

Course code	Course Name	L-T-P - Credits	Year of Introduction
FT205	FUDAMENTALS OF HEAT AND MASS TRANSFER	3-1-0-4	2016
<b>Prerequisite: Nil</b>			
<b>Course Objectives</b> To understand basic principles of heat and mass transfer in food processing and equipment used.			
<b>Syllabus</b> Conduction- Convection - Heat exchangers -Molecular Diffusion in fluids and solids -Gas Liquid Operations -Vapour Liquid Operations			
<b>Expected outcome.</b> The student will be able to (i) apply basic principles and mechanism of heat transfer processes in the design of heat transfer equipment. (ii) apply mass transfer through molecular diffusion, gas liquid and vapour liquid operations in food processing.			
<b>Text Book:</b> 1. Geankoplis C.J. "Transport Processes and Unit Operations" 3 <sup>rd</sup> edition Prentice Hall of India, 2002 2. Coulson and Richardsons, Chemical Engineering. Vol I & II, Asiali Books Pvt ltd,1998			
<b>Data Book ( Approved for use in the examination):</b>			
<b>References:</b> 1. Treybal R. E.: "Mass Transfer Operations" 3 <sup>rd</sup> edition. McGraw Hill, 1981. 2. Binay K Dutta "Principles of Mass Transfer and Separation Processes" PHI Learning Private Ltd 3. Yunus A Cengel, "Heat and Mass Transfer: A practical Approach, 3 <sup>rd</sup> edition McGraw Hill, 2006 4. J P Holman "Heat transfer" 6 <sup>th</sup> Edition, McGraw Hill			
<b>Course Plan</b>			
Module	Contents	Hours	Sem. Exam Marks
I	<b>CONDUCTION,</b> Mechanisms of heat conduction - Thermal conductivity. Heat Diffusion Equation- Steady state Conduction in one dimension: Introduction- The Plane wall- Radial Systems-Insulation and R values- multi layer plane walls, cylinders and Spheres; Concept of Individual and Overall heat transfer Coefficient- Critical Thickness of Insulation-Thermal contact resistance- Unsteady State Conduction-Introduction- Lumped Capacity Systems	9 hrs	15%
II	<b>CONVECTION :</b> Basic Concepts –Heat Transfer Coefficients – Boundary Layer Concept–Types of Convection – Free convection – Forced Convection – Dimensional Analysis –Boiling and Condensation: Pool boiling, Flow boiling, Film Condensation, Nusselt analysis, Drop wise condensation; Boilers and condensers.	10 hrs	15%

<b>FIRST INTERNAL EXAMINATION</b>			
<b>III</b>	<b>Heat Exchangers:</b> Types of Heat Exchangers – Heat Exchanger Analysis – LMTD Method and NTU method - Effectiveness – Overall Heat Transfer Coefficient – Fouling Factors. <b>Radiation:</b> Basic Concepts, Laws of Radiation – Stefan Boltzmann Law, Kirchoffs Law –Black Body Radiation– Radiative properties	10hrs	15%
<b>IV</b>	<b>MOLECULAR DIFFUSION IN FLUIDS AND SOLIDS:</b> Concentration, Flux, Velocity, Fick's Law, Steady State molecular diffusion through constant area in a Binary Gas Mixture-Multi component Diffusion-Gas phase diffusion Coefficient-Diffusion Through Variable Area-Knudsen Diffusion-Surface Diffusion-Self diffusion- Application; Mass Transfer coefficients: Types of mass Transfer Coefficient-Dimensionless Groups in Mass Transfer-Eddy diffusion-Theories of Mass Transfer , Analogies in Transport Phenomenon; Interphase Mass Transfer: Equilibrium between phases, Raoult's Law and Henry's Law, Mass Transfer between Two Phases- The overall Mass Transfer Coefficient	9hrs	15%
<b>SECOND INTERNAL EXAMINATION</b>			
<b>V</b>	<b>GAS LIQUID OPERATIONS :</b> Principles of gas absorption; Single and Multi component absorption; absorption with Chemical Reaction; Design principles of absorbers; Industrial absorbers; NTU HTU concepts.	9hrs	20%
<b>VI</b>	<b>VAPOUR LIQUID OPERATIONS :</b> V-L Equilibria; Simple, Steam and Flash Distillation; Continuous distillation; McCABE-THIELE Principles; azeotropic and Extractive distillation, Industrial distillation equipment, HETP, HTU and NTU concepts.	9hrs	20%
<b>END SEMESTER EXAM</b>			

**Question Paper Pattern :** Max. marks: 100, Time: 3 hours

The question paper shall consist of three parts

**Part A**

4 questions uniformly covering modules I and II. Each question carries 10 marks  
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part B**

4 questions uniformly covering modules III and IV. Each question carries 10 marks  
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

**Part C**

6 questions uniformly covering modules V and VI. Each question carries 10 marks  
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

**Note:** In all parts, each question can have a maximum of four sub questions, if needed.