Lecture F2 Mud: Thin Airfoil Theory – Symmetric Airfoil
(respondents)

1. **How thin does the airfoil have to be for this to apply?** (1 student)
   It depends what you're after. If you just want overall c_ℓ and c_m, TAT is remarkably accurate even for not-so-thin airfoils. For accurate detailed surface $C_p(x)$ distributions, the airfoil must be quite thin. In the PS's you will investigate this.

2. **What do you mean by "real flow and vortex-sheet model are equivalent"?** (1 student)
   They are equivalent when the model duplicates the velocity field $\vec{V}(x, z)$ of the real flow.

3. **What's ξ, $d\xi$ . . . ? Same as vorticity? What's $x - \xi$?** (5 students)
   ξ is a location along the x-axis where the $d\xi$-piece of the vortex sheet is. The sheet strength at that location is $\gamma(\xi)$, and the circulation around the piece is $d\Gamma = \gamma\, d\xi$.
   x is a different location, where the velocity $w(x)$ is being computed. The difference $x - \xi$ is just the distance between the sheet-piece location and the velocity-calculation location. Note: Here, ξ is <u>not</u> vorticity (there's not enough Greek letters to go around).

4. **What's θ_o?** (2 students)
   The θ-coordinate location corresponding to x. The other location corresponding to ξ is denoted just by θ, without any subscript.

5. **Why does the vortex sheet only give a z-component on the airfoil?** (1 student)
   By geometry. A vortex's velocity is always in the tangential direction. So each piece of the sheet has velocities along the sheet which point either straight up or straight down. Nothing horizontal.

6. **How did you get the integral formula for $w(x)$?** (1 student)
   From superposition of all the infinitesimal vortices of strength $\gamma\, d\xi$ which constitute the sheet. See the vortex-sheet stuff from last term.

7. **Is c_ℓ always $2\pi\alpha$ for any airfoil?** (1 student)
   True for any thin symmetric airfoil. You will examine not-so-thin airfoils in the first PS.

8. **Lower vortex sheet on 1st page figure looks like it increases the velocity.** (1 student)
   The sheet vortex strength directions are drawn as they typically appear. Upper surface is typically clockwise ($\gamma_u > 0$), lower surface is counterclockwise ($\gamma_\ell < 0$). For upward lift, γ_u is greater in magnitude, so $\gamma = \gamma_u + \gamma_\ell$ ends up positive.

9. **What's the Kutta condition again?** (1 student)
   The fact that the fluid flows smoothly off the trailing edge, without curling around. To represent this real situation, the vortex-sheet model must have zero sheet strength at the trailing edge point: $\gamma(x = c) = 0$, or $\gamma(\theta = \pi) = 0$.

10. **Equation for $\vec{V} = \vec{V}_\infty + w\hat{k}$ was not the same as in notes?** (1 student)
    I think I wrote it wrong on the board. It's correct in the notes.

11. **Can you do some examples?** (2 students)
    In the current PS, the next PS, and maybe in recitations.

12. **Math was too confusing.** (9 student)
    Try to keep the overall concepts clear. I'll have an overall concept summary in F3 lecture. Hopefully that will help.

13. **Why are the axes labeled $\gamma/2\alpha V_\infty$ and x/c?** (1 student)
    It's the most universal way to plot the result. Specifically, it's a plot of the simple function $(1+\cos\theta)/\sin\theta$ versus $x/c(\theta)$, with θ a free parameter.

14. **Is there a good way to review important previous material?** (1 student)
    I don't know a better way than to dig back and review it. I'll try to make specific suggestions when appropriate.

15. **Explain the PRS. What are the arrows?** (1 student)
    Tough to do here without a board. Maybe in recitation

16. **How do we use Xfoil in our home PC's? How do we use it in the Pset** (1 student)
    You can download `xfoil.exe` from `http://raphael.mit.edu/xfoil` . I suggest following the sample session commands. It becomes fairly natural with a bit of practice.

17. **No mud** (12 students)