Indian Institute of Technology Kanpur
Proposal for a New Course

1. Course No: CHE6XX
2. Course Title: Introduction to Transport Phenomena
3. Per Week Lectures: 3 (L), Tutorial: 0 (T), Laboratory: 0 (P), Additional Hours[0-2]: 0 (A), Credits (3-0-0-0): 6 Duration of Course: Modular
4. Proposing Department: Department of Chemical Engineering

   Other Departments/IDPs which may be interested in the proposed course: NA

   Other faculty members interested in teaching the proposed course: Indranil Saha Dalal, Dipin S. Pillai, Akash Chaudhary
5. Proposing Instructor(s): Naveen Tiwari (naveent@iitk.ac.in) and V. Shankar (vshankar@iitk.ac.in)
6. Course Description:
   A) Objectives:
   The course will expose fresh PhD students to basic concepts of Transport Phenomena along with some simple examples.
   B) Contents (preferably in the form of 5 to 10 broad titles):
   Lecture-wise break-up (considering the duration of each lecture is 50 minutes)

S. No.	Broad Title	Topics	No. of Lectures
1.	Vectors, Tensors, and their calculus	Stress tensor and velocity gradient tensor: Sec 7.3.2 and 7.3.3 of V. Kumaran Gradient, Divergence and Curl: Appendix 7A, 7B, and 7C of V. Kumaran	2
2.	Basic concepts of diffusion and convection	Convective and diffusive fluxes - Sec. 2.1.1 and 2.1.2 of V Kumaran Mass, heat, and momentum diffusion - Sec. 3.1 of V Kumaran	1
3.	Steady and Unsteady unidirectional shell balance for Heat, Mass, and Linear momentum transport in Rectangular Coordinates	Governing conservation equations (Sec. 4.1 of VK) Steady heat conduction in single and multiple slabs (Sec. 4.2 of VK) Steady laminar flow down an inclined plane (Sec. 4.2 of VK) Steady diffusion with homogeneous reaction (Sec. 4.2 of VK) Unsteady transport into an infinite medium - similarity solution (Sec. 4.4 of VK) Steady diffusion into a falling liquid film (Sec. 4.4.1 of VK) Transient conduction in a slab of finite thickness - separation of variables solution (Sec. 4.7 of VK)	4
4.	Steady and Unsteady unidirectional shell balance for Heat, Mass, and Linear momentum transport in Curvilinear Coordinates	Governing conservation equations in cylindrical coordinates (Sec. 5.1 of VK) Steady solutions for conduction/diffusion in cylindrical coordinates (5.1.2 of VK) Heat conduction from a thin wire into an	6

		infinite medium - similarity solution (5.1.3 of VK) Unsteady heat conduction into a cylinder - separation of variables solution (Sec. 5.1.4 of VK) Governing equations in spherical coordinates (5.2 of VK) Steady conduction from a spherical particle (5.2.2 of VK) Unsteady conduction in a sphere - separation of variables solution (5.2.3 of VK)	
5.	Forced convection, concept of Boundary Layers, Scaling analysis	Flow past a heated surface - derivation of Nusselt number - Peclet number correlation (9.1.1 of VK) Convective heat transfer due to flow around a solid particle (9.1.3 of VK) Convective heat transfer in flow past a mobile/fluid interface (9.2 of VK)	7
		Total	20

C) Recommended pre-requisites, if any (examples: a- PSO201A, or b- PSO201A or equivalent): None

D) Short summary for including in the Courses of Study Booklet:
Introduction to vectors, tensors and their calculus, basic concepts of convective and diffusive transport of mass, heat and momentum, steady and unsteady unidirectional transport in rectangular and curvilinear coordinates, boundary layer and scaling analysis

7. Recommended text/reference books:
   A) V. Kumaran, Fundamentals of Transport Processes with Applications, Cambridge
   B) Bird, Stewart, Lightfoot, Transport Phenomenon, Wiley.
8. Any other remarks: None

Dated: 08/02/25 Proposer: NT, VS

Dated: DPGC Convener:

The course is approved / not approved

Chairman, SUGC

Dated: