Course Type	Course Code	Name of the Course	L	T	P	Credits
DSC	NPEC103	Petroleum Engineering Thermodynamics and Transport Phenomena	3	0	0	3

Course Objective
This course aims to equip students with a thorough understanding of thermodynamics and transport phenomena as applied to petroleum engineering.
Learning Outcomes
• By the end of the course, students will possess a foundational understanding of thermodynamics enabling them to elucidate phenomena associated with petroleum reservoir fluids and production operations. • Students will be able to analyze and apply principles of momentum, heat, and mass transfer to solve engineering problems in various industries, including petroleum engineering, with a focus on optimizing processes for efficient energy resource utilization.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Basis Concepts of First Law and Second Law of Thermodynamics: Thermodynamic state and state functions; Enthalpy; Entropy; Free energy; P-V andT-S diagrams; Steady state and reversible process; Heat engines.	4	Students will become adept at defining thermodynamic states,applying energy concepts, interpreting diagrams, distinguishing processes, and grasping heat engine principles.
2	Introduction to phase behavior and chemical reaction equilibria (flash calculations with k-values); and equation of state applications and modelling.	4	Students will learn phase behavior, chemical equilibrium, flash calculations, and equation of state applications.
3	Thermodynamic Properties of Fluids: Property relations for homogeneous phases; Residual properties; Generalized property correlations for gases.	4	Will understand fluid property relations, residual properties, and correlations for homogeneous phases and gases.
4	Thermodynamics of Flow Processes: Principles of conservation of mass and energy for flow systems;Analysis of expansion process: turbines; throttling;compression process: compressors and pumps.	4	Will grasp conservation principles for flow systems and analyze expansion and compression processes in detail.
5	Solution Thermodynamics: Basic concepts of chemical potential and phase equilibria; Partial properties; Residual and excess Gibb's free energy.	4	Will understand chemical potential, phase equilibria, partial properties, and Gibbs free energy variations in solutions.
6	Momentum transport: Introduction; Momentum Balances; Newton's Law of Viscosity; Vector and Tensor Notation; Equations of Continuity and Motion; Steady State and Unsteady State FlowProblems.	7	Will achieve proficiency in momentum transport principles, including viscosity laws, flow balances, and continuity equation analysis.
7	Energy transport: Heat Conduction; Fourier's Law;Shell Energy Balances; Analogies; Equations of Energy; Heat Transfer Coefficients; Solution ofNon-Isothermal Problems.	7	Will grasp heat conduction, energy balances, transfer coefficients, and solve non-isothermal problems effectively.
8	Mass transport: Ordinary Diffusion, Fick's Law; Shell Mass Balances; Stagnant Film; Mass	8	Will understand diffusion, mass balances, transfer coefficients,

	Transfer Coefficients; Multicomponent Macroscopic Balances; Basic concepts of Absorption and Adsorption; Basic concepts of distillation.		multicomponent balances, absorption, adsorption, and distillation principles effectively.
	Total	42	

Text Books:

- Bejan, Adrian. *Advanced engineering thermodynamics. John Wiley & Sons, 2016.*
- J. M. Smith, Hendrick C. Van Ness, M. M. Abbott, Mark Swihart, B I Bhatt (2020) *Introduction toChemical Engineering Thermodynamics*. McGraw Hill.
- Bird, R.B., Stewart, W.E. and Lightfoot, E.N. (2007). *Transport Phenomena* (Revised Second ed.). John Wiley & Sons.
- Plawsky, Joel L. *Transport phenomena fundamentals*. CRC press, 2020.

Reference Books:

- Abbas Firoozabadi (1999). *Thermodynamics of Hydrocarbon Reservoirs*. McGraw Hill.
- Christie J. Geankoplis (1993*). Transport Processes and Unit Operations.* Prentice Hall Inc.