Spray flame

MAE 3240

# Heat Transfer

## Syllabus

V2

Wind chill

Tue/Thurs 10:10am-11:25am, Kimball B11

Instructor
C. Thomas Avedisian, cta2, 193 Grumman Hall

Teaching Assistants
Kevin Kong, lk538
Simon Shi, ls795
Songtao Guo, sg2366
Yujie Wang, 2277

[These notes will remain on Canvas throughout the term; most lectures will be presented on the chalk board; some will be by ppt. Revisions will be posted on Canvas]

1

# Broad Learning Objectives

1. Learn the terminology of heat transfer.

2. Become familiar with the art of energy balances to develop models of heat flow in various systems.

3. Develop broad understanding of basic modes of heat transfer (conduction, convection, radiation) and become proficient at predicting heat transfer rates for these modes including computing the heat transfer coefficient for forced and natural convection.

4. Formulate order of magnitude analyses on differential equations to determine how variables are related to parameters.

5. Become proficient at computing radiative exchange between surfaces.

2

2

## How your knowledge will be assessed

| | | |
|---|---|---|
| *Homework: | 10% | assigned weekly |
| *Clicker: | 2% | periodically |
| *Quiz #1 | 20% | February 29, **in-class**, @ 10:10am, B11 Kimball (Thursday) |
| *Quiz #2 | 20% | March 28, **in-class**, @ 10:10am, B11 Kimball (Thursday) |
| *Quiz #3 | 20% | May 2, **in-class**, @ 10:10am, B11 Kimball (Thursday) |
| *Final: | 28% | time and location TBD |

**EXAMS**
**open book and notes**
**computers in airplane mode**
**material covered is based on homeworks**
**lecture material presented on the Tuesday before the Thursday exam is included**

All work submitted must abide by ***Cornell's Code of Academic Integrity***:
*see http://theuniversityfaculty.cornell.edu/academic-integrity/code-of-academic-integrity/*

*"A Cornell student's submission of work for academic credit indicates that the work is the student's own. All outside assistance should be acknowledged, and the student's academic position truthfully reported at all times. In addition, Cornell students have a right to expect academic integrity from each of their peers."*

3

3

## Homework Assignments and (in-class) Quiz Schedule [keep this page handy]

| homework # | Date assigned | Date due | Graded homework returned to Canvas | |
|---|---|---|---|---|
| 1 | February 1 | February 8 | February 13 | |
| 2 | February 8 | February 15 | February 20 | |
| 3 | February 15 | February 22 | February 28 | #1 |
| **Quiz #1, in class** | **February 29, THURSDAY** | | | |
| 4 | February 29 | March 7 | March 12 | |
| 5 | March 7 | March 14 | March 19 | |
| 6 | March 14 | March 21 | March 26 | #2 |
| **Quiz #2, in class** | **March 28, THURSDAY** | | | |
| 7 | March 28 | April 11 | April 16 | |
| 8 | April 11 | April 18 | April 23 | |
| 9 | April 18 | April 23 | April 30 | #3 |
| **Quiz #3, in class** | **May 2, THURSDAY** | | | |

***--Quizzes are in-class***
***--Openbook and notes***
***--computers must be in 'airplane mode'***
***--Quizzes will start promptly at 10:10am***
***--Topics covered are on a 3 homework cycle – see above***
***--No homework is assigned the week before a quiz (to keep you focused)***
***--Example problems worked out in the two lectures prior to a quiz are covered.***

***Please note the following: the textbook includes far more topics than can be covered in quizzes.***

4

## Knowledge you presumably already have

*solutions of first order ordinary differential equations with constant coefficients (from 1910/1920/2930/2940)

*concept of 'equilibrium'

*1st and 2nd laws of thermodynamics (from 2210)

*meaning of viscosity, boundary layers and Reynolds number (from 3230)

5

Textbook: **Heat and Mass Transfer, 6th edition,** by Yunus Cengel and Afshin Ghajar (2020)

