Marine Hydrodynamics - Video course

COURSE OUTLINE

Introduction - ideal and viscous incompressible fluid; Kinematics of fluid; Lagrangian and Eulerian methods of description, velocity, acceleration, streamlines, pathlines, vorticity; Equation of continuity; Euler's Equations of motion; Bernoulli's equation and its application, Two dimensional motion - velocity potential, stream function, Sources, sinks, dipoles; Flow past a circular cylinder with and without circulation; Blasius Theorem; Problems on the motion of perfect fluids - steady translation of a cylinder in an infinite fluid medium, unsteady translation; Added mass of cylinders; Spheres;

The vortex system-circular vortex, two dimensional sources and vortex distributions, vortex sheets; Lifting Surfaces, Aerofoil theory - complex potential-Method of Conformal mapping- Joukowski profile; Flow past a Joukowski profile; Velocity and pressure distribution on aerofoils; Viscous fluids- Navier-Stokes equations, Laminar flow, Poiseuille flow, Couette flow, flow through a pipe; Boundary layer Theory-Reynolds Number; Boundary layer along a flat plate; Blasius solution; Separation, Von Karman momentum integral method;

Introduction to Turbulence; Gravity waves- Airy's wave; Free surface condition; Velocity potential- Dispersion relation; Surface tension effects; Orbital motion; Group velocity and its dynamical significance; Wave energy; Standing waves; Loops and nodes, Wave forces and Morison's equation, Long waves and waves in a canal; Tides.

COURSE DETAIL

The course content consists of five modules. Each module will have approximately 8-10 lectures. Apart from the basic theory large number of problems will be worked out to illustrate the utility of the theory. There will be couple of problems at the end of each lecture/module as home work. A brief outline of the modules is as below:

Module No.	Topic/s	Lectures
1	Introduction - ideal and viscous incompressible fluid; Kinematics of fluid; Lagrangian and Eulerian methods of description, velocity, acceleration, streamlines, pathlines, vorticity; Equation of continuity; Euler's Equations of motion; Bernoulli's equation and its application,	8-10
2	Two dimensional motion - velocity potential, stream function, sources, sinks, dipoles; Flow past a circular cylinder with and without circulation; Blasius Theorem; Problems on the motion of perfect fluids - steady translation of a cylinder in an infinite fluid medium, unsteady translation; added mass of cylinders; Spheres;	8-10
3	The vortex system-Circular Vortex, two dimensional sources and vortex distributions, Vortex Sheet, Von Karman Vortex Sheet; Lifting Surfaces, Aerofoil theory - complex potential- Method of Conformal mapping- Joukowski profile; Flow past a Joukowski profile; Velocity and pressure distribution on aerofoils;	8-10

NP-TEL

NPTEL

http://nptel.iitm.ac.in

Ocean Engineering

Pre-requisites:

Basic Engineering Mathematics

Additional Reading:

- Le Mehautte, B. (1976) "Introduction to Hydrodynamics and water waves".
- Stoker, J. J. (1992) Water Waves, "The Mathematical Theory with Applications" Wiley Interscience Edition
- Kundu, P. K. and Cohen, I. M. (2003), Fluid Mechanics, Academic Press, India
- Johnson, R. S. (1997) "A Modern Introduction to the Mathematical Theory of Water Waves", Cambridge University Press, USA.

Coordinators:

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4	Viscous fluids- Navier-Stokes equations, Laminar flow, Poiseuille flow, Couette flow, flow through a pipe; Boundary layer, Reynolds Number; Boundary layer along a flat plate; Blasius solution; Separation, Von Karman momentum integral method; Introduction to Turbulence;	8-10
5	Gravity waves; Airy's wave; Free surface condition; Velocity potential- Dispersion relation; Surface tension effects; Orbital motion; Group velocity and its dynamical significance; Wave energy; Standing waves; Loops and nodes, Wave forces and Morison's equation, Long waves and waves in a canal; Tides.	8-10

References:

1. Milne-Thomson, L. M. (1996) Theoretical Hydrodynamics, Dover Publications, Inc. New York. Introduction to Fluid Mechanics
2. Dean, R. G. & Dalrymple, R. A. (2001) "Water Wave Mechanics for Engineers and Scientists" Allied Publishers Limited, New Delhi (Reprint of World Scientific, Singapore).
3. Newman, Nick, (1977) "Marine Hydrodynamics" MIT Press.
4. Lamb, H. (1995) Hydrodynamics, 6th Edition, Cambridge University Press, USA