

NEW GENERAL ENGINEERING PROGRAM WITH ALTERNATIVE ENERGY AND POWER GENERATION TRACK AT PENN STATE

Faculty Paper
Sustainable Energy in the Curriculum

Kenneth Edward Dudeck & Wieslaw Grebski
Penn State Hazleton
ked2@psu.edu

Abstract

There is an emerging need for multidisciplinary quality engineers with broad range skills capable to design, develop, and integrate new technologies applied to the Alternative and Renewable Energy Technology industry.

The Penn State Hazleton Campus has developed a new innovative Bachelor of Science in General Engineering with an Alternative Energy and Power Generation Track. This new Bachelor of Science degree will prepare graduates to enter the job market in the alternative and renewable energy sector as well as the power generation industry. The graduates of this program will have the critical knowledge and skills needed to begin their careers in this growing industry.

This paper documents the details of this new program, which began accepting freshman into the program during fall 2010 as well as how program utilizes the campus' existing resources in its Engineering and Technology programs to implement the program. The first graduates of this program are expected in spring of 2014.

Background

The Pennsylvania State University College of Engineering offers programs in both engineering and engineering technology at various campus locations across the commonwealth. Thirteen engineering majors are available at University Park plus two additional baccalaureate degrees were offered at other campus locations prior to the implementation of the new Baccalaureate degree in General Engineering. For the most part, engineering students complete their first two years at one of the smaller campuses focusing on engineering fundamental, then transfer to the University Park Campus to finish the degree.

In addition to the engineering degrees, Penn State has offered a wide range of engineering technology programs primarily at the various campus locations across the state. Historically, Penn State has had one of the largest engineering technology programs in the country. The University offers five baccalaureate degrees and nine associate degrees at twelve locations in Pennsylvania. Engineering technology students complete their associate degree at one of the

*Proceedings of the 2011 ASEE Northeast Section Annual Conference
University of Hartford
Copyright © 2011, American Society for Engineering Education*

campuses and then enter the work force, or continue on for an additional two years to earn a baccalaureate degree in engineering technology.

For well over the past decade, engineering technology enrollments program have continued to be on the decline at major universities across the country^[1]. This has led to the closure of many engineering technology programs at major universities while enrollments at the community colleges as steadily been on the rise^[2]. At Penn State, several initiatives were undertaken to attempt to keep these engineering technology programs viable. It was observed that associate degree enrollments at the campuses that offered the baccalaureate degree in engineering technology remained the most stable. Therefore, the marketing of these programs was adjusted in order to emphasize the four year degree which would resonant more with the students' desire to continue beyond the associate degree^[3].

Since the retention in the engineering technology program is much higher than in engineering, an initiative that was undertaken was to re-design the engineering technology program to provide stronger matriculation pathways for both two-year technology and engineering transfer students into baccalaureate engineering technology programs^[4]. This new engineering technology curriculum went into effect in 2008.

Despite these efforts, since Penn State Hazleton campus only offered the two year associate in engineering technology, enrollments in engineering continued to decrease at the campus. At the same time, the engineering enrollments however remained high due to several recruitment efforts. Penn State Hazleton organized a number of Act 48 teacher in-service training programs. From awarded grants, three Act 48 workshops have been organized and conducted during the last six years. Many of these workshops and grants were focused in the area of alternative energy. An additional workshop on this topic is being currently being developed.

These Act 48 teacher in-service workshops were hands-on and interactive. Teachers performed experiments and materials were available through Penn State Hazleton for use in their classrooms. Workshop activities and lesson plans were linked to the Pennsylvania Academic Standards for Science and Technology and the Academic Standards for Environment and Ecology.

Teachers also participated in field experiences related to a 3.2 kW photovoltaic power station which is connected to the Pennsylvania Power and Light grid and a full-size solar powered car. These field experiences and related activities were conducted at the Penn State Hazleton campus. The solar car was designed by Penn State Hazleton engineering students and built in cooperation with high school students. The photovoltaic power station was erected in conjunction with a photovoltaic installers training course which was offered on site at the Penn State Hazleton campus.

As a positive result of these projects, the Penn State Hazleton Campus decided to develop and offer a new innovative Bachelor of Science in General Engineering with an Alternative Energy and Power Generation Track. The General Engineering with an Applied Materials Track was

simultaneously developed offered at Penn State's DuBois campus. The initial freshmen were admitted into both of these programs began this past fall 2010 semester. The first graduates are expected in the Spring of 2014.

Program Specifics

The General Engineering program provides students with a broad foundation in engineering with specialization in a technically and professionally relevant topic. Topics in Alternative Energy and Power Generation at the Hazelton Campus and Applied Materials at the DuBois Campus are available to suit an individual's technical interests. The program provides opportunities for team-based, industry supported research and design projects, thus preparing graduates for careers in for-profit or nonprofit organizations, or to further their education in graduate school.

