Fundamentals of Transport Processes - Video course

COURSE OUTLINE

The objective of this course it to provide a fundamental understanding of the convection and diffusion process in fluids, and how these determine the rates of transport of mass, heat and momentum.

COURSE DETAIL

S.No	Topics	No. of Hours
1	Introduction	1
2	Dimensional analysis. Limitations of unit operations approach.	3
3	Diffusion due to random motion. Estimates of diffusion coefficient from kinetic theory and for turbulent flow.	2
4	Steady and unsteady diffusion in one dimension from a flat plate. Equivalence of heat, mass and momentum transport for unsteady one dimensional diffusion.	2
5	Steady and unsteady transfer to a cylinder - balances in cylindrical co-ordinates.	2
6	Effect of pressure in fluid flow.Steady and unsteady flow in a pipe. Method of separation of variables.	2
7	Oscillatory flow in a pipe. Use of complex analysis for oscillatory flow. Boundary layer analysis.	2
8	Free surface flows down an inclined plane. Combination of convection, diffusion.	2
9	Derivation of balance laws for stationary control volumes as partial differential equations for heat, mass and momentum transfer.	3

NPTEL

http://nptel.iitm.ac.in

Chemical Engineering

Pre-requisites:

Unit operations and transport phenomena at the undergraduate level.

Coordinators:

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10	Balances in cylindrical and spherical coordinates.	3
11	Diffusion dominated transport in three dimensions. Fourier's law, Fick's law as partial differential equations.	2
12	Solution of temperature field in a cube using spherical harmonic expansions.	2
13	Temperature field around a spherical inclusion. The use of separation of variables.	2
14	Spherical harmonics. Equivalent point charge representations.	2
15	Thermal conductivity of a composite.	2
16	Effect of convection at low Peclet number. Regular perturbation expansion for streaming flow past a sphere.	2
17	Convection at high Peclet number. Boundary layer solutions for streaming past a sphere.	3
18	Computational solutions of diffusion dominated flows.	4
	Total	41

References:

1. Bird, Stewart and Lightfoot (BSL), Transport Phenomena, Wiley International, 1960.
2. L. G. Leal, Laminar Flow and Convective Transport Processes, Butterworth-Heineman, 1992.
3. G. K. Batchelor, An Introduction to Fluid Dynamics, Cambridge University Press, 1967.