SRM Institute of Science and Technology

Faculty of Engineering and Technology

Department of Chemical Engineering

Course Code & Title: **15CH307 TRANSPORT PHENOMENA FUNDAMENTALS**

Course Strategy Description

Course description:

This course deals with the fundamentals of transport processes, governing equations and the physics and mathematics of momentum, heat, and mass transfer in Chemical Engineering processes.

Compulsory/Elective course: Compulsory for B.Tech. Chemical Engineering

Credit hours: 3 Credits

Course coordinator(s): Dr.Ashish Kapoor, Associate Professor, Department of Chemical Engineering

Instructor(s):

Name of the instructor	Room number	Email (@ktr.srmuniv.ac.in)	Consultations (day order/periods)
Dr.Ashish Kapoor	PGA 201	ashishkapoor.o	Day – 2: 4 and 5
Ms.R.Thilakavathi	PGA 205	thilakavathi.r	Day – 2: 4 and 5
Ms.E.Poonguzhali	PGA 205	poonguzhali.e	Day – 2: 4 and 5

Relationship to other courses

Course category: Professional core

Prerequisite: 15CH302, 15CH303   Co-requisite: Nil

Following courses: Nil

Text book(s) and/or required materials:

1. Byron R.Bird., Warren E. Stewart and Edwin N. Lightfoot, "Transport Phenomena", 2nd edition, John Wiley & Sons, New York, 2007.

Reference book(s):

1. Christie John Geankoplis"Transport Processes and Separation Process Principles (Includes Unit Operations)", 4thEdition,Pearson Education, Prentice Hall, 2003.

2. James R. Welty., Charles E. Wicks.,Robert E. Wilson. and Gregory L. Rorrer "Fundamentals of Momentum, Heat, and Mass Transfer",5nd edition, John Wiley &Sons, New York, 2007.

3. Robert S. Brodkeyand Harry C.Hershey., Transport Phenomena - A Unified Approach,Volume 2,Brodkey Publishing, Columbus, 2001.

Class schedule: B Slot; Four 50 minutes lecture sessions per week, for 15 – 16 weeks

DAY ORDER: HOUR	TIMING
DAY - 2: 1 AND 2	8.00 AM – 9.40 AM
DAY - 4: 3	9.45 AM – 10.35AM
DAY - 5: 9	3.15 PM - 4.05 PM

Instructional Objectives (IOs) and Student Outcomes (SOs)

S.No.	Instructional Objectives	Student Outcomes				
1	Understand the chemical and physical transport processes and their mechanism.	a				
2	Familiarize various aspects of velocity, temperature and concentration distribution in laminar and turbulent flow.	a				
3	To do heat, mass and momentum transfer analysis.	a	e			
4	Analyze industrial problems along with appropriate approximations and boundary conditions.	a	e			

5	Formulate the differential forms of the equations of change for momentum, heat and mass transfer problems for steady-state flows.	a	e			

Teaching plan

Section	Topics	L/T	Text book/chapter	IOs	SOs	Problem solving (Y/N)
UNIT I: VELOCITY DISTRIBUTION IN LAMINAR FLOW		**9**				
1	Introduction - Generalization of Newton's Law of Viscosity, Pressure and Temperature Dependence of Viscosity.	1	1	1	a	N
2	Introduction - Molecular Theory of the Viscosity of Gases at Low Density, Molecular Theory of the Viscosity of Liquids.	1	1	1	a	N
3	Shell Momentum Balances and Velocity Distributions in Laminar Flow: Shell momentum balances and boundary conditions, Flow of a falling film.	2	1, 2	2-5	a	Y
4	Shell Momentum Balances and Velocity Distributions in Laminar Flow: Flow through a circular tube	2	1, 2	2-5	a	Y
5	Shell Momentum Balances and Velocity Distributions in Laminar Flow: Flow through an annulus	1	1, 2	2-5	a	Y
6	Shell Momentum Balances and Velocity Distributions in Laminar Flow: Flow of two adjacent immiscible fluids, Laminar flow in a narrow slit	2	1, 2	2-5	a	Y
UNIT II: EQUATION OF CHANGE FOR ISOTHERMAL PROCESS		**9**				
7	The equation of continuity, The equation of motion	3	1, 2	3,4	a	Y
8	The equations of change in terms of the substantial derivative	1	1	3	a	Y
9	Use of the equations of change to solve flow problems	4	1, 2	4,5	a	Y
10	Dimensional analysis of the equations of change	1	1, 2	3	a	N
UNIT III: VELOCITY DISTRIBUTION IN TURBULENT FLOW AND INTERPHASE TRANSPORTINISOTHERMAL SYSTEMS		**9**				
11	Comparisons of laminar and turbulent flows	1	1, 2	2,3	a,e	N

