CODE NO: NR422101 SET NO.3

2005 JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY

IV B.TECH. II SEMESTER SUPPLEMENTARY EXAMINATIONS
BOUNDARY LAYER THEORY
(AERONAUTICAL ENGINEERING)

JULY -2005

TIME: 3 HOURS
MAX MARKS: 80

Answer any FIVE Questions
All Questions carry equal marks

1. *Simplify the equation of continuity in cylindrical coordinates to the case of steady compressible °ow in axisymmetric coordinates (@=@µ = 0) and derive a stream function for this case.*

2. *Derive the Boundary Layer equations from Navier-stokes equations.*

3. *Explain Asymmetric bee jet.*

4. *Derive a three-dimensional Poisson relation for pressure, analogous to Poissons for unsteady imcompressible °ow.*

5. *For a °at plate, U = U0, and a wall temperature distribution Tw - Te =¢ To[1 ¡ (x=L)3], use the superposition method to compute the value of x at which the local heat transfer qw changes sign.*

6. *For the Howarth free stream velocity U = U0(1- x/L), if UoL/v = 2X106, use the correlation of Michel, to estimate the point (x/L) where boundary-layer transition occurs? Assume a free stream turbulence level of 1 percent.*

7. *Air at 20oC and approximately 1 atm °ows through a smooth square duct of cross section 30 by 30cm. The °ow rate is 2:5m3=s. Estimate the pressure drop in pascals per meter of length, using both the hydraulic-radius and e®ective-diameter methods.*

8. *Evaluate the temperature law of the wall numerically, using the van Driest eddy viscosity , for Pr1 = 1.0 and various values of Pr.*