

Total No. of Questions : 10]

SEAT No. :

P3680

[Total No. of Pages : 3

[4959]-1047

B.E. (Mechanical / Sandwich)

COMPUTATIONAL FLUID DYNAMICS

(2012 Pattern) (End Sem.) (Semester-II) (402050 A) (Theory)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Answer Q1 or Q2; Q3 or Q4; Q5 or Q6; Q7 or Q8; Q9 or Q10.*
- 2) *Figures to the right indicate full marks.*
- 3) *Neat diagrams must be drawn wherever necessary.*
- 4) *Use of electronic calculator is allowed.*
- 5) *Your answer will be valued as a whole.*
- 6) *Assume suitable data, if necessary.*

- Q1)** a) Write 1D governing equations each in Cartesian coordinates and label each term used for CFD analysis. **[5]**
- b) Justify the need of equation of state required to carry out solution of governing equations. **[5]**

OR

- Q2)** a) Give examples of three types of grid and explain any two with neat sketch. **[5]**
- b) Explain Alternating Direction Implicit method with neat sketch and the numerical method. **[5]**

- Q3)** a) Explain the central difference approach in numerical method. Write three equations citing example. **[4]**
- b) Given the function $f(x) = 0.45 x^2$; find the first derivative of f at $x = 3$; using forward, backward and central differencing of order (Δx) . Use a step size of $\Delta x = 0.1$. **[6]**

OR

P.T.O.

Q4) A horizontal pipe having a surface temperature of 67 C and diameter of 25cm is buried at a depth of 1.2 meter in the earth location where $k = 1.8 \text{ W/m. } ^\circ\text{C}$. The earth surface temperature is 15°C . Calculate the heat lost by the pipe per unit length. **[10]**

Q5) Considering first order wave equation, explain first order forward, central difference with respect X derive from Euler explicit form. **[16]**

OR

Q6) a) What is it that makes a given calculation go unstable? Explain considering three types of errors and its correlation state the stability condition. **[10]**

b) What is CFL number? **[6]**

Q7) a) Justify the need of Semi implicit method for pressure linked equations. **[10]**

b) Write steps to write algorithm for Semi Implicit method for pressure linked equations. **[6]**

OR

Q8) a) What are the boundary conditions for the pressure correction method? **[6]**

b) For the pressure correction formula, justify the need of Finite Volume approach. Explain X-momentum equation grid schematic for effective control volume. **[10]**

Q9) a) Explain the impact of Computational Fluid Dynamics in automobile and internal combustion engine applications. **[10]**

b) Illustrate the following steps of pre-processing: **[8]**

i) Creation of geometry.

ii) Mesh generation.

- iii) Selection of physics & fluid properties.
- vi) Specify boundary conditions.

OR

Q10)a) Explain any two turbulence models; **[10]**

- i) RANS.
 - ii) $k - \epsilon$ and
 - iii) $k - \omega$.
- b) How the graphical plots such as stream-lines; velocity vector plots; and animation are giving a precise picture of the analysis of computational fluid dynamics? **[8]**

