SRI VENKATESWARA COLLEGE OF ENGINEERING

COURSE DELIVERY PLAN - THEORY

Department of Chemical Engineering			LP: CH18701 Rev. No: 00 Date: 09.7.2024
B.E/B.Tech/M.E/M.Tech	: B.Tech	Regulation:2018A	
PG Specialisation	: N/A		
Sub. Code / Sub. Name	: CH18701 Transport Phenomena		
Unit	: I		

Unit Syllabus: TRANSPORT BY MOLECULAR MOTION

Importance of transport phenomena; analogous nature of transfer process; basic concepts, conservation laws; continuous concept, field, reference frames, substantial derivative and boundary conditions; methods of analysis; differential, integral and experimental methods.Phenomenological laws of transport properties, Newtonian and non Newtonian fluids; Rheological models; theories of transport properties of gases and liquids; effect of pressure and temperature.

Objective: To emphasize on the fundamentals and basic concepts of transport phenomena.

Session No *	Topics to be covered	Ref	Teaching Aids
1.	Scope and importance of Transport Phenomena.	T1, Ch-0, P – 1	BB, Chalk & PPT
2.	Continuum concept, field, frame of reference, substantial derivative and boundary conditions	R3, Ch-1, P – 1	BB, Chalk & PPT
3.	Analogous nature of transfer processes, methods of analysis.	T1, Ch-0, P – 4	BB, Chalk & PPT
4.	Transport properties, Phenomenological laws - momentum	T1, Ch-1, P –11	BB, Chalk & PPT
5.	Phenomenological laws – energy and mass, Prandtl and Schmidt numbers.	T1, Ch-9, P –266, Ch-17, P-514	BB, Chalk & PPT
6.	Newtonian and Non Newtonian fluids	R1, Ch-7, P –82	BB, Chalk & PPT
7.	Rheological characteristics of fluids.	R1, Ch-7, P –82	BB, Chalk & PPT
8.	Theories of Transport properties (viscosity, thermal conductivity and diffusivity) of gases and liquids	T1, Ch-1, P –28	BB, Chalk & PPT
9.	Problems involving transport by molecular motion	T1, Ch-1, P 1 –28,	BB, Chalk & PPT
10.	Problems involving transport by molecular motion	T1, Ch-1, P 1 –28,	BB, Chalk & PPT
11.	Effect of temperature and pressure on transport properties	T1, Ch-1, P –28	BB, Chalk & PPT
12.	Three Levels of Transport Phenomena	T1, Ch-1, P –30	BB, Chalk & PPT

Content beyond syllabus covered (if any): Three levels of Transport phenomena

* Session duration: 50 minutes

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Unit : II

Unit Syllabus: ONE DIMENSIONAL TRANSPORT IN LAMINAR FLOW (SHELL BALANCE)

General method of shell balance approach to transfer problems; Choosing the shape of the shell; most common boundary conditions; momentum flux and velocity distribution for flow of Newtonian and non-Newtonian fluids in pipes, for flow of Newtonian fluids in planes, slits and annulus.

Objective: To study one dimensional transport in laminar flow and derive velocity profile equations for fluid flow.

Session No *	Topics to be covered	Ref	Teaching Aids
13.	General method of shell balance approach to transfer problems	T1, Ch-2, P –41	BB, Chalk & PPT
14.	Choosing the shape of the shell	T1, Ch-2, P –41	BB, Chalk & PPT
15.	Most common boundary conditions	T1, Ch-2, P –41	BB, Chalk & PPT
16.	Momentum flux and velocity distribution for flow of Newtonian fluids in pipes	T1, Ch-2, P –48	BB, Chalk & PPT
17.	Momentum flux for flow of Non Newtonian fluids in pipes	T1, Ch-2, P-50	BB, Chalk & PPT
18.	Velocity distribution for flow of Non Newtonian fluids in pipes.	T1, Ch-2, P-52	BB, Chalk & PPT
19.	Momentum flux for flow of Newtonian fluids in annulus.	T1, Ch-2, P –53	BB, Chalk & PPT
20.	Velocity distribution for flow of Newtonian fluids in annulus.	T1, Ch-2, P –54	BB, Chalk & PPT
21.	Momentum flux and velocity distribution for flow of Newtonian fluids in slits	T1, Ch-2, P –47	BB, Chalk & PPT
22.	Momentum flux and velocity distribution for flow of Newtonian fluids in planes.	T1, Ch-2, P –49	BB, Chalk & PPT
23.	Momentum transfer in two immiscible fluids	T1, Ch-2, P –55	BB, Chalk & PPT
24.	Problems	T1, Ch-2	BB, Chalk & PPT

