

CE 407 Separations

Credits

Credit hours: 3

Instructor: David Courtemanche (Summer 2020)

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 and multicomponent flash distillation	1	Exams, homework
3	calculate external mass & energy balances for distillation	1	Exams, homework
4	calculate internal mass balances for distillation	1	Exams, homework
5	apply basic McCabe-Thiele method	1	Exams, homework
6	calculate stripping and enriching columns	1	Exams, homework
7	analyze partial condensers and total reboilers	1	Exams, homework
8	calculate minimum & total reflux	1	Exams, homework
9	understand optimum reflux ratio	1	Exams, homework
10	apply overall and Murphree efficiencies to distillation	1	Exams, homework
11	apply the Fenske/Underwood/ Gilliland method	1	Exams, homework
12	describe an overall design procedure for distillation columns	2	Exams, homework
13	describe trays and packing used for distillation and absorption	1	Exams, homework
14	apply hydraulic design methods for packing and trays	1	Exams, homework
15	calculate column diameter and height	1	Exams, homework
16	analyze constant reflux ratio batch distillation	1	Exams, homework

17	analyze constant distillate batch distillation	2	Exams, homework
18	calculate absorption of dilute gas mixtures graphically and with Kremser equation	2	Exams, homework
19	calculate stripping of dilute gas mixtures graphically and with Kremser equation	1	Exams, homework
20	calculate crossflow L-L extraction- immiscible solvents graphically & analytically	1	Exams, homework
21	calculate countercurrent immiscible L-L extraction analytically & graphically	1	Exams, homework
22	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	0	0	0	0

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
countercurrent extraction	operating lines for absorption	