CH EN 3453 – Heat Transfer

Scientific Reporting

Reminders…

- Homework #5 due at 4:00 today
  - Will be available for pickup by Tuesday afternoon
- There is NO homework assignment this week!
  - Also no Wednesday help session next week
- All homework will be graded by Tuesday
  - Can be picked up in ChE main office
- Midterm #1 next week Wed. October 1
  - Covers chapters 1, 2, 3, 4, 5 (mostly 3, 4, 5)
  - CLOSED BOOK! Only one 8.5x11" sheet of paper (both sides) allowed
  - Absolutely no cell phones. If a cell phone is seen, heard, smelled, you will receive a '0' on the exam.
  - Tables 3.3, 3.4, 3.5, 4.1, 4.2, 5.1 and Fig 3.19 (3.18 in 6th ed) will be made available
    - The sheet of tables is also on the "Miscellaneous" page of the class web site
  - Review session Monday, Sept. 30 at 4:00 pm in WEB 1230 (tentative)
  - Monday's lecture will also be review

October 22nd 5:30-9:00PM
Catmull Gallery
RSVP & Resume Deadline: Oct. 3st

Come for a night of career building and networking with local Chemical Engineering firms.

- **Improve yourself as a candidate in a competitive market.**
- **Formal dinner with peers & recruiters.**
- **RSVP & Formal Attire REQUIRED.**

Send resumes to ... usac@chemeng.utah.edu

Homework Problem 7

A probe for a high temperature furnace is made of a long solid rod of sapphire (aluminum oxide) and is 40 mm diameter. Suppose that the probe has been in a furnace for days so that its temperature is 800 K throughout. It is then quickly removed and immediately placed into water bath to provide rapid quenching. The water is at 300 K and effects a heat transfer coefficient of 1600 W/m^2·K. After just 35 seconds the rod is removed from the water bath and placed in a protective case that is lined with insulation so that the rod experiences no further heat losses. What will be the final temperature of the rod after it has equilibrated to a uniform temperature throughout?

Infinite Cylinder The one-term approximation to Equation 5.47a is

$$\theta^* = C_1 \exp(-\zeta_1^2 Fo) J_0(\zeta_1 r^*) \tag{5.49a}$$

or

$$\theta^* = \theta_o^* J_0(\zeta_1 r^*) \tag{5.49b}$$

where θ_o^* represents the centerline temperature and is of the form

$$\theta_o^* = C_1 \exp(-\zeta_1^2 Fo) \tag{5.49c}$$

Total energy transfer:

$$\frac{Q}{Q_o} = 1 - \frac{2\theta_o^*}{\zeta_1} J_1(\zeta_1) \tag{5.51}$$

Bessel Functions (Appendix B)

B.4

Bessel Functions of the First Kind

x	$J_0(x)$	$J_1(x)$
0.0	1.0000	0.0000
0.1	0.9975	0.0499
0.2	0.9900	0.0995
0.3	0.9776	0.1483
0.4	0.9604	0.1960
0.5	0.9385	0.2423
0.6	0.9120	0.2867
0.7	0.8812	0.3290
0.8	0.8463	0.3688
0.9	0.8075	0.4059
1.0	0.7652	0.4400
1.1	0.7196	0.4709

EXAMPLE:

If $\zeta_1 = 0.90$ then $J_1(\zeta_1) = 0.4059$

Error Functions (Appendix B)

B.2

***Gaussian Error Function*[1]**

w	erf w
0.00	0.00000
0.02	0.02256
0.04	0.04511
0.06	0.06762
0.08	0.09008
0.10	0.11246
0.12	0.13476
0.14	0.15695
0.16	0.17901
0.18	0.20094
0.20	0.22270
0.22	0.24430
0.24	0.26570

EXAMPLE:

If $\dfrac{x}{2\sqrt{\alpha t}} = 0.18$

then $\text{erf}\left(\dfrac{x}{2\sqrt{\alpha t}}\right) = 0.20094$

ALSO:

$\text{erfc}(w) = 1 - \text{erf}(w)$

Scientific Reporting

- Communicate technical observations, data, theories, models, etc. to colleagues and interested parties
- Must be clear and unambiguous
  - Details, both of systems and procedure
  - Reader must understand results and how those results were obtained
- Documentation (results, references, etc.) must be thorough and clear

Standard Technical Report Format

Report information
- Title
- Authors and affiliations

Abstract / Executive Summary

1. INTRODUCTION

2. THEORY

3. EXPERIMENTAL

3.1 Apparatus

3.2 Sample

3.3 Experimental procedure

4. RESULTS AND DISCUSSION

5. CONCLUSIONS

Acknowledgements

References

Project Lecture Schedule

Fri, September 26	**Project Introduction**
Wed, October 22	**Experimentation and Reporting**
Fri, October 24	**HEAT EXCHANGER LAB DAY**
Mon, November 3	**Data Analysis and Reporting**
Wed, December 3	**Peer-Reviewed Draft Reports Returned and Final Report Instructions**

Project Report Due Dates

Wed, October 8	**Outline of report due (with headings and subheadings)** *Major headings: Intro, Theory, Experimental, Results and Discussion, Conclusions*
Wed, October 29	**Experimental description due (apparatus and procedure)** *Approx. 2 pages. Include a schematic of the device.*
Wed, November 5	**Theory section due** *Approx. 2 pages. Discuss relations for heat exchanger performance. Include at least 2 references, properly cited. (Incropera can be one.)*
Fri, November 14	**Results section due** *Approx. 3 pages. Include at least one graph and one table.*
Fri, November 21	**Introduction and Conclusions sections and Draft Report due** *Intro (1-2 pages) should explain how a heat exchanger works, including a general figure. Conclusions (½-1 page) should summarize key findings of experiment and offer recommendations for future work.* *NOTE: Please print these on separate pages.*
Wed, December 3	**Peer-reviewed draft reports returned**
Wed, December 10	**Final reports due!**

Project Grading

- 12 points total (12% of total grade)
- 1 point each for turning in anything for the four draft report sections
  - 1 pt for experimental section
  - 1 pt for theory section
  - 1 pt for results section
  - 1 pt for intro and conlusions (0 if either is missing)
- 1 point for each peer review you perform
  - 1 pt for report #1
  - 1 pt for report #2
- Up to 6 points for quality of final revised report