Content beyond syllabus covered (if any):

* Session duration: 50 minutes

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Sub. Code / Sub. Name: CH18701 Transport Phenomena

Unit : III

Unit Syllabus : HEAT AND MASS TRANSPORT IN ONE DIMENSIONAL FLOW

Heat flux and temperature distribution using shell balance method for heat sources such as electrical, nuclear viscous and chemical; forced and free convection. Mass flux and concentration profile using shell balance method for diffusion in stagnant gas, systems involving reaction and forced convection.

Objective: To derive and solve appropriate differential equations such as heat equation and mass species balance, accounting appropriately by convective and diffusive (molecular-scale) fluxes, with sources and sinks to obtain temperature and concentration profiles.

Session No *	Topics to be covered	Ref	Teaching Aids
25.	Heat conduction with an electrical heat source.	T1, Ch-10, P –292, 310	BB, Chalk & PPT
26.	Heat transfer on Forced and free convection	T1, Ch-10, P –292, 310	BB, Chalk & PPT
27.	Heat conduction with viscous heating.	T1, Ch-10, P –298, 300	BB, Chalk & PPT
28.	Heat conduction with chemical heat source.	T1, Ch-10, P –300	BB, Chalk & PPT
29.	Heat flux and temperature distribution with a nuclear heat source.	T1, Ch-10, P –296	BB, Chalk & PPT
30.	Heat conduction in a cooling fin.	T1, Ch-10, P –297	BB, Chalk & PPT
31.	Mass flux and concentration profile for diffusion in stagnant gas	T1, Ch-10, P – 545	BB, Chalk & PPT
32.	Problems involving Heat flux	T1, Ch-10	BB, Chalk & PPT
33.	Problems involving Mass flux	T1, Ch-10	BB, Chalk & PPT
34.	Problems involving Heat flux and mass flux	T1, Ch-10, P – 292, 545	BB, Chalk & PPT
35.	Systems involving reaction and forced convection	T1, Ch-10, P –551	BB, Chalk & PPT
36.	Systems involving reaction and forced convection	T1, Ch-10, P –551	BB, Chalk & PPT

Content beyond syllabus covered (if any):

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Sub. Code / Sub. Name: CH18701 Transport Phenomena

Unit : IV

Unit Syllabus: EQUATIONS OF CHANGE AND THEIR APPLICATIONS
Conservation laws and equations of change; Development of equations of continuity motion and energy in single multi components systems in rectangular coordinates and the forms in curvilinear coordinates; simplified forms of equations for special cases, solutions of momentum, mass and heat transfer problems discussed under shell balance by applications of equation of change, scale factors; applications in scale-up

Objective: To formulate Heat equation, the Continuity equation, and the Navier-Stokes Equations and simplify them appropriately for specific transport problems.

Session No *	Topics to be covered	Ref	Teaching Aids
37.	Conservation laws, Tensors	T1, Ch-3, P –77	BB, Chalk & PPT
38.	Development of equations of continuity in single component systems in rectangular and curvilinear coordinates	T1, Ch-3, P –77	BB, Chalk & PPT
39.	Development of equations of motion in single component systems in rectangular and curvilinear coordinates	T1, Ch-3, P –78	BB, Chalk & PPT
40.	Simplified forms of Continuity and Equation of motion for special cases.	R3, Ch-9, P –106	BB, Chalk & PPT
41.	Equation of change for non-isothermal systems.	T1, Ch-11, P –333	BB, Chalk & PPT
42.	Simplification of equation of energy for special cases.	T1, Ch-11, P –336	BB, Chalk & PPT
43.	Tutorial: Use of equation of change for solving flow over a plane and through a pipe, Couette viscometer.	T1, Ch-3, P –89	BB, Chalk & PPT
44.	Steady state heat transfer in a fin	T1, Ch-10, P –311, 310	BB, Chalk & PPT
45.	Equation of continuity for a binary mixture.	T1, Ch-19, P –582	BB, Chalk & PPT
46.	Scale factors and scale up. Dimensional analysis for an agitated vessel.	T1, Ch-3, P –105	BB, Chalk & PPT
47.	Problems involving equation of change	T1, Ch-3	BB, Chalk & PPT
48.	Problems involving equation of change	T1, Ch-3	BB, Chalk & PPT

