ME EN 5810/6810: THERMAL SYSTEMS DESIGN

Fall 2008

Lecturer: Eric R. Pardyjak

Lecture Time/Location: T,Th 2:00 pm-3:20 pm WEB 120

Office Hours: 3:30pm – 4:30pm T Th - Room 171 KEN (or by appointment)

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Text:

- Design of Fluid Thermal Systems, 2nd Edition, W.S. Janna, PWS Publishing Company, 1998.

Description of the Course: Design of steam-power plants, feed-water heater systems, pumping systems, compressor blades, turbine blades, and heat exchangers. Equation fitting and economic analysis as basis of design decisions. Optimization of thermal systems using Lagrange multipliers, search methods, dynamic programming, geometric programming, and linear programming. Probabilistic approaches to design.

Prerequisites: ME EN 3600 Thermodynamics II
ME EN 3650 Heat Transfer

Corequisites: None

Scope of the Course: The lecture material will cover part or most of the material in chapters 1 through 9 in the textbook. In addition, some supplemental material will be handed out. The reading assignments are arranged such that they are made prior to when the material in the lecture will be covered. It is a good idea to read the assigned sections before coming to lecture.

Homework and Projects: Regular homework assignments and projects will be given during class and posted on the web site. There will be a total of four projects throughout the semester. Homework and projects will be due by 5pm on the specified due date.

Computers: Commercial math packages (Matlab, Maple, EES, etc.) will be used during the semester.

Topics:

1. Introduction to Thermal System Design (Ch. 1)
2. Review of Fluid Properties and Basic Equations of Fluid Mechanics (Ch. 2)
3. Piping Systems (Ch. 3 & 4)
    a. Head losses
    b. Design of piping systems – series and parallel
    c. Design of piping networks
4. Prime Movers (Ch. 5)
    a. Pump characteristics and selection
    b. Fan characteristics and selection
5. Review of Heat Transfer Fundamentals (Ch. 6)
    a. Heat exchanger designs (LMTD and Effectiveness-NTU design methods)
    b. Design of double pipe heat exchangers
    c. Design of shell-and-tube heat exchangers
    d. Design of cross-flow heat exchangers
    e. Heat exchanger design options
6. Optimization (Handouts)
7. Design of Complete Thermal Fluid Systems

Grading and Exams: Grades will be posted regularly on WebCT. The total course grade is comprised of homework and project assignments as follows:

Homework	20%
Projects	50%
Final Project	30%

Final Exam: There will be no final exam, however their will be a final team design project**.**

Cheating: You are allowed to cooperate on homework by sharing ideas and methods. Copying will not be tolerated. Submitted work copied from others will be considered academic misconduct and will be reported to the appropriate University entities.

Exemptions: The University of Utah conforms to all standards of the Americans with Disabilities Act. If you wish to qualify for exemptions under this act, notify the instructor and the Center for Disabled Students Services, 160 Union.

Class Calendar

Week	Class	Date	Day	Topic	Reading Due	Homework Due	Handouts
1	1	08/26	T	Introduction to Thermal Systems Design	None	None	Syllabus
1	2	08/28	Th	Fluid Mechanics Introduction	Ch.1, Ch.2	None	Design Handout
2	3	09/02	T	Fluid Mechanics Review	Ch.2	None	
2	4	09/04	Th	Introduction to Piping Systems	Ch. 3	Homework 1	
3	5	09/09	T	Piping Systems Lecture 2	Ch. 3		Stoecker Handout
3	6	09/11	Th	Economics Review	Stoecker	Homework 2	
4	7	09/16	T	Optimum Economic Diameter	Ch.4		EES Examples
4	8	09/18	Th	Parallel Piping Systems 1			
5	9	09/23	T	Parallel Piping Systems 2	Ch. 4	Homework 3	
5	10	09/25	Th	Flow Rate Measurement	Ch 4.7		Hodge Pipe Handout
6	11	09/30	T	Pumps and Piping Systems	Ch. 5	Design Project 1	
6	12	10/02	Th	NPSH and Dimensional Analysis	Hodge Handout		Pump Handout
7	13	10/07	T	Pumps in Series and Parallel	Pump Handout		
7	14	10/09	Th	Pardyjak in DC		Homework 4	
8		10/14	T	**Fall Break**	**No Classes**		
8		10/16	Th	**Fall Break**	**No Classes**		
9	15	10/21	T	In class Pump Demo/Lab	Handout		
9	16	10/23	Th	Intro to Heat Transfer	Ch. 6	Design Project 2	Critical Radius Example
10	17	10/28	T	Intro to Heat Exchangers(LMTD)	Ch. 7		
10	18	10/30	Th	Double Pipe Heat Exchangers	Ch. 7	Homework 5	
11	19	11/04	T	Final Design Project Team Meetings			
11	20	11/06	Th	Effectiveness-NTU	Ch. 7		
12	21	11/11	T	Intro to Shell & Tube Heat Exchangers	Ch.8		
12	22	11/13	Th	Shell & Tube Heat Exchangers	Ch. 8	Design Project 3	
13	23	11/18	T	Plate and Frame Heat Exchangers	Ch 9.1-9.2		
13	24	11/20	Th	Cross Flow Heat Exchangers	Ch. 9	Homework 6	McQuiston Handout
14	25	11/25	T	Review of Radiation Heat Transfer	McQuiston		
14		11/27	Th	**Thanksgiving Holiday**	**No Classes**		
15	26	12/02	T	Introduction to Solar Radiation	McQuisition		EES Solar Radiation
15	27	12/04	Th	Heat Gain via Fenestrations			Duffie & Beckman Solar Handout
16	28	12/09	T	Solar Flat-Plate Heat Exchs. 1	Solar Handout		
16	29	12/11	Th	Solar Flat-Plate Heat Exchs. 2	Solar Handout		
17		12/17	W	**Final Project Reports Due**		Final Project	