

X.6 Bachelor of Science Engineering Technology Hydrogen and Fuel Cell Education Program Concentration

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Objectives

- Prepare students who can successfully work as hydrogen and fuel cell technology (HFCT) professionals in government, industry, and academia.
- Program graduates will demonstrate an appropriate mastery of the knowledge, techniques, skills, and modern tools related to hydrogen and fuel cell technology.
- Program graduates will demonstrate an ability to apply current knowledge and adapt to emerging applications of hydrogen and fuel cell technology.

Technical Barriers

This project addresses the following technical barriers from the Education section (3.9.5) of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year Research, Development and Demonstration Plan:

- (A) Lack of Readily Available, Objective, and Technically Accurate Information
- (F) Mixed Messages

Contribution to Achievement of DOE Education Milestones

This project will contribute to achievement of the following DOE milestones from the Education section of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year Research, Development and Demonstration Plan:

- **Milestone 21:** Facilitate Development and Expansion of College and University Hydrogen Technology Education Offerings. (4Q, 2009)

Accomplishments

- Courses that were developed have been approved by the UCF College of Engineering Curriculum Committee and assigned course numbers as follows:

EGN4300C Hydrogen Production and Handling	3 Credit Hours
EGN4731C Fuel Cell Technologies I	3 Credit Hours
ETM4231 Applied Thermodynamics and HVAC	4 Credit Hours
EGN4730 Renewable Energy Systems	3 Credit Hours
ETM4331 Applied Fluid Mechanics	4 Credit Hours
ETM4220 Applied Energy Systems	4 Credit Hours

- The course ETM4220 Applied Energy Systems has been offered in Spring 2009.
- The following courses are offered to students in Fall 2009:

EGN4731C Fuel Cell Technologies I	3 Credit Hours
EGN4730 Renewable Energy Systems	3 Credit Hours
ETM4331 Applied Fluid Mechanics	4 Credit Hours

- The following course will be offered to students in Spring 2010:

EGN4300C Hydrogen Production and Handling	3 Credit Hours
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Students from all engineering majors and from engineering technology can register for the above courses.

- **Energy Certificate program** based on the current HFCT program has been approved.



Introduction

A program focused on HFCT in the Engineering Technology Department (ENT) jointly with the Florida Solar Energy Center (FSEC) at UCF has been developed. The HFCT Program will support the need for educated graduates that comprise the next generation workforce needed for research, development, and demonstration activities in government, industry, and academia. The efforts include the development and delivery of undergraduate courses at the ENT and FSEC within the ABET-accredited Bachelor of Science (BS) in Engineering Technology program. The mode of course offering will be both in class and on line, which will increase the number of students enrolled. The proposed project facilities are located at the College of Engineering and Computer Science, at FSEC of UCF and at all regional campuses of UCF. The FSEC is a unique component of the proposed effort. FSEC has been conducting hydrogen and fuel cell research for 25 years and has dedicated facilities and a selection of unique laboratory equipment that will be made available to the students for this project.

Current public knowledge and awareness levels of hydrogen and fuel cells are low, however, and prevalent misunderstandings of hydrogen properties have affected negative opinions about the safe use of hydrogen as an energy carrier. The Hydrogen, Fuel Cells & Infrastructure Technologies Education subprogram seeks to facilitate near-term market transformation and future commercialization by providing technically accurate and objective information to key target audiences, including: state and local government representatives, potential end users, safety and code officials, and local communities. Undergraduate and graduate students, professors, and middle and high school teachers and students comprise another important audience, as they are our nation's future researchers, scientists, engineers, technicians, and technology users

Approach

The approach for achieving the objectives of the project to develop and sustain a BS program in HFCT includes developing the courses for HFCT concentration and utilizing the existing courses to serve the HFCT program. The course offering has started from Spring 2009 by offering ETM4220 Applied Energy Systems. In Fall 2009 three more core courses are offered. These are EGN4731C Fuel Cell Technologies I, EGN4730 Renewable Energy Systems and ETM4331 Applied Fluid Mechanics. Efforts to promoting the program include extensive advertisement, recruiting students and outreach plans, visits to community colleges and other institutions, publications and presentations in professional meetings.

The evaluation of HFCT program will be conducted with help from Program Evaluation and Educational Research Group, an evaluation unit within the College of Education at UCF. The evaluation will engage multiple perspectives, use a wide range of qualitative and quantitative methods, and triangulation procedures to assess and interpret a multiplicity of information. Data will be gathered during all phases of the program to provide timely formative feedback to/from project stakeholders on implementation, participants' perspectives about the activities and what they may have learned, and how goals and objectives are being met. Formative evaluation will provide recommendations and allow for design modifications to improve course impact answering questions like: Is the program providing high-quality experiences? What impact is the program having on participating students' attitude, interest, confidence and knowledge related to hydrogen and fuel cell technology? Is faculty using project-developed content to replace some of their standard lessons?

