



Department of Chemical Engineering		LP: CH22401
B.Tech: Chemical Engineering	Regulation: 2022	Rev. No: 00
PG Specialisation : N/A		Date: 24/02/2021
Sub. Code / Sub. Name : CH22401 / HEAT TRANSFER		
Unit I : Heat Transfer by conduction		

Unit Syllabus: Importance of heat transfer in Chemical Engineering operations - Modes of heat transfer – Fourier's law of heat conduction - one dimensional steady state heat conduction equation for flat plate, hollow cylinder, spheres - Heat conduction through a series of resistances - Thermal conductivity measurement; effect of temperature on thermal conductivity; Heat transfer in extended surfaces.

Objective: Understand the theoretical knowledge on the importance of heat transfer in Chemical engineering operations and the concept of heat conduction

Session No *	Topics to be covered	Ref	Teaching Aids
1	Importance of heat transfer in Chemical Engineering operations, Modes of Heat Transfer	T1 Pg. 1-4	BB/ PPT
2	Fourier's law of heat conduction, Heat transfer Coefficient	T1 Pg. 1-4	BB/ PPT
3	One dimensional steady state heat conduction equation for flat plate, composite wall	T1 Pg. 9-15	BB/ PPT
4	Sample Problems in one dimensional steady state heat conduction	T1 Pg. 9-15	BB/ PPT
5	One dimensional steady state heat conduction equation for hollow cylinder	T1 Pg. 16-22	BB/ PPT
6	Sample Problems in one dimensional steady state heat conduction	T1 Pg. 16-22	BB/ PPT
7	Heat conduction through series of resistance	T1 Pg. 12-16	BB/ PPT
8	Thermal conductivity measurement, Effect of temperature on thermal conductivity	T1 Pg. 10-11	BB/ PPT
9	Heat transfer in extended surfaces	T2 Pg. 466-478	BB/ PPT

Content beyond syllabus covered (if any): One dimensional steady state heat conduction equation for sphere systems with variable thermal conductivity heat exchange in packed bed

* Session duration: 50 minutes



Sub. Code / Sub. Name: **CH22401 / HEAT TRANSFER**

Unit: II- Heat Transfer by convection

Unit Syllabus: Concepts of heat transfer by convection - Natural and forced convection, Buckingham Pi Theorem. Dimensional analysis in heat transfer, heat transfer coefficient for flow through a pipe, flow past flat plate, and flow through packed beds. Application for developing semi - empirical non- dimensional correlation for convection heat transfer

Objective: Impart theoretical knowledge on the convection mode of heat transfer, analogies between transfer of momentum and heat and dimensional analysis in heat transfer

Session No *	Topics to be covered	Ref	Teaching Aids
10	Introduction to natural and forced convection, Concept of heat transfer by convection, Forced convection in systems of simple geometries	T1 Pg. 215,277, 327-362	BB/ PPT
11	Sample problems in natural and forced convection heat transfer	T1 Pg. 215,277, 327-362	BB/ PPT
12	Buckingham Pi Theorem and method Dimensional analysis in heat transfer (Natural & forced convection)	T2 Pg. 340-348	BB/ PPT
13	Heat transfer coefficient for flow through pipe	T2 Pg. 336-339	BB/ PPT
14	Heat transfer coefficient for flow past flat plate	T2 Pg. 333-335	BB/ PPT
15	Sample problems based on heat transfer coefficient	T2 Pg. 333-339	BB/ PPT
16	Heat transfer coefficient for packed beds	T2 Pg. 359-362	BB/ PPT
17	Relationship between individual heat transfer and overall heat transfer coefficient & Sample problems	T2 Pg. 309-329	BB/ PPT
18	Problems in heat transfer in natural convection and forced convection	T1 Pg. 331-366	BB/ PPT
Content beyond syllabus covered (if any): Forced Convection in system of simple geometries			

* Session duration: 50 mins



Sub. Code / Sub. Name: **CH22401 / HEAT TRANSFER**

Unit: III -Heat Transfer with phase change

Unit Syllabus: Heat transfer to fluids with phase change - heat transfer from condensing vapours, drop wise and film wise condensation, Nusselt equation for vertical and horizontal tubes, condensation of superheated vapours, Heat transfer to boiling liquids - mechanism of boiling, nucleate boiling and film boiling.

