Course Type	Course Code	Name of the course	L	T	P	Credit
DE	NCED516	Advanced Fluid Mechanics	3	0	0	3

Course objectives:
To introduce fundamentals of fluid motion, stress and strain tensor, governing equations of fluid flow, viscous and turbulent flow and their application.
Learning outcomes:
Upon completion of this course, student will be able to • Apply conservation equation to solve fluid flow problem. • Analyse viscous flow and flow instability. • Evaluate boundary layer and analyse turbulent flow.

Sl. No.	Contents	Contact Hours	Learning Outcome
1.	**Theory of strain and motion:** introduction to Cartesian tensors and tensor operations, Eulerian and Lagrangian description of motion of deformable bodies, rotation and vorticity, strain rate tensor, time rate of change of volume and line integrals	8L	Able to understand the concept of fluid flow pattern, Eulerian and Lagrangian description of motion, and strain tensor
2	**Fundamental principles and theory of stress:** stress tensors, Reynolds transport theorem, Cauchy's first equation of motion, Cauchy's second equation of motion, energy equation	10L	Able to understand the concept of stress, the principle of conservation of mass, momentum and energy equation
3.	**Viscous flow:** Derivation of Navier-Stokes equations and its application, introduction to laminar flow, boundary layer, laminar sub layer, hydro-dynamically smooth and rough surface, Blasius equation, Karman momentum equation, boundary shear stress, drag, lift, local and average coefficients of friction for laminar and turbulent boundary layers, factors affecting separation of boundary layer and its control.	14L	Able to analyse the viscous flow and boundary layer formation and its application
4.	**Turbulent flow:** Kelvin- Helmholtz instability, Reynolds equation of motion, semi-empirical theories of turbulence, statistical theory of turbulence, turbulent Poiseuille flow, jets and wakes	10L	Able to analysis turbulent flow and its application.
Total Contact Hours		**42L**	

Text Books:

1. White, F.M., "Fluid Mechanics", McGraw-Hill. 1979
2. Chatterjee R, "Continuum Mechanics" Narosa Publishing house, 2002

References

1. Fox, R.W. and McDonald, A.T. (2016), Fluid Mechanics, 9th Edition, Wiley, India.
2. Schlichting, H., "Boundary Layer Theory", McGraw-Hill. 1979
3. Garde, R.J., "Turbulent Flow", Wiley Eastern Limited. 1994