by students to gain a better understanding of soil conservation and water quality, food and biological process engineering, structures and their environments, power and machinery, or microbiological engineering.

A grade of C or better is required for all courses in the minor.

Scheduling Recommendation by Semester Standing given like (Sem: 1-2)

REQUIREMENTS FOR THE MINOR: 18-19 credits

PRESCRIBED COURSES (3 credits)
BE 300(3) (Sem: 5-6)

ADDITIONAL COURSES (15-16 credits)
Select 6 credits from BE 301(3), BE 302(4), BE 303(3), BE 304(3), BE 305(3), BE 306(3), BE 307(3), BE 308(3) (Sem: 5-8)
Select 9-10 credits from one of the following areas; one course marked with * must be selected (Sem: 5-8)
(a) Power and Machinery Systems: ASM 420(3), ASM 424(3), BE 461(3)*, ME 431(3), ME 480(3)
(b) Biological Systems: BE 468(3)*, CHE 340(3), CHE 438(3), CHE 449(3), ESC 484(3)
(c) Natural Resource Systems: ASM 309(3), BE 467(3)*, BE 477(3), BE 487(3), CE 370(3), CE 371(3), CE 461(3)
(d) Food Process Systems: BE 465(3)*, BE 468(3), CHE 410(3), FDSC 430(3), IE 312(3)
(e) Structural Systems: AE 308(4), BE 462(3)*, CE 340(3), CE 341(3), CE 342(3)

Last Revised by the Department: Fall Semester 2012

Blue Sheet Item #: 41-03-046

Review Date: 11/13/2012

UCA Revision #2: 7/26/07

EN

Biomedical Engineering Minor

University Park, College of Engineering (BME)

This interdisciplinary minor is designed for students interested in the application of engineering principles to medical and biological problems. The minor is particularly suitable for students pursuing an undergraduate degree in a different engineering major, physics, or other applied science who are seeking careers in health-related professions. PHYS 211 GN(4), PHYS 212 GN(4), and calculus through differential equations (MATH 250 or 251) are required for entrance to the minor. Additional prerequisites for prescribed and supporting courses may be required and should be researched prior to applying for the minor (e.g. CHEM 112 GN(3) and CMPSC 200 GQ(3)). Students interested in pursuing this minor should contact the Department of Biomedical Engineering with any questions or for more information.

A grade of C or better is required for all courses in the minor.

Scheduling Recommendation by Semester Standing given like (Sem: 1-2)

REQUIREMENTS FOR THE MINOR: 18-20 credits

ADDITIONAL COURSES (6-8 credits)
Select 3-4 credits of physiology from BIOL 141 GN(3), BIOL 240W GN(4) or BIOL 472(3) (Sem: 3-6)
Select 3-4 credits of molecular/cell biology from BMB 251(3), BME 201(3), or BIOL 230W GN(4) (Sem: 4-8)

SUPPORTING COURSES AND RELATED AREAS (12 credits)
Select 9-12 credits of Biomedical Engineering (BME) coursework from 3-credit courses at the 400, or 500 level 300-level courses will be considered by petition and only 3 credits of research or independent study credit (BME 494H or 496) may be used. (Sem: 5-8)
Select 0-3 credits of electives from Biomedical Engineering-related courses (department list) (Sem: 5-8)

Last Revised by the Department: Fall Semester 2013

Blue Sheet Item #: 42-03-039

Review Date: 11/19/2013

UCA Revision #1: 8/2/06

EN

Engineering Leadership Development Minor

University Park, College of Engineering (E L D)

This interdisciplinary minor is designed to provide engineering students with critical principles and skills. Engineering graduates must demonstrate the ability to assume leadership roles in a competitive technologically complex global society. There are increasing demands for engineers to be able to deal effectively with other people, including the ability to work in teams and to interact with customers and other organizations on both national and international levels. Students will employ engineering case studies in active and collaborative classroom settings to develop these skills. The minor consists of 18 semester hours. A grade of C or better is required in all minor

courses. Students in all engineering majors are eligible. For admission to the minor, students must have completed ENGR 408(2). Students should apply during their sophomore year.

