

Unit 6 - Week 4

Course outline

How does an NPTEL online course work?

Week 0

Week 1

Week 2

Week 3

Week 4

Lecture 16: Boundary Layers

Lecture 17: Boundary Layers (Contd.)

Lecture 18: Boundary Layers (Contd.)

Lecture 19: Boundary Layers (Contd.)

Lecture 20: Boundary Layers (Contd.)

Quiz : Assignment 4

Week 4 Feedback Form

Week 5

Week 6

Week 7

Week 8

Week 9

Week 10

Week 11

Week 12

Text Transcripts

Assignment Detailed Solution

DOWNLOAD VIDEOS

Live Interactive Session

Assignment 4

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2020-02-26, 23:59 IST.

1) True or False: Consider both the statements, and even if one of them is false then mark the entire answer as false else mark the answer as true.

1 point

According to Prandtl's hypothesis, the effect of fluid friction at high Reynolds number is limited to a thin layer near the boundary of the body, hence the term boundary layer. Furthermore, there is no significant pressure change across the boundary layer, which means that the pressure in boundary layer is the same as the pressure in the inviscid flow outside the boundary layer.

- a. True
b. False

- a
 b

No, the answer is incorrect.
Score: 0

Accepted Answers:
a

2) True or False: Consider both the statements, and even if one of them is false then mark the entire answer as false else mark the answer as true.

1 point

The total drag on an object may be due to pressure as well as frictional effects. The drag force due to friction is caused by the tensile stress at the surface of a solid object moving through an inviscid fluid.

- a. True
b. False

- a
 b

No, the answer is incorrect.
Score: 0

Accepted Answers:
b

3) True or False: Consider both the statements, and even if one of them is false then mark the entire answer as false else mark the answer as true.

1 point

Pressure drag arises from two principal sources: one is induced drag, or drag due to lift, and the other source is wake drag, which arises from the fact that the shear stress causes the streamlines to deviate from their inviscid flow paths, and in some cases to separate from the body altogether.

In an incompressible flow, the drag coefficient depends only on the Reynolds number and is independent of the geometry of the body.

- a. True
b. False

- a
 b

No, the answer is incorrect.
Score: 0

Accepted Answers:
b

4) True or False: Consider both the statements, and even if one of them is false then mark the entire answer as false else mark the answer as true.

1 point

For the case of laminar boundary layer over a flat plate, the introduction of stream function to the governing equations of boundary layer flow, by Blasius resulted in a single third order, non-linear ordinary differential equation.

The above obtained equation was first solved by Blasius using a series expansion, and the results were significantly improved by Howarth, who used a numerical approach.

- a. True
b. False

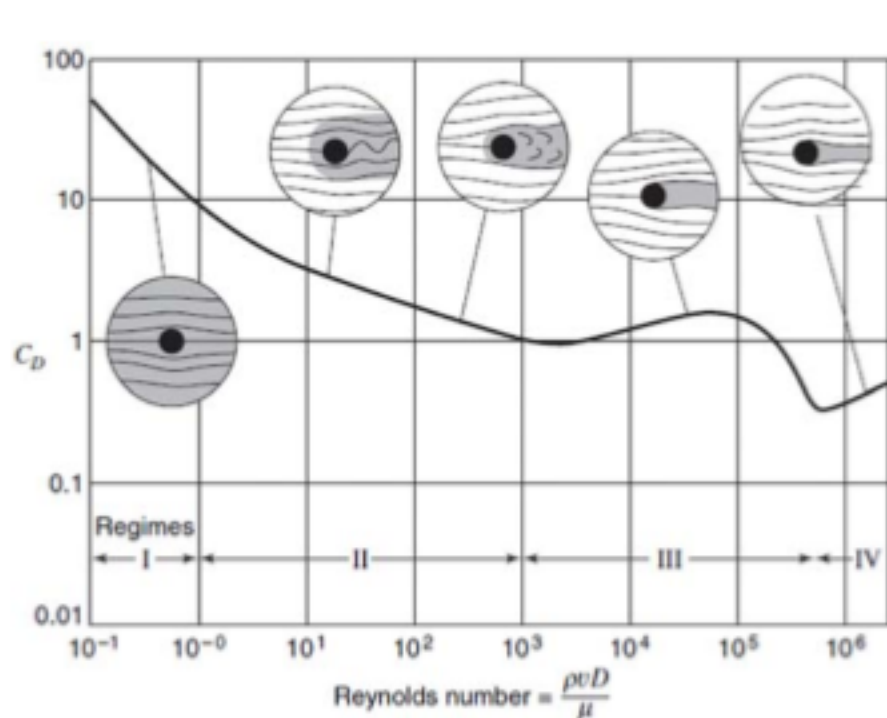
- a
 b

No, the answer is incorrect.
Score: 0

Accepted Answers:
a

5) Estimate the drag force (approx. in Newtons) on a 8-meter long radio antenna with an average diameter of 0.01 m, moving at a speed of 4.5 m/s, in an air-only ambiance, where the air moves across the length of the antenna (the projected area being that of a rectangle).

1 point



For air at 25 °C, the following properties are applicable: density of air = 1.225 kg m⁻³; viscosity of air = 18.6 × 10⁻⁶ Pa.s.

The following relationships are for reference:

$$F = C_D A_p \frac{\rho v_\infty^2}{2}; \quad F = C_D \frac{\pi d^2 \rho v_\infty^2}{4}$$

- a. 80
b. 0.875
c. 0.00987
d. 984.25

- a
 b
 c
 d

No, the answer is incorrect.
Score: 0

Accepted Answers:
b

6) A turbulent boundary layer could consist of which of the following regions?

1 point

- a. Laminar sublayer
b. Transition layer
c. Turbulent core
d. All the above

- a
 b
 c
 d

No, the answer is incorrect.
Score: 0

Accepted Answers:
d

7) Choose the correct order and nature of the Blasius equation related to the growth of the boundary layer

1 point

- a. 3, Linear
b. 2, non-linear
c. 2, linear
d. 3, non-linear

- a
 b
 c
 d

No, the answer is incorrect.
Score: 0

Accepted Answers:
d

8) Air at 1 atm and 25 °C (kinematic viscosity = 1.6 × 10⁻⁷ m²/s) flows tangentially on both sides of a thin, smooth flat plate of width 3 m and of length 1m. The velocity outside the boundary layer is constant at 6 m/s. Assuming laminar flow, compute the approximate boundary layer thickness at the trailing edge. (Select the closest value)

1 point

- a. 1 mm
b. 6 mm
c. 4 mm
d. 8 mm

- a
 b
 c
 d

No, the answer is incorrect.
Score: 0

Accepted Answers:
d

9) How is the surface of the golf ball modified to reduce the effect of wake formation?

1 point

- a. The golf ball has a porous surface
b. The golf ball has dimples on the surface
c. The color of the ball is white.
d. The ball has a very shiny surface

- a
 b
 c
 d

No, the answer is incorrect.
Score: 0

Accepted Answers:
b

10) Evaluate δ'/δ (momentum thickness/disturbance thickness) for a flow over a flat plate having velocity profile:

1 point

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

- a. 1/2
b. 3/8
c. 4/3
d. 4/5

- a
 b
 c
 d

No, the answer is incorrect.
Score: 0

Accepted Answers:
b