Fundamentals of Fluid Mechanics B Questions and Answers

Question by AME536B Student

would you be willing to allow us to turn in HW #04 at 11:59 pm rather than 11:00 am tomorrow?

No, the deadline is at 11:00 am. Submit whatever you've got by 11:00 and you can do a revision and submit it a second time next week if you wish.

Question by AME536A Student

For prob #3 in the assignment 4, is there no pressure gradient in y-direction?

The pressure varies both along x and along y. Thus, $P = P(x, y)$ as written in the answers.

Question by AME536A Student

Dr.Parent. I am waiting for your feedback for the prob #3 in the assignment 3. If you don` t mind, could you please give me your feedback?

Plan for my comments to be given within 1 week of the submission date or so.

Question by AME536A Student

I would like to make sure again that mid-term will be performed in at 11-12:15 on March 23,on next Tuesday.

Yes, this is correct. It will be proctored using zoom. Bring a pencil or a pen with black ink and some sheets of paper and a cheap calculator.

Question by AME536B Student

For journey bearing problems we can unroll the problem to solve in cartesian coordinates rather than polar coordinates if the difference in the inner and outer diameter is small.
In an example from class, we had $D_i = 10cm$ and $D_o = 11cm$ and were able to use the cartesian approximation. If we define the ratio between the diameters as follows:

$R = \frac{D_i}{D_o}$
what is the minimum value of R that allows us to use the cartesian coordinates instead of polar coordinates?

For $R > 0.9$ you can unroll the problem in xy coordinates. Then, the error will be less than $\sim$ 10% on the shear stresses.

Question by AME536B Student

In the Tables, Section 1.6, the streamfunction for Stokes flow is given as:

$$\psi = \sin^2\theta \left[\frac{q_\infty R^3}{4r} - \underbrace{\frac{3q_\infty R^2}{4}}_{(1)} + \frac{q_\infty}{2} r^2 \right]$$

Shouldn't the (1) term be

$$-\frac{3q_\infty R}{4} r$$

it appears in that form from other sources (eqn 21.8.10 in Panton).

Correct. You can verify that this is true when deriving ψ over a sphere in the next assignment. This has been corrected in the tables. See updated tables.

Question by AME536B Student

Dr. Parent. I'm unsure how to start with Problem 2 in Assignment 5. Is it right to proceed with using spherical coordinates or would some other approach be better? Also, if we must use spherical coordinates, I'm unsure how to scale θ, $\sin\theta$ etc. Could you please provide some hint with approaching this question?
Thank you.

For part (a), rewrite the terms in the momentum equation using order of magnitude approximations in the vicinity of the sphere. It's not needed to use spherical coordinates. For part (b), do the same but far away from the sphere. The terms will not simplify to the same expressions as in (a).

Question by AME536B Student

Dr. Parent, for Assignment 5, Question 1 c), I realized that it is not enough to find $\tau_{r\theta}$ in order to find drag force, because my final answer does not match the tables. I was wondering how to proceed after finding $\tau_{r\theta}$?

This needs to be integrated over the surface of the sphere.

Question by AME536B Student

Dr. Parent, for Question 3 part A, I'm not sure that the equation I am starting with is correct. Using force balance, and considering inertial terms to be 0, I would end up with

$$m\frac{dv}{dt} = F_D - F_g = 0$$

where,
F_D = *Drag force*
F_g = *Force due to gravity*

But no matter how I integrate this, I do not get a solution that would be similar to part C. I just wanted to confirm that I am starting the right way.

Yes this is correct. In part (a), the drag force should be equal to the gravitational pull force.

Question by AME536B Student

Dr. Parent, could you prove some hint as to which direction to think about for Question 2 in Assignment 6?

Both Blasius and Reynolds are exact solutions, but both differ by a lot from each other. The difference can not be due only to how they define the boundary layer height which I would expect to lead to a few percent error but not more. There is a fundamental difference in the problem that these 2 solutions are solving.. Look carefully through the assumptions and problem setup.

Question by AME536B Student

When describing wake theory, you utilize the following equation (see Assignment 8 question 1):
$f(\eta) = tanh(\eta)$
What is the physical meaning of the variable η*? Searching through my notes from class, I could not find it ever being formally defined.*

That's the non-dimensional version of the y coordinate. This was defined shortly after the guess for ψ early on in the far wake profile derivation.

Question by AME536B Student

When we approximate the velocity profile in a boundary layer with:

$$\frac{u}{u_\infty} = \frac{3}{2}\frac{y}{\delta} - \frac{1}{2}\left(\frac{y}{\delta}\right)^3$$

Are we assuming that u is the only component in the field, or is it necessary to approximate the v component as well from other means?

The answer to this question should be clear from the class notes. If we assumed a certain v distribution when deriving the u velocity profile, then you need to be consistent and keep the same v distribution. Otherwise, such u profile does not restrict how v can vary.

Question by AME536B Student

Dr. Parent, can we continue to submit revisions to the assignments until the Final exam?

Yes. It may take me 2-3 days to give you feedback.