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12MTP322

Third Semester M.Tech. Degree Examination, Dec.2014/Jan.2015
Computational Methods in Heat Transfer and Fluid Flow

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Derive the momentum and energy equations for viscous flow in differential form. **(14 Marks)**

b. Explain the method of determining the classification of the partial differential equations using eigen value method. **(06 Marks)**

2 a. Using Taylor's series, derive second order central difference for the derivative $\frac{\partial^2 u}{\partial x \partial y}$. **(10 Marks)**

b. Using one dimensional heat conduction equation given by,

$$\frac{\partial T}{\partial t} = \alpha \frac{\partial^2 T}{\partial x^2}$$

as a model equation. Explain explicit and implicit approches. **(10 Marks)**

3 A large plate of thickness L = 2 cm with constant thermal conductivity K = 0.5 W/m/K and uniform heat generation q = 1000 kW/m^3. The faces A and B are at temperatures of 100°C and 200°C respectively. Assuming that the dimensions in the y and z-directions are so large that temperature gradients are significants in the x-direction only, calculate the steady state temperature distribution using finite volume method. **(20 Marks)**

4 A thin plate is initially at a uniform temperature of 200°C. At a certain time the temperature of the east side of the plate is suddenly reduced to 0°C. The other surface is insulated use explicit finite volume method in conjunction with a suitable time step size. Derive discretized equations for various nodes. Use five equally spaced cells. **(20 Marks)**

5 A property ϕ is transported by means of convection and diffusion through one dimensional domain, the boundary conditions are $\phi_0 = 1$ at x = 0 and $\phi_L = 0$ at x = L, using five equally spaced cells and the central differencing scheme for convection and diffusion. Calculate the distribution of ϕ as a function of x for u = 0.1 m/s, L = 1.0 m, ρ = 1.0 kg/m^3, Γ = 0.1 kg/m/s^1, using finite volume method. **(20 Marks)**

6 a. With the help of flow chart, explain the simple algorithm. **(10 Marks)**

b. Explain the staggered grid arrangement for fluid flow problems. **(10 Marks)**

7 a. Formulate the stream function and verticity for two dimensional incompressible viscous flows using Lid driven cavity. **(10 Marks)**

b. Discuss the MAC algorithm for the solution of unsteady Navier-Stokes equations. **(10 Marks)**

8 a. Explain Riemann solver for one dimensional Euler equations. **(10 Marks)**

b. Explain steger and warming flux vector splitting scheme. **(10 Marks)**

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