Scheduling Recommendation by Semester Standing given like (Sem: 1-2)

REQUIREMENTS FOR THE MINOR: 18 credits

PRESCRIBED COURSES (9 credits)
ENGR 409(3) (Sem: 5-6)
ENGR 408(2) (Sem: 5-8)
ENGR 493(1), S T S 460(3) (Sem: 7-8)

ADDITIONAL COURSE (3 credits)
BA 250(3) or ENGR 407(3) (Sem: 5-6)

SUPPORTING COURSES AND RELATED AREAS (6 credits)
Select 6 credits in consultation with the coordinator of the Engineering Leadership Development Minor (Sem: 5-8)

Last Revised by the Department: Spring Semester 2002

Blue Sheet Item #: 30-03-100C

Review Date: 11/20/01

EN

Engineering Mechanics Minor

University Park, College of Engineering (E MCH)

The Engineering Mechanics minor helps students prepare to analyze and/or design simple structures that are efficient and safe under foreseen loading conditions.

Contemporary engineering design of mechanical components requires precise information and modern analysis techniques to determine material response to anticipated loading. Designers must have the analytical and experimental tools to accurately define deformation under load to characterize dynamic response and to prevent mechanical failure. In the event of failure the cause(s) must be ascertained to prevent future failure through redesign and/or material substitution. Thus, industry has a real need for those with a sound foundation in Engineering Mechanics, the engineering science that deals with the effects of forces and torques on rigid and deformable bodies. Engineering Mechanics consists of Statics (bodies in equilibrium), Dynamics (bodies in unsteady motion such as vibration, moving on curvilinear paths) and the Mechanics of Deformable Media. The latter topic covers the change in dimensions of bodies of various shapes under the influence of forces, torques, temperature, and dynamic motion. Further failure criteria under such loadings are introduced and utilized in examples of engineering design. Some twenty undergraduate courses covering the above topics are available at two levels, i.e. sophomore introductory and senior (400) courses.

A grade of C or better is required for all courses in the minor.

Scheduling Recommendation by Semester Standing given like (Sem: 1-2)

REQUIREMENTS FOR THE MINOR: 18 credits

SUPPORTING COURSES AND RELATED AREAS: (18 credits)
Select 12 credits of EMCH courses, which may include: EMCH 211(3), EMCH 212(3), EMCH 213(3), EMCH 315(2), EMCH 316(1) (Sem: 1-4)
Select 6 credits from 400-level EMCH courses (Sem: 5-8)

Last Revised by the Department: Fall Semester 2001

Review Date: 8/29/02

EN

Environmental Engineering Minor

University Park, College of Engineering (ENV E)

This minor is designed to provide students in engineering, science, and other majors with a comprehensive study of environmental issues and the skills necessary to solve problems associated with environmental pollution.

For entrance into the minor, students must be at least fifth-semester standing and have completed CHEM 110 GN(3), MATH 141 GQ(4), and PHYS 211 GN(4).

The minor consists of 18 credits, at least 6 of which must be at the 400 level. A grade of C or better is required for all courses in the minor.

An online application is available at: http://www.engr.psu.edu/CE/env_minor.html.

Scheduling Recommendation by Semester Standing given like (Sem: 1-2)

REQUIREMENTS FOR THE MINOR: 18 credits (2 credits of engineering design are included)

PRESCRIBED COURSE (3 credits)
CE 370(3) (Sem: 3-6)

ADDITIONAL COURSES (15 credits)
Select 3 credits from Chemistry and Biological Sciences: BE 308, CE 479(3), CHEM 202(3), CHEM 210(3) (Sem: 3-8)
Select 0-3 credits from Process Engineering: BE 302(4), CHE 210(3), EGEE 302(3), MNPR 301(3), NUCE 430(3) (Sem: 5-8)
Select 3 credits from Applied Fluid Mechancs: AERSP 308(3), BE 467(4), CE 371(3), CE 462(3), CHE 330(3), EME 303(3), ME 320(3), METEO 454(3), or NUCE 431(4) (Sem: 5-8)
Select 6-9 credits from Environmental Sciences and Design: BE 468(3), BE 477(3), CE 472(3), CE 475(4), CE 476(3), CHEM 402(3), ERM 411(3), ERM 412(3), ERM 413(3), ERM 447(3), ERM 450(3), EGEE/ME 430(3), EGEE 470(3), ENVSE 408(3), ENVSE 427(3), FSC 431(3), GEOSC 452(3), ME 405(3), ME 433(3), NUCE 405(3), NUCE 420(3), NUCE 428(3), SOILS 420(3) (Sem: 5-8)

Last Revised by the Department: Spring Semester 2011

Blue Sheet Item #: 39-06-067A

Review Date: 04/12/2011

UCA Revision #1: 8/4/06
UCA Revision #2: 7/27/07

EN

Information Sciences and Technology for Aerospace Engineering Minor

University Park, College of Engineering (ISASP)

