ABE 341 Tentative Schedule – Spring 2024 – Lesson Plans, Outlines, Checklists

Continually Subject to ***Change and Improvement***

Wk*	#	Day	Date	Class Topic and Activity	Reading[+] & Assignments	What's Due?*
1		M	Jan 15	**MLK, Jr Day, No class**		
	1	W	Jan 17	Welcome and course intro ○ '23: first time taught in Sp ○ Print, distribute Eqn Sheets	1.1 - 1.7 PA.1	(check Canvas for due dates)ChBE 422 apparently has an exam each Friday
	2	F	Jan 19	Material balances, conversions (Ch 1) ○ Print and distribute Eqn Sheets ○ Bring Eq sheets and use with examples ○ HO sign up sheet ○ HO student intro survey ○ review Monday's key slides ○ slides – intro, begin Ch 1; review principles ○ ex: 1.5-5: Jam mixture MB ○ let students work ○ go through example ○ example 1.5-7: MB soy process ○ set up ○ let students work ○ work solution • Post Ch 2 slides	1.1 - 1.7 PA.2	PA.2 Send out class reminder about extra batteries, bring calculator for Q1
2	3	M	Jan 22	Conservation of energy, fluid statics and viscosity (begin Ch 2) • work Problem 1.6-5: EB, enthalpy • Finish Ch 1 slides ○ Heat of reaction ○ Conservation of energy • Ex 2.2-1: pressure in a tank	2.1 - 2.4 PA.3	PA.3, H1: 1.2-1, 1.3-3, 1.4-1, 1.5-1, -6, -10, 1.6-3, -4, 1.7-2, -4 Conversions, mole frac, mass %, mass bal, energy bal, steam tables
	4	W	Jan 24	Overall mass balance, energy balance, Newtonian, non-Newtonian, laminar and turbulent flow • Ex 2.2-1: pressure in a tank • Ex 2.2-3: jet fuel (biofuel?) • pressure head ex: work Tank on a Hill from old E1 F18 • Ex: return to mass balances; set up problem with recycle stream, discuss • ~~Ex. 2.4-2~~	2.4 - 2.6 PA.4	

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Wk*	#	Day	Date	Class Topic and Activity	Reading+ & Assignments	What's Due?*
				• Ch 2 Slides: Reynolds number, MB, continuity • Slides for Ch 2.5-2.7 • Ex 2.5-1: Milk Re • Ex 2.6-6: MB unsteady state		
	5	F	Jan 26	**Quiz 1** • '21: 46/50 • '20: 41.5/50 • '19: avg = 38/50 • '18: avg = 27.9/50 • '18: conversions, MB w/recycle, similar to previous lecture) ' • 17: avg=42/50 • Unit conversions, mass balances • Release Q1 solution.	1.1-1.7; H1	Q1 *(change problems to shake up file holders)*
3	6	M	Jan 29	Energy balances, laminar and turbulent flow • slides • ~~2.7-3 skip~~ • 2.5-1: Milk Re • 2.6-6: MB unsteady state • Discuss Q1 preparation, scope • Post H2 solution	2.6 - 2.8 PA.5	H2: 2.2-2, -4, -5, 2.5-2, 2.6-5 Hydrostatics, U-tube, Re, mass bal; should include pressure head problem
	7	W	Jan 31	Momentum balances • Starra Priestaf, IL PSM talks 5 min • 2.7-6 energy balance • slides • 2.8-3: nozzle impact on wall • 2.8-2: reducing bend with friction • Need to cover thru 2.9 since H3A gets to 2.9 • Shell momentum balance	2.8 - 2.10 PA.7	
	8	F	Feb 2	**Quiz 2** • '21: Pipe flow, NRe, unsteady mass balance • ('18: conversion, mass flow rate, Re of milk, 2.6-5 MB unsteady mixing) • '21: 46/50 • '20: 42.2/50 • '19: avg = 33/50 • '18: avg=36.5/50 • '17: 42/50	1.1-2.6; H1, H2	Q2 *(change problems to shake up file holders)*

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4	9	M	Feb 5	Momentum, mechanical energy balances, gases • Shell momentum balance • 2.10-3: straight pipe friction loss • 2.10-6 pump Hp, friction	2.10 - 2.11	H3A: 2.7-4, -7, -9, -12, 2.8-2, -8, 2.9-1

