Amirkabir University of Technology
Tehran Polytechnic

Department of Aerospace Engineering

Advanced Viscous Flow

Fall 2019

Instructor: Dr. Mehran Tadjfar

Course Objectives: To provide understanding of fluid dynamics concepts, Navier-Stokes equations and their exact solutions, with particular attention to viscous flows.

Textbook: Class notes provided by the instructor.

References:
Panton, R., Incompressible Flow, Wiley.
White, F. Viscous Fluid Flow. McGraw-Hill.
Schlichting, H et al. Boundary Layer Theory, McGraw-Hill.
Batchelor, G. K. An Introduction to Fluid Dynamics. Cambridge University Press.
Sherman, F. S. Viscous Flow. McGraw-Hill.

Grading:
10% Homeworks
90% Final Exam

- Introduction.
- Tensor Field Theory and some Fundamental Theorems.
- Conservation Laws:
  - Conservation of Mass.
  - Conservation of Momentum.
  - Stress Tensor.
  - Newtonian Fluids.
  - Conservation of Energy.
  - Navier Stokes Equations (NSE) and Boundary Conditions
- Vorticity Dynamics.
- Bernoulli's Theorem.
- Exact Solutions of NSE:
  - Stokes First Problem.
  - Stokes Second Problem.
  - Stagnation Flow.
  - Channel Flow with Blowing and Suction.
- Boundary-Layer Equations (BLE):
  - Various Solutions of BLE.
  - B-L Flow on Bodies of Revolution.
  - Jet Flows.
- Low Reynolds Number Flows:
  - Different Forms of Stokes Equations.
  - Stokes Flow Over a Cylinder.
  - Oseen Flow.
- More Topics, if time allows, will be added.