**Reading Schedule**

**Note: Class lectures do not follow the course text. Rather, the text provides an alternative presentation of materials presented in class that you should find helpful. The text includes much more material than is covered in class**

| | | |
|---|---|---|
| **Conduction** | Chapter 1: | all (introduction, basic modes; Fourier, Newton and black body laws; applications) |
| | Chapter 2: | all (energy balances; conduction equation) |
| | Chapter 3: | 3-1 to 3-6 (1-D steady conduction; electrical analogy; critical radius; fins; numerical solutions to steady multidimensional conduction problems) |
| | Chapter 4: | 4-1, 4-2 (unsteady heat conduction, lumped systems; distributed 1-d transient conduction (one term approximations)) |
| **Convection** | Chapter 6: | 6-1 to 6-5, 6-7 (governing equations; scale analysis) |
| | Chapter 7: | 7-1 to 7-3 (forced convection past objects (unconfined flows); integral method) |
| | Chapter 8: | 8-1 to 8-6 (forced convection internal flows; developing and fully developed flows) |
| | Chapter 9: | 9-1 to 9-3 (natural convection for open flows; importance of Rayleigh number) |
| Radiation | Chapter 12: | 12-1 to 12-3, 12-5, 12-6 (black body; radiation intensity; atmospheric radiation) |
| | Chapter 13: | 13-1 to 13-5 (radiation between surfaces; electrical analogy (for transparent and absorbing media)) |

6

6

**Homeworks are due at 11:59 pm each Thursday**

**Help Hours, start 2/5, attend at your leisure**

| | | |
|---|---|---|
| **Monday:** | 7:30-8:30pm | Olin 155 |
| **Tues:** | 7 - 9pm | Upson 222 |
| **Wed:** | 2 - 4pm | Upson 531 |
| | 4:30-6:00pm | 193 Grumman Hall (T. Avedisian) |
| | 7:30-8:30pm | Kimball B11 (except 2/7 which will be in Olin 155) |
| **Thurs:** | 2 - 4pm | Upson 331 |
| | 7 - 9 pm | Upson 222 |

***help hours are optional**
***M/W 7:30pm periods provide an opportunity to present examples to a larger audience**

7

7

Tips for success

*ask questions
*come to class
*come to help hours
*turn in homeworks on time
*don't fall behind

***and remember:***

***There is no substitute for daily preparation***

8

## Special Accommodations:

**--Special arrangements for quizzes and homework due-dates will be made for any student for medical, handicap, athletic, religious, family or job interview reasons.**

**--Provide documentation to the instructor (e.g., coaches note, doctor's note, etc.).**

**To inquire about an accommodation, Email TAs and INSTRUCTOR; we will provide an alternative exam room and time to suit your needs**

9

9

## HOMEWORK POLICIES

**--Homeworks are to be submitted through Canvas**

**--Homeworks are due by 10:00pm Thursdays**

**--solutions are posted on following Tuesdays by which time HWs will be graded.**

**--Homeworks submitted after Thursday are reduced by 10% per day until the subsequent Tuesday, after which the score if 0%. Late homeworks are only by special arrangement; contact the TAs with subject heading "MAE 3240"**

**--One homework grade will be dropped**

**--Homeworks cannot be accepted after solutions are posted**

**--Graded homeworks will be returned through Canvas**

**--For issues with homework grading contact the TAs; you have 1 week from the date the homeworks are graded to request reconsideration of a grade; after 1 week grades are final.**

**--The date and location of the final exam are TBD.**

10

10

# General Policies and Recommendations

Learning

The course instructor believes that the greatest learning occurs when students teach themselves. This end is achieved outside the classroom, when students work out example problems on their own with known solutions (the text has many), and when students avail themselves of the various help sessions offered. Additionally, discussions with classmates can be helpful. **The class lectures and homework assignments are your guide to what is important.**

Exam conflicts with other classes

**There should be no conflicts because quizzes are in-class.**

*"It is the student's responsibility to enroll in courses that will not create a conflict in the student's examination schedule. If for any reason a student must create such a conflict, the student must first obtain permission from one of the instructors involved and resolve the issues of when and how a makeup examination will be administered."*

