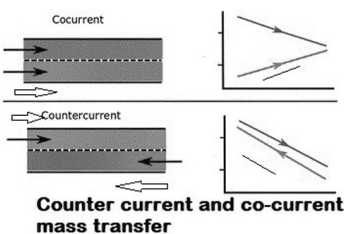


22BT303 HEAT AND MASS TRANSFER



source: <https://www.chemicalslearning.com/2022/06/counter-current-and-cocurrent-mass.html>

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Chemical engineering principles in biotechnology.

COURSE DESCRIPTION AND OBJECTIVES:

The objective of the course is to train students with the knowledge and skills required to solve problems for the design, analysis and assessment of heat and mass transfer processes. It also helps to optimize the cost of heat and mass transfer operations.

MODULE-1

UNIT-1

6L+0T+6P=12 Hours

HEAT TRANSFER MODES AND MECHANISMS

Conduction, convection and radiation, Fourier's law, Newtons law of cooling / heating, Stefan's Boltzmann law, thermal conductivity, steady state heat transfer in constant and variable area objects, energy balances, LMTD, overall and individual heat transfer co-efficients, thermal boundary layer.

UNIT-2

10L+0T+10P= 20Hours

HEAT EXCHANGE EQUIPMENT DESIGN

Empirical correlations for forced convection heat transfer in laminar and turbulent flow, natural convection to air from vertical and horizontal planes, industrial problems of natural and forced convection, general design of shell and tube heat exchangers, condensers, boilers, calandrias and evaporators.

PRACTICES:

- Estimation of rate of heat transfer through metal rod.
- Calculation of heat transfer coefficient through natural convection.
- Calculation of heat transfer coefficient through forced convection.
- Assessment of LMTD and rate of heat transfer for double pipe heat exchange in co-current and countercurrent pattern.
- Determination of LMTD, rate of heat transfer and efficiency of shell and tube heat exchanger.

MODULE-2

UNIT-1

6L+0T+6P=12 Hours

MASS TRANSFER OPERATIONS

Classification of mass transfer operations, Fick's law of diffusion, mass transfer coefficients, interphase mass transfer, basics of absorption and distillation.

UNIT-2

10L+0T+10P=20 Hours

DESIGN OF MASS TRANSFER OPERATIONS

Determination of minimum flow rate of solvent and operating lines for counter and co-current absorption and stripping of single component transfer, Steam distillation, estimation of number of trays through graphical McCabe - Thiele method for binary distillation, flash vaporization and differential distillation.

PRACTICES:

- Separation of miscible liquid mixture using simple distillation.
- Determination of degree of separation for miscible liquids using liquid-liquid extraction.
- Determination of no. of trays required for desired degree of separation using graphical McCabe-Thiele method.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply principles of heat and mass transfer to industrial problems.	Apply	1,2	1,2,4,9,10
2	Analyze problems on natural and forced convection.	Analyze	1	2,5,7,9,10
3	Develop equations for design of heat and mass transfer equipment.	Create	1,2	2,3,9,10
4	Evaluate no. of stages required for given degree of separation in mass transfer operations.	Evaluate	2	3,4,5,9,10
5	Evaluate minimum amount of solvent required for given degree of absorption mass transfer process.	Evaluate	2	2,4,5,7,9,10

TEXT BOOKS:

1. Warren L. McCabe, Jullian C. Smith and Peter Harriott, "Unit Operations of Chemical Engineering", 7th edition, McGrawHill, 2017.
2. R.E.Treybal, "Mass Transfer Operations", 3rd edition, McGraw Hill, 2017.

REFERENCE BOOKS:

1. K. A. Gavhane, "Heat Transfer Operations", 19th edition, Nirali Prakashan, 2019.
2. C. J. Geankoplis, "Transport Processes and Unit Operations", 3rd edition, Prentice Hall, 1993.
3. Ann Marie Flynn, Toshihiro Akashige and Louis Theodore, "Kern's Process Heat Transfer", 2nd edition, Wiley, 2019.

SKILLS:

- ✓ Design and operation of heat exchangers.
- ✓ Determination of LMTD and effectiveness of heat exchangers.
- ✓ Estimation of heat and mass transfer coefficients.
- ✓ Calculation of number of stages for given degree of separation in mass transfer operations.