The Assam Royal Global University, Guwahati

RSET

B. TECH 8th SEMESTER

Semester End Examination, July 2021

Course Title: Computational Fluid Dynamics & Heat Transfer

Course Code: MEE022D8021

Time: 3 Hours **Maximum Marks: 70**

Note: Attempt all questions as per instructions given.

The figures in the right-hand margin indicate marks.

Section – A

1. Attempt **all questions**. (Maximum word limit 50) **2 x 8**

a. Write continuity equation in differential and integral form.
b. Write 2D N-S equations.
c. What are the different types of PDE?
d. Define Truncation Error.
e. Convert 2nd Order PDE to FDE using CDM.
f. Convert Wave equation using FTCS method.
g. Write Upwind Scheme for wave equation.
h. What is FVM? Explain.

2. Attempt **any two** of the following: **6 x 2**

a. What are the approximations for laminar sub-boundary layer? Explain with figure.
b. Derive two dimensional Navier-Stokes equations for steady state and laminar fluid flow.
c. What do you understand by Consistency, Stability and Convergency? Explain.

3. Attempt **any two** of the following: **7 x 2**

a. State the approximations made in laminar sub-boundary layer, also find the equations using order of magnitude approach.
b. Compute Laplace equation for given boundary conditions upto second Iteration.

$$U(x,0) = 2x, \quad 0 \le x < 1 \qquad U(0,y) = 4y, \quad 0 < y < 1$$
$$U(x,1) = 6x, \quad 0 \le x < 1 \qquad U(1,y) = 8y, \quad 0 \le y \le 1$$

Assuming $\Delta x = \Delta y = 1/3$.

c. Compute Wave equation for given boundary conditions upto second Iteration.

$$U(x,0) = x, \quad 0 \le x < 1$$
$$U(0,y) = y, \quad 0 \le y < 1$$

All other boundary conditions are Zero.
Assuming $\Delta x = \Delta y = 1/3$ and Constant as 4.

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Section – B

4. Attempt **any two** of the following: **7 x 2**

a. Explain FTFS and FTBS scheme for hyperbolic equation.

b. What is Dufort Frankel Scheme for parabolic equation? Explain.

c. Explain Thomas Algorithm for Tri-Diagonal system for Crank-Nicholson implicit method.

5. Attempt **any one** of the following: **14 x 1**

a. Compute one dimensional heat conduction equation for given boundary and initial conditions for five-time steps.

B.C. $U_x(0,n) = U,$ at $x = 0$

$U_y(1,n) = -U,$ at $x = 1$

I.C. $T(x,0) = \sin x,$ $0 \le x \le 0.5$

Assuming $K = 1,\ \Delta x = 1/4$ and $r = 0.5$

b. Solve one dimensional heat conduction equation for given conditions for five time steps.

B.C. $U(0,n) = 0,$ $0 < n$

$U(1,n) = 1,$ $0 < n$

I.C. $U(x,0) = \cos x,$ $0 \le x \le 0.5$

Assuming $\Delta x = 1/4$ and $r = 1.$