Problem Set-3 in Fluids

Ashish Garg (Gate Aerospace Forum)

19 April 2011

You can send any of the format(Word,Latex file, PDF, or Scan) solution to the below given Gmail IDs

Email : *gatetestseries@gmail.com*, *ashish.garg.iisc@gmail.com*

Aerodynamics, Irrotational Flows, Viscous Flow

Problem 1 : Consider flow adjacent to a plane rigid wall. Show that the force due to viscosity is along the tangent to the wall. Assume that the flow is incompressible. Is this true if the flow is compressible ?

Problem 2 : A rigid closed container is completely filled with homogeneous, incompressible, frictionless fluid. Show that it is not possible, by any movements applied to the container, to set its contents into motion which will persist after the container has come to rest.

Problem 3 : In any incompressible potential flow, show that the magnitude of the fluid velocity cannot take a maximum value in the interior of the fluid.

Problem 4 : Consider the steady viscous flow through the annular space formed by two coaxial tubes. The flow is along the axis of the tubes and is maintained by a pressure gradient dp/dx, where the x direction is along the axis of the tubes. Show that the velocity at any radius r is

$$u(r) = \frac{1}{4\mu}\frac{dp}{dx}[(r^2 - a^2) - \frac{(b^2 - a^2)}{ln(b/a)}ln(r/a))] \tag{1}$$

where a, b are the radii of inner and outer tubes respectively.

Problem 5 : Consider flow through a circular pipe of varying cross-section. The velocity at inlet is u(r) = 1 while at outlet is $u(r) = \frac{(4R^2 - r^2)}{R^2}$.

The radii of cross-section are R and 2R at inlet and outlet respectively. Given this information, can you say if the flow inside the pipe is incompressible or not. Justify your answer.

Note : **The detailed Solutions of this Problem Set will be given with test papers to the registered students**