The role of Information Sciences and Technology in the practice of Aerospace Engineering is very important. Aerospace systems rely heavily on computers, software, and digital information; for control, sensors, and other onboard systems. The Boeing 777 has more than 1000 processors and roughly 20 million lines of software onboard, and F-16 and F-117As cannot fly without their onboard computers. In addition, many future aerospace vehicles will be unmanned, and the software challenges will be even greater. The onboard memory has also increased exponentially, the F-106 had 20 KBytes of memory and the new Joint Strike Fighter might have 2 GBytes of memory. The hardware and software must be carefully designed and thoroughly tested, since most aerospace systems are mission- or safety-critical systems. Computers and software are heavily used in the design, development, and manufacturing of aerospace systems. Large supercomputers are often used in the design process. The IST minor will enrich their educational achievements and increase their chances in obtaining employment or entering graduate school. The NSF and the DOD are encouraging universities to enhance their educational programs so that we have well-qualified engineers for future systems, and our IPAC members have stressed the importance of IT for our students.

Student must apply for entrance to the minor no later than their 7th semester.

A grade of C or better is required for all courses in the minor.

Scheduling Recommendation by Semester Standing given like (Sem: 1-2)

REQUIREMENTS FOR THE MINOR: 18 credits

PRESCRIBED COURSES (13 credits)
CMPSC 201(3), IST 110 GS(3) (Sem: 1-4)
IST 210(3), IST 220(3) (Sem: 5-6)

ADDITIONAL COURSES (6 credits)
Select 6 credits from: AERSP 423(3), AERSP 424(3), AERSP 440(3), or AERSP 460(3) (Sem: 5-8)

Last Revised by the Department: Spring 2015

Blue Sheet Item #:43-06-080

Review Date: 4/14/2015

UCA Revision #2: 7/26/07

Comments

EN

Information Sciences and Technology for Industrial Engineering Minor

University Park, College of Engineering (ISTIE)

Collection and processing of information have increased in all sectors for solving engineering problems, including manufacturing and service related problems. Efficient and timely analysis of data is critical for the survival of companies. There is a need for industrial engineers with a strong background in information technology and systems. The minor in Information Sciences and Technology for Industrial Engineering will augment the skills of students in the Department of Industrial and Manufacturing Engineering in the information systems area. All students pursuing a baccalaureate degree in Industrial Engineering are eligible for this minor.

A grade of C or better is required for all courses in the minor.

Scheduling Recommendation by Semester Standing given like (Sem: 1-2)

REQUIREMENTS FOR THE MINOR: 21 credits

PRESCRIBED COURSES (12 credits)
IST 110 GS(3) (Sem: 1-4)
IE 330(3), IST 210(3), IST 220(3) (Sem: 5-6)

ADDITIONAL COURSES: (9 credits)
Select 6-9 credits from IE 418(3), IE 462(3) and IE 433(3) (Sem: 7-8)
Select 0-3 credits from MATH 451(3), MATH 455(3), MATH 456(3), IST 441(3) (Sem: 7-8)

Last Revised by the Department: Spring Semester 2015

Blue Sheet Item #: 43-06-000

Review Date: 04/14/2015

EN/IS

International Engineering Minor

College of Engineering (IENGR)

The International Engineering Minor is paired with any engineering baccalaureate major at any campus in order to provide students with an opportunity to learn about, and understand their profession in a global context. It is designed to provide students with knowledge, language skills, and experiences to help prepare them for a professional career that is likely to include collaborations with professionals from various parts of the world. The minor will help students understand the cross-cultural communications challenges and the global arena in which their profession is practiced. Students completing this minor will gain a competitive advantage because they will be able to demonstrate a broader understanding of the role of their profession and will have demonstrated their ability to communicate across cultural lines.

A grade of C or better is required for all courses in the minor.

