

CE 407 Separations

Credits

Credit hours: 3

Instructor: David Courtemanche (Fall 2018)

Textbook and/or other required materials

McCabe JC, Smith JC, Harriott P. 2005. Unit Operations of Chemical Engineering, 7th ed. McGraw-Hill, New York.

Catalog description

Staged operations of distillation, absorption, leaching, and extraction. Phase equilibria and application of equilibrium data to calculational methods provide knowledge of solution methods and limitations for binary and multicomponent systems.

Type	Prerequisites	Corequisites
Required	CE304, CE318	None

Course goals

The following table lists course learning outcomes for CE407. The statements generally complete the sentence “Upon completing this course, students should be able to...”

	Goal	ABET Student Outcome	Assessment Method
1	apply binary vapor-liquid equilibrium	1	Exams, homework
2	calculate binary flash distillation	1	Exams, homework
3	calculate multicomponent flash distillation	1	Exams, homework
4	calculate external mass & energy balances for distillation	1	Exams, homework
5	calculate internal mass balances for distillation	1	Exams, homework
6	apply basic McCabe-Thiele method	1	Exams, homework
7	apply McCabe-Thiele with open steam heating	1	Exams, homework
8	apply McCabe Thiele method with two feeds	1	Exams, homework
9	apply McCabe Thiele method with side streams	1	Exams, homework
10	calculate stripping columns	1	Exams, homework
11	calculate enriching columns	1	Exams, homework
12	analyze partial condensers and total reboilers	1	Exams, homework
13	calculate minimum & total reflux	1	Exams, homework
14	understand optimum reflux ratio	2	Exams, homework

15	apply overall efficiencies to distillation and absorption	1	Exams, homework
16	apply the Fenske/Underwood/ Gilliland method	1	Exams, homework
17	analyze steam distillation	1	Exams, homework
18	describe extractive & azeotropic distillation	1	Exams, homework
19	describe an overall design procedure for distillation columns	2	Exams, homework
20	describe energy saving methods for distillation	2	Exams, homework
21	describe trays and packing used for distillation and absorption	1	Exams, homework
22	apply hydraulic design methods for packing and trays	1	Exams, homework
23	choose the best tray or packing for the application	1	Exams, homework
24	calculate column diameter and height	1	Exams, homework
25	analyze constant reflux ratio batch distillation	1	Exams, homework
26	analyze constant distillate batch distillation	1	Exams, homework
27	calculate absorption of dilute gas mixtures graphically	1	Exams, homework
28	calculate absorption of dilute gas mixtures using Kremser equation	1	Exams, homework
29	calculate stripping of dilute gas mixtures graphically	1	Exams, homework
30	calculate stripping of dilute gas mixtures using Kremser equation	1	Exams, homework
31	calculate absorption of rich gas mixtures	1	Exams, homework
32	calculate absorption & stripping of multicomponent mixtures	1	Exams, homework
33	calculate crossflow L-L extraction- immiscible solvents graphically	1	Exams, homework
34	calculate crossflow L-L extraction -immiscible solvents analytically	1	Exams, homework
35	calculate countercurrent immiscible L-L extn analytically & graphically	1	Exams, homework
36	calculate crossflow L-L extn with miscible solvents	1	Exams, homework
37	calculate countercurrent L-L extn with miscible solvents	1	Exams, homework
38	calculate absorption columns assuming continuous contact	1	Exams, homework

Student Outcome Support

0: No coverage, 1: Introduced, 2: Practiced/Reinforced, 3: Mastered

Student Outcome	1	2	3	4	5	6	7
Support Level	3	2	0	2	0	0	1

Topics Covered

economic trade-offs	minimum solvent rate	valve tray design
concentrated immiscible extraction	tray efficiencies	packed column internals
single-stage and cross-flow systems	flash distillation	stripping analysis
mixing calculations and the lever-arm rule	column diameter calculations	height of packing: HETP method
countercurrent extraction cascades	dilute multisoluble absorbers and strippers	tower diameter
single-stage and cross-flow extraction	analytical solution: Kremser equation	sieve tray layout and tray hydraulics
multicomponent distillation	staged column equipment description	packed column flooding and diameter calculation
column distillation: internal stage-by-stage balances	batch distillation	generalized McCabe-Thiele and Kremser procedures
complex distillation methods	operating lines for absorption	countercurrent extraction