Problem Set-2 in Fluids

Ashish Garg (Gate Aerospace Forum)

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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 : Suppose that it is desired to estimate volume flow Q in a pipe by measuring the axial velocity u(r) at specific points. For cost reasons only three measuring points are to be used. What are the best radii selections for these three points?

Problem 2 : In fully developed straight-duct flow, the velocity profiles do not change (why?), but the pressure drops along the pipe axis. Thus there is pressure work done on the fluid. If, say, the pipe is insulated from heat loss, where does this energy go? Make a thermodynamic analysis of the pipe flow

Problem 3 : The Reynolds number for transition to turbulence in pipe flow was about $Re_{turbulence} = 2300$, whereas in flatplate flow $Re_{turbulence} = 1000000$, nearly three orders of magnitude higher. What accounts for the difference?

Problem 4 : Describe how an observer, running along a normal-shock wave at finite speed V, will see what appears to be an oblique-shock wave. Is there any limit to the running speed ?

Problem 5 : Prove from Ackeret theory that for a given supersonic airfoil shape with sharp leading and trailing edges and a given thickness, the minimum-thickness drag occurs for a symmetric double-wedge

shape

Problem 6 : Do the Mach waves upstream of an oblique-shock wave intersect with the shock? Assuming supersonic downstream flow, do the downstream Mach waves intersect the shock? Show that for small deflections the shock-wave angle β lies halfway between μ_1 and $\mu_2 + \theta$ for any Mach Number.

Problem 7 : (a) water and mercury and (b) aluminum and steel have nearly the same speeds of sound, yet the second of the two materials is much denser. Can you account for this oddity? Can molecular theory explain it?

Problem 8 : During horizontal channel flow over a bump, is the specific energy constant? Explain.

Problem 9 : Cite some similarities, and perhaps some dissimilarities, between a hydraulic jump and a gas-dynamic normalshock wave.

Problem 10 : A shallow-water wave propagates at the speed $c = (gy)^{1/2}$. What makes it propagate? That is, what is the balance of forces in such wave motion? In which direction does such a wave propagate?

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