19BT302 HEAT AND MASS TRANSFER FOR BIOTECHNOLOGISTS

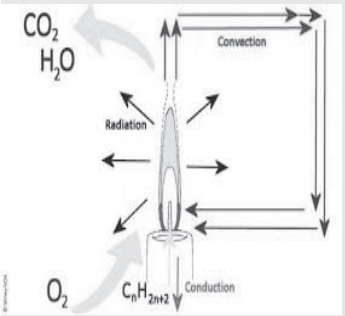
Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
20	50	-	3	2	2



Source:
http://ecoursesonline.iasri.res.in/course/view.php?id=61

COURSE DESCRIPTION AND OBJECTIVES:

The course aims to develop familiarity with major heat transfer operations. It also enables students to develop familiarity with design of heat transfer equipment and optimize the cost of heat transfer operations.It imparts knowledge of different mass transfer operations used in industries and design of mass transfer equipments.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Understand the concepts of various heat and mass transfer operations.	1, 2
2	Apply heat and mass transfer operations to industrial problems.	1
3	Analyze heat transfer operations with and without phase change.	2
4	Evaluate no. of stages required for given separation in mass transfer equipments.	3, 4
5	Design heat and mass transfer equipments.	1, 3

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.*

UNIT - I **L-9**

MODES OF HEAT TRANSFER: Modes of heat transfer; Fourier's law, thermal conductivity; Steady state conduction in plane wall and composite walls; Heat flow in cylinder and spheres, Countercurrent and parallel current flows; Energy balances, Rate of heat transfer, Overall heat transfer coefficient, Logarithmic mean temperature difference, Individual heat transfer coefficients.

UNIT - II **L-9**

HEAT TRANSFER TO FLUIDS WITHOUT PHASE CHANGE AND WITH PHASE CHANGE & RADIATION: Thermal boundary layer, Heat transfer by forced convection in laminar flow and turbulent flow; Natural convection to air from vertical and horizontal planes, Heat transfer from condensing vapors and heat transfer to boiling liquids; Heat transfer by radiation.

UNIT - III **L-9**

DESIGN OF HEAT TRANSFER EQUIPMENTS: General design of heat exchange equipment, Heat exchangers, Condensers, Boilers and Calandrias; Liquid characteristics; Types of evaporators, Performance of tubular evaporators, Enthalpy balances for single effect evaporator.

UNIT - IV **L-9**

DIFFUSION AND MASS TRANSFER: Mass transfer operations, Molecular diffusion in fluids, Fick's law of diffusion, Steady state equimolar counter current diffusion, Mass transfer coefficients; Interphase mass transfer, Theories of mass transfer.

UNIT - V **L-9**

MASS TRANSFER OPERATIONS: Introduction, Counter and co-current isothermal absorption and stripping of single component, Operating lines, Minimum flow rate, Determination of number of transfer units and height of continuous absorber, Determination of number of plates; Steam distillation, Flash vaporization and differential distillation for binary and multi component mixtures.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS **TOTAL HOURS: 30**

1. Identification of various flow patterns (laminar and turbulent) using Reynolds apparatus.
2. Verification of Bernoulli's equation for variable cross sectional pipe.
3. Determination of coefficient of discharge for Venturi meter.
4. Estimation of coefficient of discharge for Orifice meter.
5. Assessment of pressure drop for packed bed reactor.
6. Determination of pressure drop for fluidized bed reactor.
7. Determination of various characteristic curves of single stage centrifugal pump.
8. Estimation of rate of heat transfer through metal rod.
9. Calculation of heat transfer coefficient through natural convection.
10. Calculation of heat transfer coefficient through forced convection.
11. Assessment of LMTD and rate of heat transfer for double pipe heat exchanger in cocurrent and counter current pattern.
12. Determination of LMTD, rate of heat transfer and efficiency of shell and tube heat exchanger.
13. Determination of degree of separation for miscible liquids using liquid-liquid extraction.
14. Separation of miscible liquid mixture using simple distillation.

TEXT BOOKS:

1. Warren L. McCabe, Jullian C. Smith and Peter Harriott, "Unit Operations of Chemical Engineering", 7th edition, McGraw Hill, 2005.
2. R. E. Treybal, "Mass Transfer Operations", 3rd edition, McGraw Hill International, 1981.
3. A. Suryanarayana, "Mass Transfer Operations", 1st edition, New - Age, International, 2006.

REFERENCE BOOKS:

1. D. Q. Kern, "Process Heat Transfer", McGraw-Hill, 2001.
2. C. J. King, "Separation Processes", 2nd edition, McGraw Hill, 2014.
3. P.M. Doran, "Bioprocess Engineering Principles", 2nd edition, Academic Press, 2012.
4. K. A. Gavhane, "Heat Transfer Operations", 19th Edition, Nirali publications, 2008.