Ahmedabad University

Course	CHE508 Advanced Transport Phenomena	Semester	Monsoon Semester 2024
Faculty Name(s)	Arijit Ganguli	Contact	arijit.ganguli@ahduni.edu.in
School	SEAS	Credits	3
GER Category:		Teaching Pedagogy Enable:NO	P/NP Course: Can not be taken as P/NP

Schedule

Section 1	02:00 pm to 03:00 pm	Thu	01-08-24 to 26-11-24
	03:00 pm to 04:00 pm	Thu	01-08-24 to 26-11-24
	04:00 pm to 05:00 pm	Thu	01-08-24 to 26-11-24

Prerequisite	CHE201 Fluid Mechanics & CHE300 Mass Transfer Operations - II & CHE301 Heat Transfer & CHE204 Mass Transfer Operations - I
Antirequisite	Not Applicable
Corequisite	Not Applicable
Course Description	Transport phenomena deals with the study of momentum, heat and mass transfer in terms of spatial variation of velocities, temperatures or concentrations for different types of geometries with incorporation of boundary conditions. The advanced course deals with two phase flows pressure drop in two phase systems, temperature and concentration distribution in such systems and practical applications of the same

Course Objectives	Shell balances for various geometries to provide analytical solutions for velocity distributions, temperature distributions and concentration distributions across various geometries Understanding of velocity distributions in laminar and turbulent flows and their corresponding temperature and concentration distributions Understanding of velocity, temperature and concentration distributions in two phase systems
Learning Outcomes	The students taking this course should be able to Derive analytical solutions for velocity, temperature or concentration distributions for single and two phase systems Apply the knowledge in practical applications
Pedagogy	Lectures, PPTs, Problem solving, Discussions
Expectation From Students	Students must try to derive the analytical solutions for various cases provided in the form of home assignments Students must complete their projects in time

Assessment/Evaluation	• End Semester Examination:
	  ◦ Project - 50%
	  ◦ Assignment - 20%
	  ◦ Written - 30%

Attendance Policy	As per Ahmedabad University Policy.
Project / Assignment Details	Project will consist of review of research articles in topic of interest and report submission
Course Material	
Additional Information	

Session Plan

NO.	TOPIC TITLE	TOPIC & SUBTOPIC DETAILS	READINGS,CASES,ETC.	ACTIVITIES	IMPORTANT DATES
1	Introduction	flow through circular tubes	Bird, Chapter 2	Lecture	
2	Velocity distribution with more than one independent variable	Flow past flat plate with boundary layer approximation	Bird, Chapter 5	Lecture	
3	Velocity distribution in turbulent flow	Time-smoothed equations of change for incompressible fluids	Bird, Chapter 5	Lecture	
4	Interphase transport in isothermal systems	Friction factor for flow in tubes and past packed columns	Bird, Chapter 6	Lecture	
5	Shell energy balances and temperature distributions in solids and laminar flows	Heat conduction with a chemical heat source	Bird, Chapter 10	Lecture	
6	Equations of change for non-isothermal systems	Free convection heat transfer from a vertical plate	Bird, Chapter 11	Lecture	
7	Interphase transport in non-isothermal systems	Heat Transfer coefficients for Forced convection around packed beds	Bird, Chapter 14	Lecture	
8	Unsteady heat transfer in solids	Unsteady heat transfer with and without temperature variation inside solids	Incropera Dewitt, Chapter, 9	Lecture	
9	Concentration distribution in solids and laminar flow	Diffusion into a falling liquid film: Gas absorption from rising bubbles	Bird, Chapter 18	Lecture	

10	Concentration distribution in solids and laminar flow	Diffusion with a moving interface: Diffusion through a non-isothermal spherical film	Bird, Chapter 18	Lecture	
11	Concentration distribution in solids and laminar flow	Diffusion with slow homegeneous reaction: Gas absorption with chemical reaction in an Agitated tank	Bird, Chapter 18	Lecture	
12	Concentration distribution in solids and laminar flow	Diffusion with slow heterogeneous reaction	Bird, Chapter 18	Lecture	
13	Concentration distribution in solids and laminar flow	Diffusion and chemical reaction inside a porous catalyst	Bird, Chapter 18	Lecture	
14	Concentration distributions in turbulent flow	Enhancement of mass transfer by a first order reaction in turbulent flow	Bird, Chapter 21	Lecture	
15	Interphase transport in non-isothermal mixtures	Mass transfer and chemical reactions: Estimation of interfacial area in a packed column	Bird, Chapter 22	Lecture	
16	Interphase transport in non-isothermal mixtures	Combined heat and mass transfer by free convection: Free convection heat transfer as a source of forced convection mass transfer	Bird, Chapter 22	Lecture	
17	Mixing in Stirred vessels	Circulation velocities and power consumption in Agitated Vessels	McCabe and Smith, Chapter 9	Lecture	
18	Mixing in Stirred vessels	Suspension of Solid particles	McCabe and Smith, Chapter 9	Lecture	
19	Mixing in Stirred vessels	Dispersion operations	McCabe and Smith, Chapter 9	Lecture	

20	Flow past immersed bodies	Fluidization	McCabe and Smith, Chapter 7	Lecture	
21	Transport phenomena stirred vessel reactor	Oxidation reaction in a stirred vessel reactor	Froment and Bishop	Lecture	
22	Transport phenomena Fludized bed reactor	Production of acrylonitrile in a Fluidized bed Reactor	Froment and Bishop	Lecture	
23	Transport phenomena Fludized bed reactor	Production of acrylonitrile in a Fluidized bed Reactor	Froment and Bishop	Lecture	
24	Transport phenomena inBubble column reactor	Oxidation reaction in a Bubble column reactor	Froment and Bishop	Lecture	
25	Transport phenomena inTrickle Bed reactor	Effectiveness factor of a partially wetted catalyst	Research articles	Lecture	
26	Transport phenomena inThree Phase bubble Column reactor	Transport phenomena in Bubble column slurry reactors	Research articles	Lecture	