

Code.No: R05412110

R05

SET-1

IV B.TECH – I SEM EXAMINATIONS, NOVEMBER - 2010
ADVANCED COMPUTATIONAL FLUID DYNAMICS
(AERONAUTICAL ENGINEERING)

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

Answer any FIVE questions
All questions carry equal marks

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1. Develop the source panel method to compute potential flow in a two dimensional channel with sudden expansion. Identify the region of adverse pressure gradient and the point of separation. Study the sensitivity of solution to the number of panels, order and number of control points. [16]
2. Using vortex panel method, obtain the lift generated by a flat plate considering N vortex panels. Make necessary assumptions. [16]
3. Consider a nozzle of parabolic area distribution given by, $A = 1 + 2.2(x - 1.5)^2$. Throat of the nozzle is at $x = 1.5$, for $x < 1.5$, the nozzle is convergent and for $x > 1.5$, the nozzle is divergent. The initial conditions are given by,

$$\rho = 1 - 0.3146x$$

$$T = 1 - 0.2314x$$

$$V = (0.1 + 1.09x)T^{0.5}$$

Obtain the flow field variables after the first time step using the numerical method. [16]

4. Obtain the finite difference expression for Transonic Small Perturbation equation for irrotational flow over an aerofoil. Make necessary assumptions. [16]
5. For a nozzle, with a supersonic outlet flow, explain the numerical solution illustrating the aspect of shock capturing with a specified exit pressure. What is the need for artificial viscosity in the intermediate time marching procedure? Explain making necessary assumptions. [16]
6. For two dimensional and three dimensional steady flow draw the regions of influence and domain of dependence for the resulting parabolic equation. [16]
7. Discretize the Euler's equations for unsteady, two dimensional flow using Mac Cormack technique. Write comments about this method and its accuracy. How different this method is from Lax-Wendroff method? [16]
8. Discretize the one dimensional, unsteady general fluid flow equation without source terms using Leap Frog method. Write comments about its stability. Also discretize the above governing equation using Crank-Nicolson method and write comments about its stability and accuracy. [16]