12	Time-smoothed equations of change for incompressible fluids	2	1, 2	2,3	a,e	N
13	The time-smoothed velocity profile near a wall, Empirical expressions for the turbulent momentum flux	1	1	2,3	a,e	N
14	Definition of friction factors, Friction factors for flow in tubes	2	1	2,3	a,e	Y
15	Friction factors for flow around spheres	1	1, 2	2,3	a,e	Y
16	Friction factors for packed columns	2	1, 2, 3, 4	4,5	a,e	Y
UNIT IV: ENERGY TRANSPORT		**9**				
17	Thermal Conductivity and the mechanisms of Energy Transport, Temperature and pressure dependence of Thermal conductivity	1	1, 2	3	a,e	N
18	Shell Energy Balances and Temperature Distributions in Solids and Laminar Flow: Shell energy balances; boundary conditions, Heat conduction with an electrical heat source	1	1	3,4	a,e	Y
19	Heat conduction with a nuclear heat source, Heat conduction through composite walls	2	1, 2	3,4	a,e	Y
20	Heat conduction in a cooling fin	1	1	3,4	a,e	Y
21	The Equations of Change for Non isothermal Systems: The energy equation, Special forms of the energy equation	2	1	3,4	a,e	N
22	Steady state heat conduction problem	2	1, 2, 3, 4	5	a,e	Y
UNIT V: MASS TRANSPORT		**9**				
23	Diffusivity and the Mechanisms of Mass Transport: Fick's law of binary diffusion (Molecular Mass Transport), Temperature and pressure dependence of diffusivities	1	1, 2	3	a,e	N
24	Concentration Distributions in Solids and in Laminar Flow : Shell mass balances; boundary conditions, Diffusion through a stagnant gas film	2	1	3, 4	a,e	Y
25	Diffusion with a heterogeneous chemical reaction , Diffusion with a homogeneous chemical reaction	2	1	3, 4	a,e	Y
26	Diffusion and chemical reaction inside a porous catalyst	1	1	3, 4	a,e	Y
27	Equations of Change for Multicomponent Systems: The equations of continuity for a multicomponent mixture, Use of the equations of change for mixtures	1	1, 2	3, 4	a,e	Y
28	Analogies between momentum, heat and mass transport	2	1, 2	4	a,e	N

Evaluation methods

S.NO.	Test	Topics covered	Marks	Test/Exam duration (min)
1.	Cycle test – I	Unit I and II	15	90
2.	Cycle test – II	Unit III, IV and V	25	180
3.	Surprise test	Questions from any units	5	20
4.	Assignment	Questions from any units	5	-
5.	Final exam	All the units	50	180

Surprise test

The surprise test will not be announced. The questions for this test will be covered until the previous class.

Home assignments

A few units will have home assignment. All the assignments should be submitted on or before the last date of submission.

Teaching Methodology

Chalk and talk for the entire course

Prepared by: E.Poonguzhali , Assistant Professor, Department of Chemical Engineering

Dated: 02/01/2018

Revision no.:   **Date of revision:**   **Revised by:**

Course Coordinator   Academic Coordinator   HoD/Chemical