	10	W	Feb 7	Gases, Ethics Introduction – Part 1
				• 2.10-4 trial and error
				• gas flow
				• 2.11-2 compressible flow
				• '23: did 2.10-6, 2.10-4, but not 2.11-2 or Ethics intro
				• '23: only 3 slides left from Ch 2 at end of this lecture
				• New in '21
				  ○ Code of Ethics, Engineering Practice
				  ○ Discuss one of the scenarios in Loui's Ethics handout
				  ○ Only got thru first 6 slides of slide deck on Ethics
				• '18: 2.10-4 and 2.11-2 took the full period due to iterative nature
					2.10 – 2.11
					PA.10
						Ethics information posted

	11	F	Feb 9	**Quiz 2B** • '21: avg = 39/50 = 78% • '21: Q2B replaces E1 • Mult choice (vap press, temp diff, enthalpy, turb/lam, mc, water in truck, NRe milk, tank on a hill) • '20: avg = 81 (E1) • '18: mult choice (vapor press, temp conv, enthalpy, turb/laminar), %db mc, water in truck, mass flow rate, velocity, fric factor, tank on a hill • '18 avg – 70, but adjusted to 83.8 • '17: avg = 77; mult choice: conversions, steam, energy, m.c., Re, friction factor; pressure head • '17: mass flow, friction factor, pressure head • '15: "easy" E2 #1-8	H1, H2, H3A	Q2B
5	12	M	Feb 12	Flow past immersed objects, drag force, packed beds	3.1-3.2 PA.12	H3B: 2.10-2, -5, 2.11-3

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				• '23: pressure drop in gasses (3 slides)
				• '23: due to work 2.11-2 (a bit behind)
				• Code of Ethics, Engineering Practice
				  ○ Discuss one of the scenarios in Loui's Ethics handout
				  ○ Only got thru first 6 slides of slide deck on Ethics
				• '23: should begin Ch 3
				• '20: went until 11:40, could have covered more material than below; should have covered all of packed beds
				• Begin Ch 3 slides, fluidized beds
				• Ex 3.1-4 drag force
				• Ex 3.1-5 surface area, packed bed		

	13	W	Feb 14	Packed and fluidized beds • '23: 3.1-5 continued • Ethics part 1 • Ergun equation, packed beds • Darcy's law, fluidized beds • 3.1-8 flow in beds • 3.1-12 fluidization, expansion • 3.4-xx examples??	3.1, 3.2 PA.13	*'18: 3.4 was new section; part of Bastounes Honors work*
	14	F	Feb 16	**Quiz 3** • '21: KR gone, proctored by Amir • Fluid statics, gas flow, mom bal, energy bal • '18: manometer, max gas velocity, reducing bend (mom bal), pumping between 2 tanks (en bal, shaft work, kW input) • '21: 46/50 • '20: 37.5/50 • '19: 37/50 • '18: avg=39.5/50 • '17: avg=38/50 • '16: drying MB • '17: most took entire 50 min	2.2-2.11; H3A, H3B	Q3 *(change problems to shake up file holders)*

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6	15	M	Feb 19	Fluidized beds, flow measurement, agitation and mixing • '23: Darcy's law, fluidized beds • 3.1-12 fluidization, expansion • '23: 3.1-12 done; '22: Finish 3.1-12 • '23: Measurement of flow • '23: 3.2-1 pitot tube	3.1, 3.2, 3.4 PA.15	
	16	W	Feb 21	Agitation; scale up of vessels; non-Newtonian fluids • Section 3.4 slides • 3.4-3 p162 agitation scale up • Non-Newtonian fluids • 3.5-1 press drop banana puree • '20: skipped 3.4 but said we might revisit at a later time with jacketed kettles • '20: didn't get to 4.3-4, but should have since there was time	3.2, 3.5, 3.4	H4: 3.1-9, -10, -11, 3.2-4, 3.4-1, -7, 3.5-3 *('18: H4 due after this lecture)*
	17	F	Feb 23	**Quiz 3B** • '21: Q2B replaced E2; 4 problems very different from '20 to cover more problems from H3A, H3B, H4 • '20: based on time to finish exam, perhaps E2 is too easy or the file is available • '21: 45/50 • '20: avg=90.8 • '19: avg=93/100 • '18: packed bed calcs, en bal on pump, mass bal dryer, mom bal nozzle • '18: 83.6 • '17: avg=85; Short Q: packed bed • Pump soy oil EB, #2.7-7 • MB, simple • Momentum example #2.8-2 • Not asked: E1 '15 #9, 10	2.2-3.5; H3A, H3B, H4	Q3B
7	18	M	Feb 26	Conduction, convection • Return Q3B and discuss • Finish 4.3-4 • Problem 4.3-6	4.1-4.3 PA.18	

