AQ – 2849

Second Semester M. E. (Thermal Engg.) Examination

COMPUTATIONAL FLUID DYNAMICS

Paper – 2 MTE 5

P. Pages : 2

Time : Three Hours] [Max. Marks : 80

Note : (1) Separate answer book must be used for each Section in the subject Geology, Engineering material of civil branch and Separate answer – book must be used for Section A and B in Pharmacy and Cosmetic Tech.
(2) All questions carry marks as indicated.
(3) Answer **three** questions from Section A and **three** questions from Section B.
(4) Due credit will be given to neatness and adequate dimensions.
(5) Assume suitable data wherever necessary.
(6) Illustrate your answer wherever necessary with the help of neat sketches.
(7) Use pen of Blue/Black ink/refill only for writing the answer book.

SECTION A

1. (a) What are important applications of CFD in engineering ? Explain in detail. 6

   (b) Write the energy equation and also explain the terms involved. 7

2. Derive continuity equation in cartesian co – ordinates. 14

3. (a) Enlist discretization methods and explain any one of them with example. 9

   (b) Explain stability analysis in brief. 4

4. (a) State and explain the difference between explicit and implicit methods with suitable example. 6

   (b) Explain Gauss – Seidel method used in computational fluid dynamics. 7

5. Derive Navier Stokes equation for incompressible flow. 13

SECTION B

6. Using Taylor series expansion, derive finite difference formulation of Lax – Wendroff method. 13

7. (a) Explain explicit relaxation technique. 7

   (b) Explain the philosophy of pressure correction technique. 6

8. Consider flow between two parallel plates separated by a distance 2 H. The fluid is driven between the plates by an applied pressure gradient in the X – direction. Assume laminar flow of a constant density fluid with constant viscosity. Determine the velocity distribution of the fluid as a function of velocity. 14

9. Compare the first two steps of the numerical solution of the inviscid Burgers equation $0 \leq x \leq 1$, $t > 0$.

$$\frac{\partial u}{\partial t} + \frac{\partial \left(\frac{1}{2} u^2 \right)}{\partial x} = 0$$

subject to initial boundary condition

$u(x, 0) = x$, $x > 0$

$u(0, t) = 0$, $t > 0$

compute the numerical solution with the exact solution ;

$$u = \frac{x}{1+t}$$

taking $\Delta x = 0.2$ and $\frac{\Delta t}{\Delta x} = 0.5$

13

10. Explain Alternating Direction Implicit technique. 13