Scheduling Recommendation by Semester Standing given like (Sem: 1-2)

REQUIREMENTS FOR THE MINOR: 18 credits

PRESCRIBED COURSES (3 credits)
ECON 333 GS(3) (Sem: 2-8)

SUPPORTING COURSES AND RELATED AREAS (15 credits)
Demonstrate language skills in a currently spoken world language other than English. Students must take a minimum of 6 credits in the same language, at a level determined by the Language Placement Policy, and achieve a minimum of 12th-credit proficiency in that language. Transfer credits for language courses taken prior to enrollment at Penn State may not be used. (Sem: 1-6)

Select 3 credits of Engineering/computer science courses with significant international content from a program list or as approved by the director of the program. (Sem: 2-8)

Select 6 credits of 400-level engineering or computer science courses, in consultation with departmental undergraduate coordinator, to be taken abroad at an international institution and taught by faculty at that institution. (Sem: 5-8)

Last Revised by the Department: Spring Semester 2014

Blue Sheet Item #: 42-05-045

Review Date: 02/25/2014

Nanotechnology Minor

University Park, College of Engineering (NANO)

The Nanotechnology minor is designed to help prepare students from diverse disciplines for careers in a broad range of industries innovating with nanotechnology. The minor builds on the singular strengths of Penn State's nanofabrication facilities including its class 1 and class 10 clean rooms, its faculty, and existing academic programs. The minor provides students with fundamental knowledge and skills in simulation, design, modeling, syntheses, characterization, properties, processing, manufacturing, and applications at the nano scale.

As nanotechnology increasingly bridges across disciplines, a basic understanding of mathematics, physics, biology, and chemistry is recommended. To complete the 18 credit nanotechnology minor, students will take two prescribed courses (6 credits) in nanoscience fundamentals, and then select four additional courses (12 credits) from a growing list of courses that address the areas described in the previous paragraph. A grade of C or better is required for all courses in the minor.

In addition to nanotechnology career opportunities in microelectronics, information storage, optoelectronics, bioelectronics, pharmaceuticals, agriculture, medicine, life sciences and the sciences, the minor prepares undergraduate students to support major new nanotechnology research programs as graduate students. Interested 3rd and 4th year students from related fields in engineering, the chemical, physical, and the biological sciences, medicine, life, and agricultural sciences are encouraged to enroll.

Scheduling Recommendation by Semester Standing given like (Sem: 1-2)

REQUIREMENTS FOR THE MINOR: 18 credits

PRESCRIBED COURSES: (6 credits)
ESC 312(3), ESC 313(3) (Sem: 5-6)

SUPPORTING COURSES AND RELATED AREAS: (12 credits)
Select 12 credits from an approved list, at least 6 credits must be at the 400 level. (Sem: 5-8)

Last Revised by the Department: Summer Session 2006

Blue Sheet Item #: 34-04-029

Review Date: 1/17/06

EN

Product Realization Minor

University Park, College of Engineering (PRODR)

This 21-credit interdisciplinary minor is designed for any engineering student who is interested in state-of-the-art practice in integrated product/process design and manufacturing. The program culminates with a one-semester project involving the design and manufacture of a new product.

The purpose of the minor is to offer students state-of-the-art practice in integrated product/process design and manufacturing. Students completing the minor should:

understand the interaction of design and manufacturing through practical examples;

be familiar with the entrepreneurial skills needed to transfer a new product from initial idea to market;

understand the technical and management aspects of concurrent engineering and total quality management; and

have hands-on experience in designing and manufacturing a product, organizing and managing the effort, and interacting with the customer.

A grade of C or better is required for all courses in the minor.

Scheduling Recommendation by Semester Standing given like (Sem: 1-2)

REQUIREMENTS FOR THE MINOR: 21 credits

PRESCRIBED COURSES (9 credits)
ME 240(3) (Sem: 1-4)
ENGR 407(3) (Sem: 5-6)
IE 466(3) (Sem: 5-8)

ADDITIONAL COURSES (12 credits)
Select 9 credits in Product Design, Quality Engineering, and Manufacturing Processes courses approved by the professor in charge of the minor (Dr. Simpson). Example courses include: EE 310, EE 441, IE 305, IE 306, IE 310, IE 311, IE 312, IE 424, IE 428, IE 464, ME 340, ME 445 (Sem: 5-8)
Select a 3-credit senior project: team-based design or industrial projects course, as approved by the coordinator (Sem: 7-8)

Last Revised by the Department: Summer Session 2007

Blue Sheet Item #: 35-01-138

Review Date: 8/29/06

UCA Revision #2: 7/30/07

EN

Residential Construction Minor

University Park, College of Engineering (RCNEN)

The objective of the Residential Construction Minor is to provide an opportunity for students to gain an understanding of the residential building construction topics and issues with emphasis on sustainable land development, design and construction of residential buildings, as well as construction management of residential projects. Residential building construction is a unique interdisciplinary field that draws upon civil and architectural engineering, architecture, real estate, management, finance, and marketing disciplines, and design principles including economical, safe, and serviceable structural design, green building systems design, sustainable land development, and construction management. This minor is expected to be primarily of interest to student from Civil and Environmental Engineering, Architectural Engineering, and Architecture majors, but students from other majors can also enroll in this minor. This minor will help students to increase their competitiveness for employment in residential market and construction industry.

