ME 4325 Introduction to Fuel Cell Systems (Elective)

Catalog Description: ME 4325 Introduction to Fuel Cell Systems (3-0-3)

Prerequisites: ME 3322 Thermodynamics

Fuel cell systems are explained and analyzed, including single cells and stacks, and balance-of-plant fundamentals, with emphasis upon prevalent fuel cell types and their applications.

Textbook: James Larminie and Andrew Dicks, *Fuel Cell Systems Explained*, 2nd Edition, John Wiley and Sons, 2003.

Topics Covered:

1. Introductory thermodynamics/transport phenomena of fuel cells
2. Categorization and characteristics of the prevalent fuel cell types
3. Operating conditions parameters of fuel cells
4. Fuel processing
5. Reactants supply turbomachinery
6. Basic power electronics
7. Fuel cell system integration
8. Fuel cell application sectors
9. Opportunities for, and challenges to, fuel cells application

Course Outcomes:

Outcome 1: To provide students an appreciation for the need and promise of alternative, "clean energy" technologies such as fuel cells.

1.1 Students will enhance their knowledge of present and pending energy challenges within society via exam discussion questions as well as related commentary within group projects as introduced in (5.2) below.

Outcome 2: To teach students the basic principles, prevalent types, and applications of fuel cells and expose students to near-term implementations of the technology.

2.1 Students will engage in various assignments (i.e., tests, homeworks, project) to exhibit their understanding of the operating principles, designs, and opportunities for fuel cells.

Outcome 3: To teach students about the ancillary components needed for an integrated fuel cell *system*.

3.1 Students will learn about the balance of plant of a fuel cell system, which add significant complications to the system (e.g., subsystems sizing, integration, and system control).

3.2 Students will perform design/analysis exercises related to synthesizing fuel cell *systems*.

Outcome 4: To introduce students to societal catalysts and challenges regarding fuel cell implementation ("clean energy" incentives, energy security, codes and regulatory needs, etc.).

4.1 Students will demonstrate their understanding of "societal catalysts and fuel cells" via exam discussion questions as well as related commentary within group projects as introduced in (5.2) below.

Outcome 5: To provide a platform for students to formulate and define problems based on the needs of the research area.

5.1 Students will study the literature to define group projects based on the diversity of engineering needs within fuel cells research and development.

5.2 Students will demonstrate their knowledge of the fuel cell state-of-the-art, as well as opportunities for improvement, by proposing a project wherein they leverage their engineering skillsets and interests to a specific fuel cell system design/enhancement.

Outcome 6: To enable students to work in groups on projects of interest to them.

6.1 Students will demonstrate their ability to work in teams by conducting a research project designed, developed, and implemented by the group (ref. (5.1)-(5.2)).

Outcome 7: To enhance a student's ability to communicate in oral and written forms.

7.1 Students will give oral presentations based upon initial findings associated with their proposed projects.

7.2 Students will provide written reports (including pre-proposals and final reports) detailing their expected contribution and preliminary results, respectively.

Correlation between Course Outcomes and Student Outcomes:

ME 4325											
	Mechanical Engineering Student Outcomes										
Course Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Outcome 1.1						X		X		X	
Course Outcome 2.1	X				X						
Course Outcome 3.1	X				X						
Course Outcome 3.2	X				X						
Course Outcome 4.1			X			X		X		X	
Course Outcome 5.1			X		X			X	X	X	X
Course Outcome 5.2	X		X		X			X	X		X
Course Outcome 6.1			X	X							X
Course Outcome 7.1							X				X
Course Outcome 7.2							X				X

GWW School of Mechanical Engineering 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

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