

DEPARTMENT OF CHEMICAL & BIOLOGICAL ENGINEERING
UNIVERSITY OF WISCONSIN

CBE 326: MOMENTUM- AND HEAT-TRANSFER OPERATIONS

Fall, 2007

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<u>Exam Schedule</u>		<u>Grading</u>	
<u>Exam</u>	<u>Date</u>	Midterm Exams (3 x 20%)	60%
1	Tues 10-2 (7:15pm)	Final Exam	20%
2	Tues 10-30 (7:15pm)	Design Assignment	10%
3	Tues 11-27 (7:15pm)	Weekly Homework	10%
Final	Fri 12-21 (2:45pm)		<u>100%</u>

Course Policies

- Exams will be open-book, open-notes.
- Since homework is allocated a portion of the course grade, homework assignments are to be *original, individual work*. Any use of existing solutions prior to submitting homework for grading is prohibited and considered unethical. This includes any solutions prepared by the instructor or previous TAs, or solutions worked out by students who took the course in a prior semester, regardless of how they might be obtained. Discussion among fellow students is acceptable as long as the discussion does not extend to giving answers and/or copying solutions.

The major way you will develop skill at engineering problem solving is by doing the homework problems. Short-circuiting this process is self-defeating, no matter how busy a given week might be. Both the instructor and the TA are eager to provide assistance when needed.

- Homework will be due on Friday at the beginning of the discussion period, and solutions will be posted on Mondays, unless stated otherwise. Homework will not be accepted late except by specific agreement of the TA.
- Students with legitimate reasons to reschedule an exam or turn in an assignment late are asked to inform the instructor in advance so that alternate arrangements can be made.

Texts:

1. McCabe, Smith, and Harriott, "Unit Operations of Chemical Engineering", McGraw-Hill, 7th ed. (2005).
2. Bird, Stewart, and Lightfoot, "Transport Phenomena", 2nd ed., Wiley (2002).

Recommended References:

1. Perry et al. (Eds.), "Chemical Engineer's Handbook", 7th Edition, McGraw-Hill (1997).
2. Levenspiel, O., "Engineering Flow and Heat Exchange", Rev. ed., Plenum (1998).
3. Holman, J.P., "Heat Transfer", 9th ed. (or most recent), McGraw-Hill (2002).
4. Johnson, R.W. (Ed.), "The Handbook of Fluid Dynamics", CRC Press (1998).
5. Schetz, J.A and A.E. Fuhs (Eds.), "Handbook of Fluid Dynamics and Fluid Machinery", Wiley (1996).
6. Hewitt, G.F. "Heat Exchanger Design Handbook", Hemisphere (1990). (Wendt Library reference section.)
7. Hottel, H.C. and A.F. Sarofim, "Radiative Transfer", McGraw-Hill (1967).
8. Kuppan, T., "Heat Exchanger Design Handbook", Marcel Dekker (2000).
9. Kays, W.M. and A.L. London, "Compact Heat Exchangers", 3rd Edition, McGraw-Hill (1984).
10. Siegel, R. and J.R. Howell, "Thermal Radiation Heat Transfer", 3rd Edition, Hemisphere (1992).

Course Schedule

<u>Date</u>	<u>Topic</u>	<u>Reading</u>
W 9-5	Course introduction; review of macroscopic, microscopic mass/momentum/energy balances	MSH-1; BSL-2,3,10,11
F 9-7	Macroscopic mechanical energy balance – Bernoulli equation	MSH-2,4; BSL-7
M 9-10	Qualitative fluid mechanics: turbulence, boundary layers, vortices, “skin” friction and “form” drag	MSH-3; P6–4-5
W 9-12	Flow in conduits; valves and fittings; flow systems and networks	MSH-5; BSL-5,6,7; P6–9-13,16-22
F 9-14	”	P10–67-102
M 9-17	”	
W 9-19	Compressible flow: isothermal, adiabatic, critical flow, shock waves	MSH-6; BSL-7,11
F 9-21	”	
M 9-24	Metering	MSH-8; P10–6-20
W 9-26	”	
F 9-28	Pumps and compressors	MSH-8; P10–20-37,45-56
M 10-1	”	
W 10-3	Compressors	
F 10-5	”	
M 10-8	Packed beds/porous media; tube banks	MSH-7; BSL-6; P6–36-40
W 10-10	Particles; Filtration	MSH-29; P6–50-54; MSH-7; BSL-6; P17–39-51, P18–74-105
F 10-12	Fluidized beds	MSH-7; P17–2-19
M 10-15	Cyclones, impingement, electrostatic precipitators	MSH-29; P17–22-39,51-59
W 10-17	Two-phase flow	P6–26-29
F 10-19	Mixing	MSH-9; P6–34-35, P18–5-22

Course Schedule (cont.)

<u>Date</u>	<u>Topic</u>	<u>Reading</u>
M 10-22	Thermal conduction in solids	MSH-10; BSL-9,10
W 10-24	Unsteady-state conduction in solids	MSH-10; BSL-12; P5-10-11
F 10-26	”	
M 10-29	Resistances, series and parallel; heat transfer coefficients, individual and overall	MSH-10,11; P5-9-10,12
W 10-31	Extended surfaces	MSH-15; BSL-10; P11-22-23,47-51
F 11-2	Macroscopic energy balance	MSH-11; BSL-15
M 11-5	Mean temperature difference and transfer units	MSH-11
W 11-7	T-Q diagrams, operating lines, effectiveness	MSH-11
F 11-9	Exchangers in series, parallel, and networks; nonlinear enthalpy lines	
M 11-12	Thermal contacting patterns, cross-current and multipass; MTD and pinches	MSH-15; P11-4-6
W 11-14	”	
F 11-16	Periodic unsteady-state contacting, regenerators	MSH-15; P27-52-54
M 11-19	Heat transfer coefficients in forced and natural convection; dimensionless groups; the analogy	MSH-12; BSL-14; P5-12-19, P11-25-27
W 11-21	”	
F 11-23	(Thanksgiving Recess)	
M 11-26	Condensation	MSH-13,15; BSL-14; P5-20-22
W 11-28	”	
F 11-30	Boiling	MSH-13,15; P5-22-23, P11-13-17
M 12-3	Shell-and-tube exchangers	MSH-15; P11-7-10,33-45
W 12-5	Radiation heat transfer	MSH-14; BSL-16; P5-23-27, P11-31-32
F 12-7	Assemblies and interchange factors	MSH-14; P5-27-32
M 12-10	Radiant transfer with gases	P5-32-40
W 12-12	Furnaces	P5-40-42
F 12-14	Summary topics	