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Wk*	#	Day	Date	Class Topic and Activity	Reading[+] & Assignments	What's Due?*
	19	W	Feb 28	**Quiz 4** • '22: KR gone; proctored by Amir • '21: scope 3.4, 3.5 from H4 • '21: 46/50 • '20: avg=40.6/50 • '19: avg = 40/50 • '18: X area of Sched 40 pipe, fluid bed calcs, Pitot tube, non Newt fluid turb/lam, cond/conv through wall • '18: avg=39.7/50 • 5 problems, no mult choice • Pipe dimen., fluid bed, pitot tube, non-Newt Re, conduction • '17: avg=44/50 • mult choice: dimen no., h • fluidized beds, Ch 3.1 • cond, conv thru glass window • '17 Ch 3.1, 4.1-4.3 not 4.5-4.7 material • '16: dimen nos, fluid bed, htx window	3.4-3.5; H4	Q4
	20	F	Mar 1	Conduction, convection • '23 & '22: finish 4.3-6 • "example 3": buried pipe using Table 4.4-1 • 4.5-1 heating air by condensing steam • '21: did not start 4.5-4 • 4.5-4 log mean delta T begin • '20: ex 3 and 4.5-1 were previously covered in lecture 18; perhaps behind schedule? • discuss Q4 scope, eqn sheets	4.3 - 4.5	H5: 4.1-1, -2, 4.2-4, 4.3-2, -3, -5, -7
8	21	M	Mar 4	Forced and natural convection • '23: finished 4.6-2 Chilling meat • '22: 4.5-4 log mean delta T begin • 4.5-4 log mean delta T – finish • 4.6-2 conv heat tr coef • 4.6-4 force conv, HTX, long ex, iterative • '21: 4.6-2, part of 4.6-4; 4.5-4 was finished last week on Oct 6.	4.3-4.7 PA.21	

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				• Begin natural convection slides • '18: Distribute EIF, early informal feedback • Have class annotate Eq Sheet for R values for convection, conduction • review nat conv slides, EIF tally sheet		
	22	W	Mar 6	Natural convection, enclosed spaces • '23: did only 4.6-4, 4.7-1 • Prob 4.7-1: nat conv oven wall • Example Prob 4.7-2 nat conv cylinder (should do 4.7-2 before double pane window) • Ex: heat loss double pane window • '18: Discuss EIF, use tally page • slides give k_{eff} but text doesn't. need to create examples and homework using k_{eff} • Return Q4 • '17: only worked 4.7-2, could give more examples	4.7-4.8 PA.22	
	23	F	Mar 8	**Quiz 5** • '22: 3 of 4 students finished in 40 min; could be longer? • '22: avg= • '18: mult choice (nat conv, forced conv, defns of Gr, Nu, Re, Ra, Pr), log mean temp diff, S factor cond calc, conv to cool an orange • '21: 47/50 • '20: avg=38.8/50 • '19: avg = 34/50 • '18: avg 40.1/50 • '17: avg=42/50; H5, H6, thru 4.7, mult choice dimen nos, concepts, log mean T, wall cond, simplified cond, force conv • '16: mult choice dimen nos, log mean T, wall conduction	4.1-4.3; H5	Q5
9				Mar 9-17 **Spring Break**		
10	24	M	Mar 18	Boiling and condensation ○ '23: start with 4.7-2 nat conv ○ '22: double pane window ex.	4.8A&B PA.24	H6: 4.4-3, 4.5-3, 4.6-3, 4.7-4