A grade of C or better is required for all courses in the minor.

Scheduling Recommendation by Semester Standing given like (Sem: 1-2)

REQUIREMENTS FOR THE MINOR: 22 credits

PRESCRIBED COURSES (10 credits)
AE 470(3), AE 471(3), ARCH 412(3), CE 411(1) (Sem: 5-8)

ADDITIONAL COURSES (12 credits)

Architecture Track - Take 12 credits form the following: AE 211(3), AE 421 (3), AE 422(3), FIN 100(3), or RM 303(3) (Sem: 3-8)

Architectural Engineering Track - Take 12 credits from the following: AE 202(3), AE 372(3), AE 402(3), AE 404(3), AE 454(3), AE 456(3), AE 542(3) or BE 462(3) (Sem: 3-8)

Civil Engineering Track - Take 12 credits from the following: AE 432(3), AE 542(3), BE 462(3), CE 332(3), CE 341(3), or CE 410(3) (Sem: 5-8)

Last Revised by the Department: Fall Semester 2014

Blue Sheet Item #: 43-05-036

Review Date: 02/24/2015

Service Enterprise Engineering Minor

University Park, College of Engineering (SEENG_UMNR)

Service sector represents over 80% of the economy and represents over 70% of jobs in the U.S. Service enterprises constitute a wide range in terms of labor intensity, information intensity, and prevailing productivity. Examples of service enterprises include hospitals, retailers, banks, financial institutions, and airlines. This mnior is designed for students interested in learning about applying industrial engineering techniques to service enterprises. Students completing this minor will gain an understanding of applying industrial engineering and operations research tools for modeling, analysis, design and control of service enterprises.

In addition to the stated courses for the minor, students in IE pursuing this minor may require HPA 301 or HDFS 129. Students in HPA, HDFS and any other major will require MATH 220 as a prerequisite for IE 405. IE 405 and IE 322 (or an equivalent course in probability and statistics) are prerequisites for IE 460.

A grade of C or better is required for all courses in the minor.

Scheduling Recommendation by Semester Standing given like (Sem: 1-2)

REQUIREMENTS FOR THE MINOR: 18 credits

PRESCRIBED COURSES (6 credits)
IE 460(3), IE 478(3)

ADDITIONAL COURSES (12 credits)
Select 6 credits from Engineering Cluster (Sem: 5-8)
IE 302(3), IE 322(3), IE 323(3), IE 330(3), IE 402(3), IE 405(3) or MATH 484(3), IE 424(3), IE 467(3), IE 468(3), IE 480 WAC(3)

Select 6 credits from the Service Cluster (Sem: 5-8)
HPA 332(3), HPA 433(3), HPA 442(3), HPA 475(3), HDFS 311(3), HDFS 455(3)

Lasted Revised by the Department: Fall Semester 2017

Blue Sheet Item #: 46-01-038

Review Date: 8/22/2017

Six Sigma Minor

University Park, College of Engineering (SIGMA)

Six Sigma has been increasingly internalized by companies involved in manufacturing, health care, and service industries. The Six Sigma process has also been used to address environmental concerns such as water quality and energy conservation. Thus, this minor is designed for students who are interested in the Six Sigma statistical methodology for increasing productivity and enhancing quality. The minor will provide students with an understanding of how business models are changing in response to globalization and how the Six Sigma process and product improvement methodology is thus a vehicle for industry prosperity in this climate. Students completing the minor will develop their analytical and statistical skills, and gain a competitive advantage in the work place.

A grade of C or better is required for all courses in the minor.

Scheduling Recommendation by Semester Standing given like (Sem: 1-2)

REQUIREMENTS FOR THE MINOR: 18 credits

PRESCRIBED COURSES (18 credits)
IE 305 (3), IE 322 (3), IE 323 (3) (Sem: 5-6)
IE 433 (3), IE 434 (3), IE 436 (3) (Sem: 7-8)

Last Revised by the Department: Summer Session 2009

Blue Sheet Item #: 37-06-042

Review Date: 4/14/09

EN