STATE UNIVERSITY OF NEW YORK !
COLLEGE OF TECHNOLOGY !
CANTON, NEW YORK !

MASTER SYLLABUS

COURSE NUMBER – COURSE NAME
AREA 300 - Fuel Cells

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Canino School of Engineering Technology !

Department: Mechanical & Energy Technology !

Semester/Year: Fall/2018 !

A. **TITLE**: Fuel Cells

B. **COURSE NUMBER:** AREA 300

C. **CREDIT HOURS: (Hours of Lecture, Laboratory, Recitation, Tutorial, Activity)**

 # Credit Hours: 3
 # Lecture Hours: 3 **per week**
 # Lab Hours: **per week**
Other: **per week**

Course Length: 15 **Weeks**

D. **WRITING INTENSIVE COURSE**: Yes ☐ No ☒

E. **GER CATEGORY: None:** ☒ **Yes:** GER !
***If course satisfies more than one*:** GER !

F. **SEMESTER(S) OFFERED: Fall** ☒ **Spring** ☒ **Fall & Spring** ☐

G. **COURSE DESCRIPTION:**

Students will discover the science involved in the operation of fuel cells and technical applications of a fuel cell in providing electricity and heat. Topics explored are hydrogen as a fuel, energy efficiency, and operational characteristics of a fuel cell. In depth studies of proton exchange membrane, alkaline electrolyte fuel cells, and direct methanol fuel cells will teach students about the conversion of hydrogen fuel to useable forms of energy.

H. **PRE-REQUISITES: None** ☐ **Yes** ☐ **If yes, list below:**

CHEM 150, College Chemistry I

CO-REQUISITES: None ☒ **Yes** ☐ **If yes, list below:**

I. STUDENT LEARNING OUTCOMES: (*see key below*)

By the end of this course, the student will be able to:

Course Student Learning Outcome [SLO]	***Program Student Learning Outcome [PSLO]***	***GER*** *[If Applicable]*	***ISLO & SUBSETS***	
Define fuel cells and how they function.	SO #1 An appropriate mastery of the knowledge, techniques, and skills, and modern tools of their disciplines utilizing renewable energy systems and design parameters		2-Crit Think 5-Ind, Prof, Disc, Know Skills ISLO	IA Subsets Subsets Subsets
Identify the major types of fuel cells.	SO # 6 An ability to identify, analyze and solve technical problems.		2-Crit Think 5-Ind, Prof, Disc, Know Skills ISLO	CA Subsets Subsets Subsets
Evaluate the benefits and disadvantages of fuel cells as a means of providing power.	SO # 8 A recognition of the need for, and an ability to engage in lifelong learning.		1-Comm Skills 5-Ind, Prof, Disc, Know Skills ISLO	W Subsets Subsets Subsets
Create a graphical image describing the function of a full cell.	SO # 6 An ability to identify, analyze and solve technical problems.		2-Crit Think 5-Ind, Prof, Disc, Know Skills ISLO	CA Subsets Subsets Subsets
Calculate operational and capital costs of a typical fuel cell.	SO #2 An ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering, and technology by applying these areas to renewable energy systems		2-Crit Think 5-Ind, Prof, Disc, Know Skills ISLO	PS Subsets Subsets Subsets

KEY	**Institutional Student Learning Outcomes [ISLO 1 – 5]**
ISLO #	**ISLO & Subsets**
1	**Communication Skills** Oral [O], Written [W]
2	**Critical Thinking** *Critical Analysis [CA] , Inquiry & Analysis [IA] , Problem Solving [PS]*
3	**Foundational Skills** *Information Management [IM], Quantitative Lit,/Reasoning [QTR]*
4	**Social Responsibility** *Ethical Reasoning [ER], Global Learning [GL], Intercultural Knowledge [IK], Teamwork [T]*
5	**Industry, Professional, Discipline Specific Knowledge and Skills**

*Include program objectives if applicable. Please consult with Program Coordinator !

J. APPLIED LEARNING COMPONENT: Yes ☒ No ☐

If YES, select one or more of the following categories:

- ☒ Classroom/Lab
- ☐ Internship
- ☐ Clinical Placement
- ☐ Practicum
- ☐ Service Learning
- ☐ Community Service
- ☐ Civic Engagement
- ☐ Creative Works/Senior Project
- ☐ Research
- ☐ Entrepreneurship (program, class, project)

K. TEXTS:

Larminie, James and Dicks, Andrew; Fuel Cell Systems Explained, 2nd Edition, ISBN 0-470-8857-X, 2003, Wiley

L. REFERENCES:

Parsons Inc. EG&G Services, 2000, Fuel Cells: A Handbook, 5th ed., US Department of Energy
International Journal of Hydrogen Energy
Journal of the Electrochemical Society
Journal of Power Sources
Hogarth M. and Hards G., 1999, Direct methanol fuel cells: technological advances and further requirements", Platinum Metals Review, pp 150-159.

M. EQUIPMENT: None ☐ **Needed:** Technology enhanced classroom

N. GRADING METHOD: A- F

O. SUGGESTED MEASUREMENT CRITERIA/METHODS:

Exams 3-4
Homework and Quizzes
Term Research Project
Short Paper/ Presentation

P. DETAILED COURSE OUTLINE:

I. Introduction to Fuel Cells
- **a. Basic Principles**
- **b. Types of fuel cells**
- **c. Limits to fuel cells**
- **d. Advantages and applications**

II. Efficiency of Fuel Cells
- **a. Energy and Electromagnetic force**
- **b. Open circuit voltage**
- **c. Efficiency and limits of fuel cells**

d. Effect of pressurization and gas levels

III. Operation of Fuel Cells
- **a. Terminology**
- **b. Irreversibility and voltage drop**
- **c. Types of losses**
- **d. Fuel cross over and internal currents**
- **e. Double layering charges**

IV. Proton Exchange Membrane Fuel Cells
- **a. How a polymer electrolyte works**
- **b. Electrodes and structures necessary to produce current**
- **c. Water and air flow problems**
- **d. Cell cooling**
- **e. Bipolar plate**
- **f. Operating pressure**
- **g. System examples**

V. Alkaline Electrolyte Fuel Cells
- **a. Basic principle and advantages**
- **b. Types of alkaline electrolyte fuel cells**
- **c. Pressures and temperatures**
- **d. Materials for electrodes**
- **e. Systemic problems**

Q. <u>LABORATORY OUTLINE</u>: None ☒ Yes ☐