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				○ '20: watched most of video after introducing boiling ○ Ex: nucleate boiling ○ '19: lecture only on boiling, youtube video (water), Example 11 nucleate boiling (prewritten shown on doc cam), said I would post videos of same example ○ text does boil/cond first, then goes back to convection in HTX ○ outline M and W classes, Oct 22, 24 ○ Boiling theory, Leidenfrost video ○ Ex: "example 11" nucleate boiling ○ Eqn sheets need Rohsenow eqn, Csf, n, sigma info • '15: Could use more examples worked, develop more material from Cengel or Geankoplis 4.x subsections		
	25	W	Mar 20	Condensation • '23: boiling, condensation, log mean Temp, m-dot for HTX examples • '22: finish boiling example • '20: condensation only; 1 example; E3 scope; finished at 11:35, could have lectured more? • '19: in class activity, 6 questions on Ch 4 • Review Exam 3, scope • Ex: "example 12" condensation • '19: finished with plenty time, could add an example • Note: '15 lecture length was relatively short. Could use more examples, develop more material from Geankpls 4.x subsections	4.8A&B	H7A**
	26	F	Mar 22	**Quiz 5B** • '22: avg= • '21: replaces Exam 3 • '21: avg = 43/50 • '19: avg = 86.3; std dev = 13.8	3.1-3.5, 4.1-4.7 H4, H5, H6; Q4, Q5	Q5B

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				• '18: avg=85.1; mult choice (Nu, Re, Gr, Ra, density), fluid bed, cond wall (2), log mean temp diff (parallel, c'curr), eval htx configs, orange cooled film coeff • '18: scope should be W4, W5, H4, H5, H6, not boil or cond. • '17: avg=92; dimen nos, concepts, lmTdiff (2), H5, H6, forced and nat conv, not boiling or condens. • '16: 85% avg, dimen nos, lmTdiff (2), wall cond, drag F, forced conv • E2 '15 #1 to 5, mult choice, add W4, 5 problems		
11	27	M	Mar 25	Heat exchangers, correction factor, log mean temperature difference (again) • '21 and '20: recorded this lecture since out of town • '19: ex. 13, 14 (log mean temp diff) and #4.9-1 (F_T adjustment; a.k.a. ex. 15) • '18: example 13 and 14 • '17: Need to cover enclosed space nat conv ht trans with keff • '17: Ex 13, 14, 15 (4.9-1) • '16: did Ex 13, 14, 15 with discussion; did not get through all of Example 16 (effectiveness). No fouling covered. • '15: lecture length was relatively short. Could use more examples worked, develop more material from Geankoplis 4.x subsections	4.9	
	28	W	Mar 27	Heat exchangers • '20: HTX effectiveness, one example; HTX fouling research, Mel George quote, Fun Facts 2 & 3; went well, but had about 10 min to spare – keff example next time? • '19: Ex. 16 or 4.9-2 p298 Example 15: 1-2 HTX effectiveness	4.9	

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				• Eqn sheet annotations: Condensation • W6 scope: H7A and H7B • recapped heat exchanger calculations, rationale • '17: noted W7 doesn't have any corresponding homework • Ex "16" or Ex 4.9-2 p298 finished • Briefly fouling		
	29	F	Mar 29	Radiation / EOH – lecture on zoom? • Begin radiation • Ex 17: baking a loaf of bread • View factors • '20: 4.11-5 perpin plates • '20: had 5 min for questions at end • '19: distributed EIF (early informal feedback), should have been earlier in semester • '19: Begin radiation thru combined radiation and convection, baking bread example • '19: plenty of time; should have started view factors, leaving more time for fins	4.10-4.11	H7B** (convection)
12	30	M	Apr 1	**Quiz 6** *(old W6 and 7 combined)* • '21: avg = 41/50 • '20: avg=35.5/50 • '19: avg = 40/50 • '18: T/F boil, t/f cond, nat conv horz cyl, boil, cond, F_T, log mean temp diff of 1-4 htx, heat bal on htx, calc U for 1-2 htx • '18: W6 avg = 51/64 or 79.6% • '18: long, tough W; 11 T/F boil/cond; 5 problems; H6. H7A, H7B • '17: W6: avg=48/50 • '17: begin in class, then take home, turn in Friday • '16: W6 was longer than usual and had a lot of calculations (avg = 74%). Overall, many students	4.5, 4.8A,B; H6, H7A,B	Q6 *('18: combined W6 & W7 from '17, created only one assignment per week)*

