Code.No: R05422107 | R05 | SET-1

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
IV B.TECH II SEM–REGULAR/SUPPLEMENTARY EXAMINATIONS MAY - 2010
BOUNDARY LAYER THEORY
(AERONAUTICAL ENGINEERING)

Time: 3hours **Max.Marks:80**

Answer any FIVE questions
All questions carry equal marks

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1. Derive the continuity equation for a fluid in motion in the form of a differential equation. [16]

2. Sketch velocity profiles of boundary layer flows under the following conditions, and explain the phenomena:
   (a) Favourable pressure gradient,
   (b) Zero pressure gradient,
   (c) Weak adverse pressure gradient,
   (d) Critical adverse pressure gradient,
   (e) Strong velocity pressure gradient. [16]

3. Derive the Navier – Stokes equation along X – axis. [16]

4. Explain with neat sketches, flow over a sphere at very low Reynolds numbers. Compare the drag coefficients of spheres in laminar and turbulent flows. [16]

5.a) Given the velocity profile as $\frac{u}{U} = 6\eta^2 - 8\eta^3 + 3\eta^4$ where $\eta = \frac{Y}{\delta}$. Determine the displacement thickness and momentum thickness of the boundary layer. Obtain the shape factor.

b) Discuss the formation of boundary layer over a flat plate. Illustrate it with sketches in full details. [8+8]

6. Explain the merits for the Pohlhausen solution Vis-a-Vis Blasius solution of Laminar BL equations. Hence describe the Pohlhausen method with its work out. [16]

7.a) Define mean values and fluctuations of velocity components in turbulent boundary layers with illustrations.

b) What is understood by the terms laminar viscosity and turbulent viscosity? Explain with an example each. [8+8]

8. Explain various turbulent boundary layer profiles for $\frac{\partial p}{\partial x} < 0, \frac{\partial p}{\partial x} = 0, \frac{\partial p}{\partial x} > 0$ on a single plot of $\frac{\bar{u}}{U_e}$ and $\frac{y}{\delta}$. Explain the variations of these curves between curves for strongly favorable and strongly adverse pressure gradients. [16]

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