Results

Courses that were developed have been approved by the UCF College of Engineering Curriculum Committee and assigned course numbers as follows:

EGN4300C Hydrogen Production and Handling	3 Credit Hours
EGN4731C Fuel Cell Technologies I	3 Credit Hours
ETM4231 Applied Thermodynamics and HVAC	4 Credit Hours
EGN4730 Renewable Energy Systems	3 Credit Hours
ETM4331 Applied Fluid Mechanics	4 Credit Hours
ETM4220 Applied Energy Systems	4 Credit Hours

The course ETM4220 Applied Energy Systems has been offered in Spring 2009. This course is taught by Dr. Sleiti as part of the HFCT program. Thirty-seven students have taken the course. The ETM4200 course is both a requirement for ENT as well as an elective course for other engineering programs.

The following courses are offered to students in Fall 2009:

EGN4731C Fuel Cell Technologies I	3 Credit Hours
EGN4730 Renewable Energy Systems	3 Credit Hours
ETM4331 Applied Fluid Mechanics	4 Credit Hours

The following course will be offered to students in Spring 2010:

EGN4300C Hydrogen Production and Handling	3 Credit Hours
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Students from all engineering majors and from engineering technology can register for the above

courses. The courses will be offered to students according to the schedule in Table 1.

The principle investigator (PI) leads the plan to promote the HFCT program and recruit students. It is anticipated that a large number of current UCF students will join the program as the courses are being offered for all engineering majors and engineering technology students.

UCF approval to offer an **Energy Certificate program** based on the current HFCT program has been granted.

The team has started delivering the courses in Spring 2009, which began January 2009. The course ETM4220, Applied Energy Systems, has been offered and taught by the PI, Dr. Sleiti. The following three courses are already scheduled to be offered to students in Fall 2009 and Spring 2010:

EGN4300C Hydrogen Production and Handling	3 Credit Hours
EGN4731C Fuel Cell Technologies I	3 Credit Hours
EGN4730 Analysis of Renewable Energy Systems	3 Credit Hours
ETM4331 Applied Fluid Mechanics	4 Credit Hours

The project director is coordinating the work of the team, following up with the college curriculum committee at UCF, communicating with school districts, community colleges and potential partners from industry, and submitting progress reports to the DOE program manager.

Conclusions and Future Directions

It is concluded that the HFCT program is a unique program that will support the need for educated graduates that comprise the next generation workforce needed for research, development, and demonstration activities in government, industry, and academia.

The plans for the future directions are:

- Continue offering the courses for the HFCT concentration.
- Evaluate courses offered.
- Continue working on promoting the program and recruiting students.
- Attend seminars and meetings to disseminate program results.
- Conduct visits to community colleges, school districts and industries.
- Prepare and present technical papers.

FY 2009 Publications/Presentations

1. A.K. Sleiti, "Bachelor of Science Engineering Technology Hydrogen and Fuel Cell Education Program Concentration", presentation at the 2009 DOE Hydrogen Program Merit Review and Peer Evaluation Meeting, Arlington, Virginia, May 21, 2009.
2. A.K. Sleiti, "Bachelor of Science - Engineering Technology Hydrogen and Fuel Cell Education Program Concentration", ASME 2009 International Mechanical Congress and Exposition (IMECE) IMECE2009-12314, November 13-19, 2009, Lake Buena Vista, FL, USA.

TABLE 1. Course Schedule

Course Title	2008-2009			2009-2010			2010-2011			2011-2012			2012-2013		
	SU	F	S	SU	F	S	SU	F	S	SU	F	S	SU	F	S
ETM4220 Applied Energy Systems			X			X			X			X			X
EGN4300C Hydrogen Production and Handling						X		X			X			X	
EGN4731C Fuel Cell Technologies I					X			X			X			X	
ETM4331 Applied Fluid Mechanics					X			X			X			X	
ETM4231 Applied Thermodynamics and Heat Transfer						X			X			X			X
EGN4730 Analysis of Renewable Energy Systems					X			X			X			X	
EGN4XXXC Hydrogen Applications								TBD			TBD			TBD	
EGN4XXXC Fuel Cell Technologies II								TBD			TBD			TBD	

TBD – to be determined