22PEB101T					Transport Phenomena					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To give an introduction to the Petroleum Engineering foundation that requires analysis of Transport Phenomena.
- It helps in formulation of a given physical problem in terms of appropriate conservation equations
- It will help in physical understanding of the Petroleum engineering problems and phenomena

9 Hrs.

UNIT I : Fluids: Statics and Dynamics

Introduction: Continuum, Force, Stress, Strain, Solids vs. Fluids, Types of fluids, Fluid Properties, Newton's law of viscosity, Stokes' theorem, Fundamental Concepts: Fluid flow definition (Eulerian vs. Langrangian), System vs. Control Volume, Fluid Statics: Hydrostatic law, Pascal's law, Pressure at a point, Total Pressure, Barometric Equation. Fluid Kinematics: Types of flow (steady vs. unsteady, uniform vs. non-uniform, laminar vs. turbulent, One, Two and Three dimensional, compressible vs. incompressible, rotational vs. Irrotational), Stream lines, path lines, streak lines, velocity components, stream function. Fluid Dynamics: Bernoulli's equation, Application of Bernoulli's equation

UNIT II: Momentum Transport **10 Hrs.**

Viscosity, temperature effect on viscosity of gases and liquids,
Mechanism of momentum transport, shell momentum balance, pressure and velocity distributions in falling film, circular tube, annulus, slit. Equations of Continuity and Motion. Equation of continuity, motion, mechanical energy, use of equations of change to solve flow problems, comparison of laminar and turbulent flows, time-smoothed equation of change, empirical expressions.

UNIT III: Energy Transport **8 Hrs.**

Thermal conductivity, temperature and pressure effect on thermal conductivity of gases and liquids, Fourier's law, mechanism of energy transport, shell energy balance, temperature distribution in solids and laminar flow with different types of heat source, heat conduction through composite walls, cylinders, spheres, fins, slits.

UNIT IV: Mass Transport **9 Hrs.**

Diffusivity, temperature and pressure effect, Fick's law, mechanism of mass transport, theory of diffusion in gases and liquids, shell mass balances, concentration distribution in solids and in laminar flow: stagnant gas film, heterogeneous and homogeneous chemical reaction systems, The equation of continuity, summary of equations of change and flux.

Max . 36 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Estimate the transport properties and describe the governing laws and also to examine the dependency of process parameters on each transport property.

CO2 : Solve differential equations arising in transport problems by setting up shell momentum, energy and mass balance and recognize initial and boundary conditions.

CO3 : Interpret and develop the general equations of change based on conservation of mass and transport entities.

CO4: Simplify the general equations of change for solving momentum, energy and mass flow problems.

CO5 : Solve a time periodic linear momentum, energy and mass transfer problems.

CO6:Analyze the momentum, heat and mass transport problems involved in process equipment.

TEXT/REFERENCE 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.
3. L.S.Sissom, and D.R.Pitts, "Elements of Transport Phenomena", McGraw-Hill, New York, 1972.
4. R.W.Fahien, "Elementary Transport Phenomena", McGraw-Hill, New York, 1983.
5. 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

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

PART A: <Question: <Short Notes, Problems, Numerical> **20 Marks**

PART B:<Justification, Criticism, Long answers, Interpretation > **80 Marks**