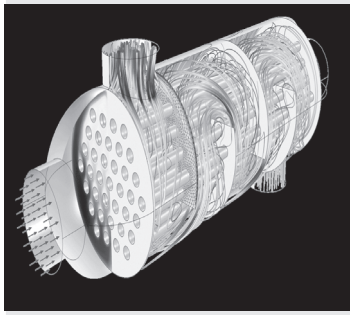
19AG204 HEAT AND MASS TRANSFER



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Hours Per Week :

L	T	P	C
2	0	0	2

Total Hours :

L	T	P
30	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
2	40	2	5	2	2

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with the basics of heat and mass transfer properties of material and applications of different heat transfer processes in various food engineering aspects. The objective of this course is to enable the student to analyze heat as well as mass transfer phenomenon that takes place during food processing.

COURSE OUTCOMES:

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

COs	Course Outcomes	POs
1	Understand, discuss and apply the principles of heat and mass transfer to basic engineering systems.	---
2	Apply the knowledge of conduction, convection and radiation heat transfer in designing heat exchangers and other equipments.	2
3	Create new technology after finding out problems that take place during the radiation test develop new technology.	3
4	Analyse the trend and current scenario of industries where different heating equipments are used and advise convenient ideas too.	4,7
5	Create and develop new equipments by applying knowledge of drying, evaporation distillation and freezing.	9,12
6	Create different components of dryer, freezer, evaporator by considering heat transfer and mass transfer coefficient and fouling factor.	9,12

SKILLS:

- ✓ *Calculate various thermal properties like thermal conductivity, specific heat, thermal diffusivity for various food materials.*
- ✓ *Understand the basic principles of conduction, convection and radiation.*
- ✓ *Recognize the various types of fins and identify its application in food industry.*
- ✓ *Calculate critical thickness of insulation and its application in cold storage design.*
- ✓ *Analyze various types of heat exchangers and design it according to its effectiveness.*

UNIT -I **L- 6**

Basics and conduction heat transfer: Introductory concepts, Modes of heat transfer, Properties related to heat transfer, Thermal conductivity of materials, Measurement, One dimensional steady state conduction through plane wall, tubes and spheres without heat generation, Electrical analogy and its application for thermal circuits.

UNIT - II **L-6**

Insulation and convection heat transfer: Insulation materials, Critical thickness of insulation, rectangular and circular fins, Fins with equation of temperature distribution and heat loss to atmosphere, effectiveness and efficiency of fins, Free and forced convection, Newton's law of cooling, Heat transfer coefficient in convection, Dimensional analysis of free and forced convection, Useful non dimensional numbers and empirical relationships for free and forced convection to determine heat transfer coefficient.

UNIT - III **L-6**

Radiation heat transfer: Heat radiation, Emissivity, Absorptivity, Reflectivity and transmissivity of radiation, Black body and monochromatic radiation, Planck' s law, Stefan-Boltzman law, Kirchoff' s law, Grey bodies and emissive power, Solid angle, Intensity of radiation, Radiation exchange between black surfaces,Geometric configuration factor or shape factor.

UNIT - IV **L- 6**

Heat exchangers: Shell and tube, plate, counter flow and concurrent heat exchangers, Fouling factor, Log mean temperature difference, Heat exchanger performance, No. of Transfer units, Heat exchanger design, Heat exchanger analysis restricted to parallel and counterflow heat exchangers. Application of heat exchanger in different food and dairy industry.

UNIT - V **L-6**

Mass transfer: Steady state molecular diffusion in fluids at rest and in laminar flow, Flick's law, Mass transfer coefficients, Mass diffusivity, Reynold's analogy, equimolal diffusion, isothermal evaporation of water into air, Application in dairy and food industry.

TEXT BOOK :

1. R. K. Rajput, 2015, "Heat and Mass Transfer", S. Chand and Company Pvt. Ltd.,2015.

REFERENCE BOOKS:

1. R. C.Sachdeva,2010, "Fundamentals of Engineering Heat and Mass Transfer", 7th edition, New Age International.
2. S. C. Arora and S. Domkundwar,2010, "A Course in Heat & Mass Transfer", 8th edition, DhanpatRai and Sons, Delhi.
3. C.J. Geankoplis,2003, "Transport Processes and UNIT Operations", 4th edition, Prentice Hall of India, New Delhi.
4. P. K. Nag, 2011, "Heat and Mass Transfer", 3rd edition, Tata McGraw Hill.