

20FT017 - HEAT AND MASS TRANSFER

Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P
45	15	-

WA/RA	SSH/HSB	CS	SA	S	BS
15	30	-	5	5	-

Course Description and Objectives:

This course deals with technologies related to heat transfer, processing, of food items like milk, juices etc. The objective of this course is to impart skill and knowledge required to apply the principles and concepts behind 'heat and mass transfer' processing including conduction , convection , radiation etc of the products.

Course Outcomes:

Upon successful completion of this course student should be able to:

- Gain knowledge on heat and mass transfer
- Know about drying curves designing of heat exchanger, pasteurization and sterilization
- Know the certain dryer working principle like spray dryer

SKILLS

- ✓ Identify the instrument in dairy processing, juice industry and extruded products .
- ✓ Explain and understand the why a particular time temperature combination is used for sterilization of food .
- ✓ Suggest suitable time and temperature for processing of perishable food items

UNIT-I

Conduction heat transfer: Introduction to heat and mass transfer and their analogous behavior - steady and unsteady state heat conduction - analytical and numerical solution of unsteady state. Convection: Free and forced convection, dimensionless numbers in convective heat transfer, heat transfer coefficients, Laminar and turbulent heat transfer inside and outside tubes and finned tubes, Natural convection. Radiation: Kirchhoff's Law, Stephen's Law Heat flux by radiation.

UNIT-II

Convective heat transfer: Convective heat transfer in food processing systems involving laminar, Pasteurization and Sterilization - Basic concept, Kinetics of Microbial Death. Energy requirement and rate of operations involved in process time evaluation in batch and continuous sterilization.

UNIT-III

Heat exchanger: Design of heat exchanger - parallel and counter flow – types - plate heat exchanger, shell and tube type heat exchanger, Effectiveness, flow arrangement.

UNIT-IV

Radiation heat transfer: Diffused radiation - angle factor - rate of radiant loss - absorption factor method - uniform radiation. Concentration and Evaporation: Concentration of liquid foods in batch and continuous type evaporators; heat and energy balance in single and multiple effect evaporators;

UNIT – V

Mass transfer: Mass transfer-molecular diffusion in gases, liquids, solids, biological solutions and suspensions - Drying of Foods: various mechanisms of moisture removal in solid and liquid foods during drying; properties of air-water vapor mixture; psychrometry.

ACTIVITY:

- o To study the design of Spray dryer

TEXT BOOKS:

1. Bird R. Byron, Warren E. Stewart and Edwin N. Lightfoot. 2006. Transport Phenomena. Wiley India Pvt. Ltd., New Delhi.
2. Earle, R.L. 1985. UNIT Operations in Food Processing. Pergamon Press, UK
3. Geankoplis J. Christie. 1999. Transport Process and UNIT Operations. Third Edition, Prentice Hall of India, NewDelhi.

REFERENCE BOOKS:

1. McCabe L. Warren, Smith C. Jullian and Peter Harriott.1993. UNIT Operations of Chemical Engineering. McGraw Hill Inc. New York.
2. Paul Singh, R. and Dennis R. Heldman. 2004. Introduction to Food Engineering. Elsevier India Pvt. Ltd., NewDelhi.
3. Sinnott, R.K.2000. Coulson and Richardson's Chemical Engineering. Volume VI. Butterworth Heinemann, New delhi