Course Type	Course Code	Name of Course	L	T	P	Credit
DE	NPED502	Fluid Flow through Porous Media	3	0	0	3

Course Objective

- Fundamental aspects of flow and transport processes in porous media
- Preparing students for reservoir modelling concepts and applications

Learning Outcomes

Upon successful completion of this course, students will:

- Able to write mass, momentum and energy conservation equations for flow in porous media
- Develop skills in modelling single- and multiphase fluid flow in porous media
- Understand fluid flow in rocks and its applications in reservoir engineering

Unit No.	Topics to be Covered	Contact Hours	Learning Outcome
1.	Introduction: Importance of studying fluid flow through porous medium, natural vs. synthetic porous media, differences in fluid flow phenomena in porous materials with those in channels/pipes/tubes, pore structure, homogeneous vs heterogeneous porous media, scale-dependence of heterogeneity, and fractals.	4	To learn about the concept and applicability of flow through porous media, particularly in in petroleum reservoir.
2.	Properties of Porous Media: porosity and permeability, bundle of capillary tube models of porous medium, porosity-permeability relationships, pore connectivityand parametric functions, data analysis and correlation methods of typical permeability data.	5	To know about the fundamental properties of reservoir rock estimation methodology.
3.	Macroscopic transport in porous media: representative elementary volume (REV), volume averaging, applications of volume and surface averaging rules, tortuosity, and macroscopic transport by control volume analysis.	5	To know about the macroscopictransport phenomena in porous media
4.	Effective properties of porous media: effective medium, determination of effective properties through Monte-Carlo simulations, effective properties of anisotropic porous media, pore connectivity and disorder, introduction to percolation theory.	5	To determine the effective properties of porous media, anisotropy and pore connectivity.
5.	Single-phase flow in porous media: flow potential, incompressible and compressible flow in porous media, Darcy's law and non-Darcy effects, mass, momentum and energy transport equations, Forchheimer's equation and determination of its parameters, and viscous dissipation in porous media flow.	6	To know about the various transport equations for the flow of single phase incompressible and slightlycompressible fluid through porous media
6.	Gas transport in tight rocks: gas transport mechanisms through nanopores, flow regimes, Knudsen number and mean flow paths, slip flow, thermal effects, apparent gas permeability, single- and multicomponent gas flow, and effect of pore size distribution on gas transport through porous media.	6	To know about the various transport equations for the flow of single and multicomponent gas flow through porous media
7.	Multi-phase flow in porous media: wettability and threshold potential, capillary pressure and its estimation, capillary pressure function, permeability dependence of capillary pressure and Leverett scaling, relative permeability, steady-state and unsteady-state relative permeability measurements and data interpretation.	6	To know about the various transport equations for the flow of multi-phase flow through porous media

8	Mass, momentum, and energy transport in porous Media: molecular diffusion, hydrodynamic dispersion, convective flux functions, coupled transport equations, constitutive relationships, sources and sinks, phase transition and applications.	5	The applications of porous media transport equations for reservoir engineering problems.
	Total contact hours:	**42**	

Text Books:

1. Flow of Fluids Through Porous materials, Collins, R.E., Reinhold Publishing Corporation, NY, 1961

Reference Books:

1. Dynamics of Fluids in Porous Media, Bear, J., Dover, 1988
2. Porous Media Transport Phenomena, Civan, F.A, Wiley, 2011
3. Porous Media: Fluid Transport and Pore Structure, Dullien, F.A.L, 2nd Edition, Elsevier, 1991