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				finished most of W6 in 50 min. More students stayed the full 50 min than any other W or E to date. • **W7** • '17: T/F, condensation, log mean delta T, 1-4 and 1-2 HTX, NTU, effectiveness • '17: avg=41/50; overall HT coefficient, HT rates; seemed about right length • '16, '17: no homework on T_{lm}, F_T		
	31	W	Apr 3	Radiation, jacketed kettles, special HTX coefficients, fins • Finish radiation • Ex 19: 4.11-9 radiation between disks • Ex 20: 4.13-3 fin • 4.13A, B discuss what will be on Q7 • 4.13B – scraped surface HTX but no examples	4.10-11, 4.13A-C PA.31	Radiation H8: 4.9-2, 4.9-4, 4.10-3, -5, 4.11-3, -6, 4.11-8, 4.13-1, -4*; H8 revised in '21 to include 4.9-2 & -4; this was H9 in '16*
	32	F	Apr 5	**Quiz 7** (old W7 F18, old W8 F17) ○ '21: avg = 42/50 ○ '20: avg= 40.7/60 ○ '19: avg = 37.5/50=75% ○ '18: 38.3/50 ○ '17: avg=38/50; most finished on time, several rushed ○ '18: simp eqs for Ra, h horz pipe, perpind plate view factor F12, #4.11-8 view fact parallel squares, jacketed agitated vessel, longitudinal fin ○ '18: based on H8: #4.10-3 and/or 4.10-5 (add table 4.7-2) to W7 front page ○ '17: parallel plate radiation, view factor, longitudinal fin efficiency, jacketed vessel ○ '16: W8 several rushed to finish ○ '16: covered topics since E4 thru 11.9 (radiation, fins, agitated vessels, lumped capacity)	4.7, 4.9, 4.10, 4.11; H6 and H8	Q7

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				○ '15: W8 was done within the hour		
13	33	M	Apr 8	Unsteady (transient) heat transfer • '21: started 5.3-4; had about 4 min left in period • '20: Ch 5 intro, 5.2-3 only; in 30 min, had 20 min to spare • '19: finished fins; fin example, stirred tank example, returned Q7. Had 5 min leftover. If fins were finished in previous lecture, would have had a lot of time to cover transient heat transfer. • Ex: 5.2-3: unsteady heating stirred tank • Skipped 4.12: Non-Newtonian fluid flow • 2015: used examples from ABE 483, separate slides module reviewing Ch 3 and 4 (~20 min)	5.1-5.3 ~~3.5, 4.12~~	
	34	W	Apr 10	Unsteady (transient) heat transfer • '22: KR out of town for Nov 9 and 11; recorded lecture given Nov 9 • '21: H9 and H9B created so that H9 covers 5.2 and 5.3 only, and can be covered on Q7B • '19: Heisler charts, 5.3-4, then stopped with 10 min left. Should have went on to do 5.3-10. • Heisler charts • 5.3-4: heating wall with insulation • 5.3-10: hardening steel sphere • Q7B scope	5.1-5.3	H9: 5.2-1, 5.3-2, -8
	35	F	Apr 12	**Quiz 7B** • '21: replaces Exam 4 • '21: avg = 42/50 • '19: avg=75.5 • '19 scope: 5 probs, H7A, H7B, H8, Q6, Q7; no fins, no transient HT • '18: avg = 81.7 • '17: avg=79 • '16: 87% avg, boil, cond, lmTdiff, q NTU, concen cyl htx	4.13, 5.2, 5.3, H8, H9; Q6, Q7	Q7B