11

11

# Homeworks and Teams

Conventional wisdom holds that working in teams is a beneficial way to learn.. However, when the ultimate measure of your success will be performance on an exam which you take without any help from others, team learning can often mask deficiencies in understanding key concepts and provide false confidence about your understanding. Countless times students have rebutted a poor performance on an exam with "...but my homework scores were excellent...", even when exam problems were similar to homework problems or in-class examples, only to later recognize that homeworks may have been prepared with significant input from peers, and in fact that the student did not understand key concepts or approaches as a result of relying on others to complete problems.

THOUGH IT IS NOT ADVOCATED THAT YOU ABANDON COLLABORATING WITH PEERS IT IS, HOWEVER, RECOMMENDED THAT YOU TAKE MEASURES TO ENSURE THAT YOU DO IN FACT UNDERSTAND MATERIAL. TO THIS END, THE FOLLOWING IS RECOMMENDED (see next slide)

12

12

**1:** Try assigned homework problems yourself *without help.*

**2:** If #1 does not work, feel free to consult your peers

**3**: Come to help or 'office' hours and speak with TAs or the instructor. Many office hours are offered and you should have no difficulty finding at least one time convenient to you where you can get help. If not the case, contact the instructor.

**4**: The text has many problems at the end of chapters where numerical answers are provided. Work these out at your discretion; some of the assigned problems will include these (such problems won't be graded but solutions will be provided).

**5:** Don't fall behind. The material in this course is too dense for a 'catch-up', or 'cramming', approach to work effectively. And remember (for all of your classes)

***There is no substitute for daily preparation***

13

13

**Homework submission format:**

**Cover page:**

**first line:**

**-print your name (last name first)**
**-sign your name**
**-indicate submission date**

**second line: problem set number; due date**

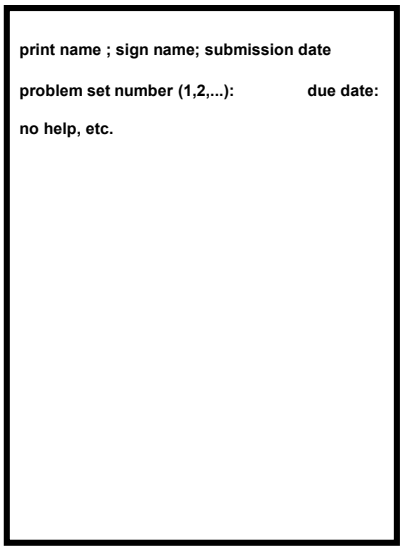
**third line(s)+:** list who you consulted and the materials you used (not counting the text, information in recitation or help hours, or your class notes) as follows:

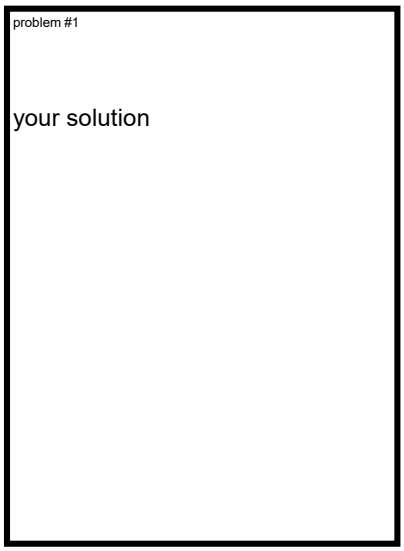
"no help" (i.e., you did the problems entirely on your own)
"I got help from (or worked with) Jane Smith, Bill Teasedale, etc."
"I copied the solution from Art Fern"
"I used the following websites..."

***You will not lose credit for giving credit,*** **but don't violate academic integrity rules:** ***be clear about who helped you. If you got help and you didn't acknowledge that help (per the above) you will be in violation of the Cornell Code of Academic Integrity.***

14

14

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15

15

Canvas site:
http://canvas.cornell.edu

Ed Discussion:
https://edstem.org/us/courses/54873

16

16