Content beyond syllabus covered (if any):

* Session duration: 50 minutes

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Sub. Code / Sub. Name: CH8701 Transport Phenomena

Unit : V

Unit Syllabus: TRANSPORT IN TURBULENT AND BOUNDARY LAYER FLOW &ANALOGIES BETWEEN TRANSPORT PROCESSES

Turbulent phenomena; phenomenological relations for transfer fluxes; time smoothed equations of change and their applications for turbulent flow in pipes; boundary layer theory; laminar and turbulent hydrodynamics thermal and concentration boundary layer and their thickness; analysis of flow over flat surface. Importance of analogy, development and applications of analogies between momentum and mass transfer, Reynolds, Prandtl, Von Karman and Colburn analogies.

Objective: To study the turbulence phenomena, on the methods of characterizing the turbulence fluxes and the boundary layer theory and to co-relate and study the application of various analogies between momentum, heat and mass transfer.

Session No *	Topics to be covered	Ref	Teaching Aids
49.	Turbulent phenomena; phenomenological relations for transfer fluxes	T1, Ch-5, P –154	BB, Chalk & PPT
50.	Time smoothed equations of change and their applications for turbulent flow in pipes;	T1, Ch-5, P –155	BB, Chalk & PPT
51.	Tutorial problems – Relative magnitude of molecular and eddy diffusivity.	T1, Ch-5, P –167	BB, Chalk & PPT
52.	Boundary Layer theory; laminar and turbulent boundary layer thickness.	R3, Ch-12, P –144	BB, Chalk & PPT
53.	Momentum, thermal and concentration boundary layer thickness	T1, Ch-20, P –625	BB, Chalk & PPT
54.	Analysis of flow over flat plate	T1, Ch-20, P –632	BB, Chalk & PPT
55.	Analogy concept between momentum, energy and mass transfer. Models for convective mass transfer coefficients	T1, Ch-20, P –613	BB, Chalk & PPT
56.	Derivations of Prandtl and Reynolds analogies.	R3, Ch-19, P –291	BB, Chalk & PPT
57.	Derivation of Von Karman and Colburn analogies.	R3, Ch-19, P –285	BB, Chalk & PPT
58.	Problems: On use of analogies for heat transfer and mass transfer.	R3, Ch-19	BB, Chalk & PPT
59.	Problems: On use of analogies for heat transfer and mass transfer.	R3, Ch-19	BB, Chalk & PPT
60.	Problems: On use of analogies for heat transfer and mass transfer.	R3, Ch-19	BB, Chalk & PPT

Content beyond syllabus covered (if any):

* Session duration: 50 minutes

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TEXT BOOKS:

1 . R.B. Bird, W.E. Stewart and E.W. Lightfoot, "Transport Phenomena", John Wiley, II Edition 2006.

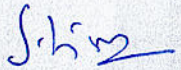
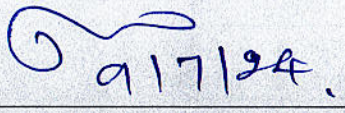
2. Robert, S Brodkey, Harry C. Hershey, "Transport Phenomena A Unified Approach ", Brodkey Publishing 2003.

REFERENCES:

1 . L.S.Sissom, and D.R.Pitts, "Elements of Transport Phenomena", McGrawHill, New York, 1972.

2. R.W.Fahien, "Elementary Transport Phenomena", McGraw-Hill, New York, 1983.

3. J.R. Welty, R.W. Wilson, and C.W.Wicks, Rorer G.E, Wilson R.W. "Fundamentals of Momentum Heat and Mass Transfer", V Edn. John Wiley, New York, 2007.

	Prepared by	Approved by
Signature		
Name	Mr. S.Jai Ganesh	Dr. N. Meyyappan
Designation	Assistant Professor	Professor and Head of the Department
Date	09.7.2024	09.7.2024
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