ME/Sem II/CBCGS/MECH /Computational THERMAL Fluid Dynamics/ND-17

Q. P. Code: 18041

3 Hours) [80 Marks]

N. B. :

i) Solve any **FOUR** questions.
ii) Assume suitable additional data if necessary & draw the sketches wherever required

Q1) a) Discuss ICs and BCs needed for solving following equation. 05

$$\frac{d\emptyset}{dt} + u\frac{\partial\emptyset}{\partial x} + v\frac{\partial\emptyset}{\partial x} + w\frac{\partial\emptyset}{\partial x} = \alpha\left(\frac{\partial^2\emptyset}{\partial x^2} + \frac{\partial^2\emptyset}{\partial y^2} + \frac{\partial^2\emptyset}{\partial z^2}\right) + \frac{q'''}{\rho C_p}$$

b) What are the advantages and disadvantages of Algebraic grid generation & Elliptic grid generation? 07

c) Explain LES and RANS Turbulence Models 08

Q2) a) Derive pressure correction equation used in SIMPLE algorithm. 10

b) Derive Thermal Energy equation. 10

Q3) a) Derive the equation for transforming the governing partial differential equations in terms of Jacobian matrix. 10

b) Explain Reynolds's Transport Theorem. 10

Q4) a) Consider 1-D thermal diffusion equation $\frac{dT}{dt} = \alpha\left(\frac{\partial^2 T}{\partial x^2}\right)$ 12

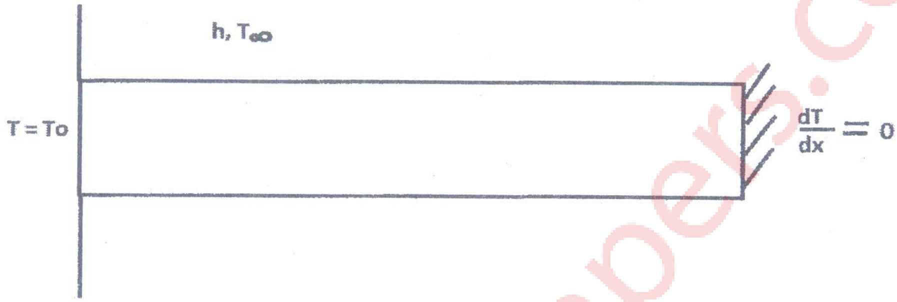
Using central differencing for the convection and diffusion terms and forward differencing for $\frac{dT}{dt}$

Derive (a) Explicit FDE (b) Crank-Nicolson type (Semi-Implicit) FDE that can be used to solve this problem.

b) Explain briefly CFD and its methodology. 08

Turn Over

Q5) a) Consider the 1 D steady state heat conduction in an isolated rectangular horizontal fin. The base temperature is maintained at $T=T_0$ & tip of fin is insulated. The fin is exposed to a convective environment which is at $(T_\infty < T_0)$. The length of the fin is 'L' & the coordinate axis begins at the base of the fin. 12



The energy equation for the fin at the steady state is

$$\frac{d^2T}{dx^2} + \frac{hP}{kA}(T - T_m) = 0$$

Where P = perimeter, A = cross section area of the fin,
h = heat transfer coefficient
Solve this problem using FDM and write matrix

b) Explain Forward, Backward and Central difference methods. 08

Q6) Write short notes on (ANY FOUR) 20

i. Mathematical Behavior of PDEs
ii. Implicit Method
iii. Numerical error
iv. Application of CFD
v. Grid Quality