Objective: Impart theoretical knowledge on heat transfer to fluids with phase change

Session No *	Topics to be covered	Ref	Teaching Aids
19	Heat transfer to fluids with phase change	T2 Pg. 388-389	BB/ PPT
20	Heat transfer from condensing vapors	T1 Pg. 481-491	BB/ PPT
21	Drop wise and film wise condensation	T1 Pg. 487-495	BB/ PPT
22	Nusselt equation for condensation in vertical and horizontal tubes	T1 Pg. 197-201	BB/ PPT
23	Condensation of superheated vapors	T1 Pg. 505-511	BB/ PPT
24	Heat transfer to boiling liquids	T1 Pg. 505-511	BB/ PPT
25	Mechanism of boiling,	T2 Pg. 398-400	BB/ PPT
26	Nucleate boiling	T1 Pg. 496-502	BB/ PPT
27	Film boiling	T2 Pg. 406-412	BB/ PPT
Content beyond syllabus covered (if any): Reboiler types - Kettle type reboiler Condensation in the presence of non-condensable gases			

* Session duration: 50 mins



Sub. Code / Sub. Name: **CH22401 / HEAT TRANSFER**

Unit: IV - Evaporation and radiation heat transfer

Unit Syllabus: Theory of evaporation - single effect and multiple effect evaporation. Thermal Design calculation for single and multiple effect evaporation. Radiation heat transfer - Black body radiation, Emissivity, Stefan - Boltzman law, Plank's law, radiation between surfaces – Concepts of shape factor, Heat exchange between grey bodies, radiation shields.

Objective: Apply the concept of heat exchange in evaporators, understand thermal radiation and their applications

Session No *	Topics to be covered	Ref	Teaching Aids
28	Theory of evaporation,	T2 Pg. 463	BB/ PPT
29	single effect and multiple effect evaporation.	T2 Pg. 490-492	BB/ PPT
30	Thermal Design calculation for single and multiple effect evaporation	T2 Pg. 500-505	BB/ PPT
31	Radiation heat transfer	T2 Pg. 476-480	BB/ PPT
32	Black body radiation	T2 Pg. 481-489	BB/ PPT
33	Emissivity, Stefan - Boltzman law, Plank's law,	T2 Pg. 595-600	BB/ PPT
34	Radiation between surfaces – Concepts of shape factor	T2 Pg. 598-600	BB/ PPT
35	Heat exchange between grey bodies	T2 Pg. 417-439	BB/ PPT
36	Radiation shield	T2 Pg. 405-407	BB/ PPT

Content beyond syllabus covered (if any): Desalination using Multiple effect Evaporators

* Session duration: 50 mins



Sub. Code / Sub. Name: **CH22401 / HEAT TRANSFER**

Unit:V -Design of Heat Exchangers

Unit Syllabus: Classification of heat exchangers - overall and individual film coefficients heat transfer coefficient and fouling factor - Concepts of LMTD, and NTU methods - plate heat exchangers; use of correction factor charts; heat exchangers effectiveness; - Chart for different configurations - Fouling factors

Objective: Design and develop heat exchangers

Session No *	Topics to be covered	Ref	Teaching Aids
37	Classification of heat exchangers,	T1 Pg. 525-527	BB/ PPT
38	Overall and individual film coefficients heat transfer coefficient	R1 Pg. 127-148	BB/ PPT
39	Fouling factor	R1 Pg. 102-109	BB/ PPT
40	Concepts of LMTD, and NTU methods	T2 Pg. 446-449	BB/ PPT
41	Plate heat exchangers	T2 Pg. 581-583	BB/ PPT
42	Use of correction factor charts	T2 Pg. 446	BB/ PPT
43	Heat exchangers effectiveness	R1 Pg. 113-123	BB/ PPT
44	Chart for different configurations	T1 Pg. 548	BB/ PPT
45	Review	T1 Pg. 332 -	BB/ PPT

Content beyond syllabus covered (if any): Heat transfer in an agitator vessel





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TEXTBOOKS:

1. Holman J.P., "Heat Transfer", 8th Edition, McGraw Hill, 1997.
2. McCabe, W.L., Smith J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edition, McGraw Hill, 2005.

REFERENCES:

1. Kern, D.Q., "Process Heat Transfer", McGraw Hill, 1999.
2. Coulson, J.M. and Richardson, J.F., "Chemical Engineering", Vol. I, 4th Edition, Asian Books Pvt. Ltd., India, 1998.

	Prepared by	Approved by
Signature		
Name	Dr. N. Meyyappan	Dr. N. Meyyappan
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Date	22.01.2024	22.01.2024
Remarks *:		
Remarks *:		

* If the same lesson plan is followed in the subsequent semester/year it should be mentioned and signed by the Faculty and the HOD

Verified

20/01/24