

Unit 13 - Week 11: Finite volume method - II

Course outline

How does an NPTEL online course work?

Week 0: Prerequisite

Week 1: Introduction to Computational Fluid Dynamics

Week 2: Classification of PDEs

Week 3: Finite Difference Method

Week 4: Elliptic Equations

Week 5: Parabolic Equations

Week 6: Hyperbolic Equations

Week 7: Stability Analysis

Week 8: Vorticity-Stream Function Formulation

Week 9: MAC Algorithm

Week 10: Finite Volume Method - I

Week 11: Finite volume method - II

● Lec 1: Finite volume discretization of steady convection-diffusion equation

● Lec 2: Finite volume discretization of unsteady convection-diffusion equation

● Lec 3: Convection Schemes

○ Quiz : Assignment 11

○ Feedback form for week 11

Week 12: SIMPLE Algorithm

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Assignment 11

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2020-04-15, 23:59 IST.

1) Which one of the following represents two-dimensional unsteady energy equation with constant properties without any source term? **1 point**

$$\rho \left[\frac{\partial(uT)}{\partial x} + \frac{\partial(vT)}{\partial y} \right] = k \left(\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} \right)$$

$$\rho \left[\frac{\partial T}{\partial t} + \frac{\partial(uT)}{\partial x} + \frac{\partial(vT)}{\partial y} \right] = k \left(\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} \right)$$

$$\rho C_p \left[\frac{\partial T}{\partial t} + \frac{\partial(uT)}{\partial x} + \frac{\partial(vT)}{\partial y} \right] = k \left(\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} \right)$$

$$\rho C_p \left[\frac{\partial T}{\partial t} + \frac{\partial T}{\partial x} + \frac{\partial T}{\partial y} \right] = k \left(\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} \right)$$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$$\rho C_p \left[\frac{\partial T}{\partial t} + \frac{\partial(uT)}{\partial x} + \frac{\partial(vT)}{\partial y} \right] = k \left(\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} \right)$$

2) The convective flux vector in convection-diffusion for general variable ϕ is represented as **1 point**

$$\rho \mathbf{u} \phi - \Gamma \nabla \phi$$

$$\rho \mathbf{u} \phi + \Gamma \nabla \phi$$

$$\rho \mathbf{u} \phi$$

$$-\Gamma \nabla \phi$$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$$\rho \mathbf{u} \phi$$

3) The diffusion flux in east face center with central difference scheme for uniform grid can be written as **1 point**

$$\mathbf{J}_e \cdot \mathbf{S}_e = \rho u_e A_e \frac{\phi_E + \phi_P}{2} - \Gamma_e A_e \frac{\phi_P - \phi_E}{\Delta x}$$

$$\mathbf{J}_e \cdot \mathbf{S}_e = \rho u_e A_e \frac{\phi_E + \phi_P}{2} - \Gamma_e A_e \frac{\phi_E - \phi_P}{\Delta x}$$

$$\mathbf{J}_e \cdot \mathbf{S}_e = \rho u_e A_e \frac{\phi_E - \phi_P}{2} - \Gamma_e A_e \frac{\phi_E - \phi_P}{\Delta x}$$

$$\mathbf{J}_e \cdot \mathbf{S}_e = \rho u_e A_e \frac{\phi_E - \phi_P}{2} - \Gamma_e A_e \frac{\phi_P - \phi_E}{\Delta x}$$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$$\mathbf{J}_e \cdot \mathbf{S}_e = \rho u_e A_e \frac{\phi_E + \phi_P}{2} - \Gamma_e A_e \frac{\phi_E - \phi_P}{\Delta x}$$

4) The net mass outflow from the two-dimensional cell P is **1 point**

$$\sum F_f = \rho u_e A_e + \rho u_w A_w + \rho u_n A_n + \rho u_s A_s$$

$$\sum F_f = \rho u_e A_e - \rho u_w A_w + \rho u_n A_n - \rho u_s A_s$$

$$\sum F_f = \rho u_e A_e + \rho u_w A_w + \rho v_n A_n + \rho v_s A_s$$

$$\sum F_f = \rho u_e A_e - \rho u_w A_w + \rho v_n A_n - \rho v_s A_s$$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$$\sum F_f = \rho u_e A_e - \rho u_w A_w + \rho v_n A_n - \rho v_s A_s$$

5) In the final discretized equation of two-dimensional convection-diffusion equation using first-order upwind scheme, the coefficient a_w is **0 points**

$$D_w - [|F_w, 0|]$$

$$D_w + [|F_w, 0|]$$

$$D_w - [| - F_w, 0|]$$

$$D_w + [| - F_w, 0|]$$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$$D_w - [|F_w, 0|]$$

6) Which one of the following is correct? **1 point**

The Scarborough criterion is used as a necessary condition for convergent iterative method.

The Scarborough criterion is used as a sufficient condition for convergent iterative method.

The Scarborough criterion is used as both sufficient and necessary conditions for convergent iterative method

None of the above

No, the answer is incorrect.
Score: 0

Accepted Answers:

The Scarborough criterion is used as a sufficient condition for convergent iterative method.

7) Quadratic Upstream Interpolation for Convective Kinematics scheme is second order accurate in space. **1 point**

True

False

No, the answer is incorrect.
Score: 0

Accepted Answers:

False

8) For fluid flow problem, the cell Peclet number is also known as cell Reynolds number. **1 point**

True

False

No, the answer is incorrect.
Score: 0

Accepted Answers:

True