GANPAT UNIVERSITY									
FACULTY OF ENGINEERING & TECHNOLOGY									
Programme	Master of Technology				Branch/Spec.	Chemical Engineering			
Semester	II				Version	1.0.0.0			
Effective from Academic Year		2026-27			Effective for the batch Admitted in			July 2026	
Subject code	**3CH21PE11**	Subject Name			**Applied Transport Phenomena**				
Teaching scheme					Examination scheme (Marks)				
(Per week)	Lecture (DT)		Practical (Lab.)	Total		CE	SEE	Total	
	L	TU	P	TW					
Credit	3	0	0	0	3	Theory	40	60	100
Hours	3	0	0	0	3	Practical	0	0	0

Pre-requisites:

Course Outcomes

On successful completion of the course, the students will be able to:

CO1	Apply the fundamental mechanisms of momentum, energy, and mass transport
CO2	Formulate mathematical models for transport processes using shell balances
CO3	Analyze complex transport problems by applying equations of change for isothermal and non-isothermal systems
CO4	Analyze interphase transport and correlate macroscopic balances with microscopic phenomena

Theory syllabus

Unit	Content	Hrs
1	**Vector Mathematics:** Introduction to Vectors and Tensors, Principle of Mass Conservation, Momentum Conservation, Eulerian & Lagrangian criteria for fluid flow equations, Equations of Continuity, Equations of Change in terms of the Substantial Derivative, Use of the Equations to solve Flow Problems, Dimensional Analysis of the Equations of Change, Time Dependent Flow of Newtonian Fluids. Velocity Distributions in Turbulent Flow -Comparisons of Laminar and Turbulent Flows, Time Smoothed Equations of Change for Incompressible Fluids	8
2	**Momentum Transport:** Macroscopic Mass Balance and Momentum Balance, The Macroscopic Mechanical Energy Balance, Estimating the Viscous Loss, Using the Macroscopic Balances for Steady-State Problems, Deriving the Macroscopic Mechanical Energy Balance. Equations of Change for Non-Isothermal Systems: The Energy Equation, Special forms of the Energy Equation, The Boussinesq Equation of Motion for Forced and Free Convection, Use of the Equations of change to Solve Steady-State Problems, Dimensional Analysis of the Equations of Change for Non-Isothermal Systems	10
3	**Energy Transport:** Shell energy balances, Temperature Distributions in Solids and in Laminar Flow: Heat Conduction with an Electrical Heat Source, Heat Conduction with a Viscous Heat Source. Temperature Distributions with more than One Independent Variable - Unsteady Heat Conduction in Solids, Time-Smoothed Equations of Change for Incompressible Non-Isothermal Flow, Time-Smoothed Temperature Profile near a Wall, Empirical Expressions for the Turbulent Heat Flux	9
4	**Energy Transport under Non-isothermal Conditions**: Macroscopic Balances For Non-Isothermal Systems: Macroscopic Energy Balance, Macroscopic Mechanical Energy Balance, Use of The Macroscopic Balances To Solve Steady State Problems With Flat Velocity Profiles, Concentration Distributions in Solids and in Laminar Flow: Shell Mass Balances, Boundary Conditions, Diffusion through a Stagnant Gas Film, Diffusion with a Heterogeneous Chemical	9

	Reaction. Concentration Distributions with more than One Independent Variable: Time-Dependent Diffusion, Steady-State Transport in Binary Boundary Layers, Concentration Distributions in Turbulent Flow - Concentration Fluctuations and the Time-Smoothed Concentration, Time-Smoothing of the Equation of Continuity of A, Semi-Empirical Expressions for the Turbulent Mass Flux, Enhancement of Mass Transfer by a First-Order Reaction in Turbulent Flow, Boundary layer analysis for momentum, heat, and mass transfer Hydrodynamic boundary layer	
5	**Mass Transport:** Interphase Transport in Multi-Component Systems: Definition of Transfer Coefficients in One Phase, Analytical Expressions for Mass Transfer Coefficients, Correlation of Binary Transfer Coefficients in One Phase, Definition of Transfer Coefficients in Two Phases, Mass Transfer and Chemical Reactions. Macroscopic Balances for Multi-Component Systems: Macroscopic Mass Balances, Macroscopic Momentum, Use of the Macroscopic Balances to solve Steady-State Problems	9

Text Books	
1	*Transport Phenomena* (Revised 2nd Ed.) Wiley India Pvt Ltd, 2002 by **Bird, Stewart, and Lightfoot**
2	*Analysis of Transport Phenomena* (5^{th} Ed.) Wiley India Pvt Ltd, 2007 by **William M. Deen**
3	*Transport Processes and Unit Operations*, (4^{th} Ed.) Prentice Hall (India) Pvt. Ltd., New Delhi. 2004 by **C.J Geankopolis**
Reference Books	
1	*Introduction to Transport Phenomena* Prentice Hall, 2000 by **W.J Thompson**
2	*Fundamentals of Momentum, Mass and Heat Transfer* by J Welty, C.E Wicks, R.E Wilson and G.L Rorrer

ICT/MOOCs references

1) **NPTEL (Swayam):** "Transport Phenomena" by Prof. Sunando Dasgupta (IIT Kharagpur). https://nptel.ac.in/courses/103105128
2) **MIT OpenCourseWare (OCW):** "Transport Processes" (Course 10.302) https://ocw.mit.edu/courses/10-302-transport-processes-fall-2004/

Mapping of CO with PO and PSO:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**1**	**3**
CO2	**3**	**3**	**2**	**2**	**1**	**2**	**1**	**1**	**2**	**1**	**2**	**3**	**2**	**3**
CO3	**3**	**3**	**2**	**2**	**1**	**1**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**3**
CO4	**3**	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**3**	**1**	**3**