The educational objectives of the General Engineering program are to produce graduates who, during the first few years of professional practice will:

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

The degree offers students the option to select an academic track that fits their interests and regional aspirations. The first two years the degree aligns with other engineering programs and prepares students with math, science and engineering fundamentals. Both topical tracks in the degree offer multiple years of design courses culminating in a two semester senior capstone project allowing students to complete a research project from conception through prototyping.

The Alternative Energy and Power Generation track provides students with a broad foundation in energy sources commonly used to supply utility power and alternative approaches such as nuclear, solar, and wind to supplement traditional coal and gas power. The Applied Materials track offers students the fundamentals of materials design, processing, testing and characterization. Students work with metals, ceramics, polymers, composites and particulate materials.

Program Requirements

The proposed engineering curriculum is comprised of five different categories of courses:

*Proceedings of the 2011 ASEE Northeast Section Annual Conference
University of Hartford
Copyright © 2011, American Society for Engineering Education*

- General Education – 31 credits (46)
- Basic Mathematics and Science – 34 credits
- Engineering Fundamentals – 16 credits
- Design Component – 11 credits
- Track Courses/Professional Focus – 38 credits

The total credits needed for graduation is 127. It should also be noted that 15 credits from basic mathematics and science also count towards Penn State’s 46 credit general education requirement.

The specific category breakdown of the required courses is shown below in Table 1. The prerequisite flow chart is shown in Table 2. The courses in red are the track specific courses.

General Education (31/46 credits)

Speaking and Writing
 Health and Physical Activity
 Natural Sciences
 Arts
 Humanities
 Social Sciences
 First Year Seminar

Basic Math and Science (35 credits)

Calculus/Differential Equations
 Chemistry (Lecture and Laboratory)
 Physics (Lecture and Laboratory)

Engineering Fundamentals (12 credits)

Statics
 Computation and Modern Methods
 Strength of Materials
 Thermodynamics

Design Component (11 credits)

Computer Aided Design/Drafting/Modeling
 Capstone Design Project

Track Courses/Professional Focus (38 credits)

Detailed below.

Specific Track Courses for Alternative Energy and Power Generation Track

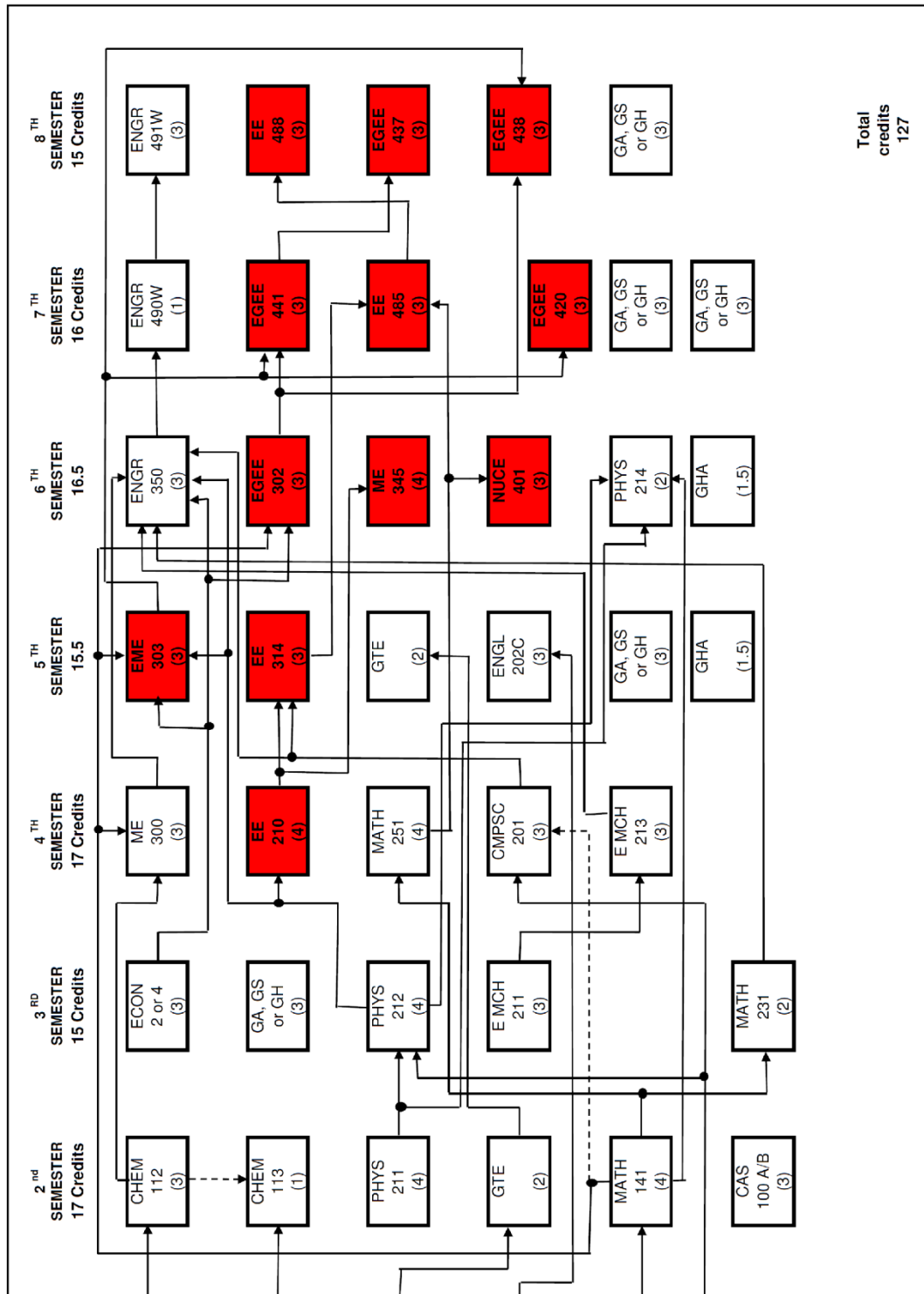
Course	Name	Cr
EE 210	Circuits and Devices	4
EME 303	Fluid Mechanics in Energy	3
EE 314	Signals and Circuits II	3
EE 485	Energy Systems and Conversion	3
EE 488	Power System Analysis I	3
EGEE 302	Principles of Energy Engineering	3
EGEE 420	Hydrogen and Fuel Cells	3

EGEE 437	Fundamentals of Renewable Energy	3
EGEE 438	Sustainable Energy Options	3
EGEE 441	Electrochemical Energy Conversion	3
ME 345	Instrumentation, Measurement, and Statistics	4
NUCE 401	Introduction to Nuclear Engineering	3

Table 1 – Category Distribution by Topic for BS General Engineering

Table 2 Prerequisite flow chart for Alternative Energy and Power Generation Track

General Engineering Degree with Alternative Energy and Power Generation Track
127 Credit Course Sequence



Implementation of the New Program

The new BS in General Engineering program requires a total of 127 credits. Of those credits, 79 credits from existing courses are taught in the first two years of Penn State Hazleton's traditional engineering programs. The remaining 48 credits represent new courses that will be taught at the campus. By elimination of the associate degrees in Electrical Engineering Technology, and Mechanical Engineering Technology, the campus saves 45 credits of faculty teaching load. These resources can then be applied to the engineering program yielding little additional teaching costs to the campus.

Since the first two years of the program uses the same courses as the courses used for University Park bound students, the first two years are already fully implemented. Officially the campus began admitting freshmen into the new program Fall 2010, but the teaching assignment impact will not be felt until Fall 2012 when the first junior level courses begin. The transition plan is shown below in Table 3. The notations used in the Table 3 denote engineering students (ENGR), engineering technology students (ET), and students in the new BS General Engineering Program (BSGEN)

Level	Fall 2010	Fall 2011	Fall 2012	Fall 2013
Freshmen	ENGR*, ET	ENGR*, ET	ENGR*, ET	ENGR*, ET
Sophomore	ENGR, ET	ENGR*, ET	ENGR*, ET	ENGR*, ET
Junior	none	none	BSGEN	BSGEN
Senior	none	none	none	BSGEN

* Both ENGR and BSGEN

Table 3 – Campus Transition Plan

Conclusion

This paper describes the development and implementation of the General Engineering with Alternative Energy and Power Generation Track program. The curriculum was designed around Penn State Hazleton's existing programs which were already strong and proven. Development of the BS General Engineering degree was a challenging, but very rewarding experience.

Although the seeds of strong program have been planted, additional work must continue to ensure its long term success. This stems from the realization that the program cannot flourish in isolation. The present focus of the engineering faculty and campus administration is to rapidly build an *ecosystem* for the new degree by developing strong partnerships. The creation of the ecosystem is being done for the purpose of shortening the implementation cycle, allowing the

Proceedings of the 2011 ASEE Northeast Section Annual Conference

University of Hartford

Copyright © 2011, American Society for Engineering Education

program to mature, as well as allowing the program to remain relevant to the marketplace in Northeastern Pennsylvania. Key partners of the ecosystem have been identified and mutually beneficial partnerships are being established. At the present time, partners of the ecosystem include: industry, a local business incubator, local school districts, alumni, the university relations department, the local community, work force development agencies, and federal, state, and local agencies committed the advancement of sustainable energy initiatives.

Bibliography

[1] Buchanan, W., Bostwick, W.; “Managing Declining Enrollments in Engineering and Technology” American Society for Engineering Education, (ASEE) Annual Conference Proceedings, v 2, p 2628-2631, 1995.

[2] Frenzel Jr., Louis, “The Disappearing Associate Degree Program in Electronics Technology” American Society for Engineering Education, (ASEE) Annual Conference Proceedings, p 1439-1448, 2003.

[3] Ferrara, I., Vavreck, A., “Meeting Enrollment Challenges in Engineering Technology at Penn State Altoona”, American Society for Engineering Education (ASEE) Annual Conference Proceedings, 2008.

[4] Dudeck, K., Grebski, W., “A New Vision for Engineering Technology Programs to Strengthen Recruitment and Retention,” Proceedings of American Society for Engineering Education (ASEE) 2008 Annual Conference, June 2008.