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				• '19: forced conv, HTX (ΔTlm, ΔTm, F_T), conden, HTX (NTUs), perpin plate view factor • '18: t/f boil, t/f cond, matching, 2-4 HTX, nat conv, conden, vert plates, cond calc, not boiling (for length), HTX effectiveness, NTU • "W6, W7, H7" and "some mult choice" • E2 '15 #6 to 13 ? (long)		
14	36	M	Apr 15	Unsteady heat transfer (cont) • 5.3-10: hardening steel sphere • Chilling and freezing meat examples (2) • Chilling meat from Cengel (ex. 4-11) • 5.5-2 Freezing meat • Q/Q_{max} graphs • Scope of W8 and W9 • Add discussion, example from 5.5 Heisler charts	5.1-5.3, 5.5	'18: was out of town for Q8 and Q9
	37	W	Apr 17	Unsteady heat transfer, Ethics Part 2 • '21: plan to discuss another Loui ethical scenario, present Challenger YouTube video(s) • Product method, finite cylinder • '20: short brass cylinder; did not cover total heat transfer or its example • '20: did not start diffusion • '19: covered product solution method and an example (short brass cylinder); did not cover Q/Qmax slides • Product solution method • Cooling finite cylinder • Ex: Cengel 4.8, 4.9 (requires Fig 4.16c Cengel), 4.11 Cengel p.257ff • HOs: Figs 4-16, 4-17 from Cengel p240	5.1-5.3, 5.5	H9B: 5.5-1, -4
	38	F	Apr 19	**Quiz 8** *(old W9 F17)*	5.3, 5.5 H9, H9B	Q8

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				• '23: Q8 swapped with 1st diffusion lecture due to KR conflict (Fri swapped with Mon) • '22: in person • '21: avg = 44/50 in person • '20: avg=39.5/50 • '19: avg = 32.7/50 • '19: lumped capacity, large slab, short cylinder. Should have added freezing problem. • '18: take home since out of town, no proctor • '18: lumped capac, semi infinite slab, finite cylinder • '18 take home; avg: 43.7/50 • '17: avg=40/50 • '17: lumped capacity, transient htx to find therm diffusivity, time to cool center, short Al cylinder		
15	39	M	Apr 22	Molecular diffusion • 6.1-2: binary gas mixture • 6.2-3: A through stagnant B 6.3-4: diffusivity of methanol in H2O	6.1-6.3	
	40	W	Apr 24	Molecular diffusion (cont) • 6.3-4 cont • 6.4-4: diffusion of uric acid in protein solution, protein binding • 6.5-3 diffusivity and permeability • F16, 15: lecture went to about 40 min • need diffusion through liquids, solids development (section 6.5)	6.1-6.5	
	41	F	Apr 26	Ethics wrap up • '21: Order of the Ring – ethics • '21: FE and PE discussion • '21: replaces Exam 5 • '19: avg=84 • '18: perpin plates (radiation, view factor), fin eff, fin heat loss, stirred tank heat change, slab of beef (th. Diff, time to cool), diffusivity estimate for oxygen through protein	Exam 5: 5.1-5.5, 6.1-6.4; H9, H10; Q8, Q9	H10: 6.1-1, 6.2-7, 6.3-3, 6.4-3, 6.5-7

+Reading from Geankoplis text, 4th edition or Quiz coverage
*Wk = week of semester; # = class no.; PA.x = participation activity for Class "x" on Canvas; H = Homework assigned from Geankoplis (4th ed); Q = Quiz

Wk*	#	Day	Date	Class Topic and Activity	Reading[+] & Assignments	What's Due?*
				• '18: many students finished early • '18: avg = 80.1 '17: avg=83; about 4 of 30 finished on time		
16	42	M	**Apr 29**	**Quiz 9** *(old W10 F17)* • '21: avg = 41/50 • '20: avg=40.8/50 • '19: 31.6/50 • '18: 1 t/f, eq mol c'diff, diffusivity estimation, protein diffusivity • '18: take home • '18: 44.9/50 • '17: avg=44/50 • '17: T/F, counterdiffusion, diffusivity • '16: T/F, counterdiffusion, diffusivity '15 and earlier: Q10 did not cover mass diffusion. No problems at all on 6.5.	TBA	Q9 *('16 & '17 the same; should change problems)*
	43	W	May 1	Review of course • Discussion of ethics essays, responses • Review & study strategies for Exam 5, Final • introduce "comment starters" • introduce ICES about 25 min total before ICES start		Ethics Essay
	44	Th	May 2	**Reading day**		
17		**Th**	**May 9**	8:00-11:00**AM**, room 208	**Comprehensive**	

**H7A&B assignment descriptions are posted in Canvas

[+]Reading from Geankoplis text, 4th edition or Quiz coverage
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