

GUJARAT TECHNOLOGICAL UNIVERSITY
BRANCH NAME: CHEMICAL ENGINEERING
SUBJECT NAME: TRANSPORT PHENOMENA
SUBJECT CODE: 2180507
B.E. 8th SEMESTER

Type of course: Chemical Engineering

Prerequisite: A course on Fluid Flow Operation, Process Heat Transfer, Mass Transfer Operation and Vector Calculus.

Rationale: Transport Phenomena is the subject which deals with the movement of different physical quantities such as momentum, energy and mass in any chemical or mechanical process and combines the basic principles (conservation laws) and laws of various types of transport.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	0	3	70	20	10	0	0	0	100

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Introduction to Transport Phenomenon: Classification of Transport Processes, Conservation Laws, Vector and Tensor Calculus	3	5
2	Principles of Momentum Transport: Concept of Viscosity, Newton's Law of Viscosity, Shell Momentum Balance, Application of Shell Momentum Balance, Flow of Falling Film, Flow Through Circular Pipe, Flow Through annulus, Flow Over Moving Plate, Couette Viscometer, Equation of Changes: Continuity Equation, Equation Motion, Navier-Stokes Equation in Cartesian Co-ordinate's and Cylindrical Co-ordinate, Basics of Velocity Distribution	20	37
3	Principles of Steady State Heat Transport: Steady State Condition and Fourier's Law, Shell Energy Balance, Applications of Shell Energy Balance: Heat Conduction with Electrical Source, Heat Conduction with Chemical Heat Source, Temperature Distribution in Two Concentric Cylinder's, Natural Convention Heat Transfer Governing Equation, Flow over Flat Plate	14	26
4	Principles of Mass Transport: Equation of Molecular Mass Transport, Molecular Diffusion in Gases, Equimolar Counter Diffusion, Diffusion of A through Non-Diffusing B, Mass and Molar Transport by Convection: Mass and Molar Concentrations, Mass Average and Molar Average Velocity, Molecular Mass and Molar Fluxes, Convective Mass and Molar Fluxes	17	32

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	20	20	10	5	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. R. Byron Bird, "Transport Phenomena", 2nd Edition, John Wiley & Sons (Asia) pvt. Ltd.
2. Christie John Geankoplis, "Transport Processes and Separation Process Principles", 4th Edition, PHI Learning Private Limited., New Delhi
3. Incropera, "Fundamentals of Heat and Mass Transfer", 6th Edition, John Wiley & Sons (Asia) pvt. Ltd.
4. W.J.Thomson, "Introduction to Transport Phenomena", Pearson Education Asia, New Delhi, 2001.

Course Outcome:

After learning the course the students should be able to:

- Setup overall balances for conservation of momentum, energy and mass.
- Recognize and apply analogies among momentum, heat and mass transfer.
- Reduce and solve the appropriate equations of change to obtain desired profiles for velocity, temperature and concentration.
- Utilize information obtained from solutions of the balance equations to obtain Engineering quantities of interest.
- Reduce and solve appropriate macroscopic balances for conservation of momentum, energy and mass.

List of Open Source Software/learning website:

- NPTEL lecture series
- Literature available on Transport Phenomena
- MIT Open course lecture on Transport Phenomena

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.