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Courses » **Computational Fluid Dynamics** Announcements **Course** Ask a Question Progress FAQ

Unit 12 - Week 11

Course outline

Week 11 Assignment 11

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

Due on 2018-10-17, 23:59 IST.

1) The stream function-vorticity approach cannot be used for *1 point*

(a) three-dimensional flows
(b) time-dependent flows
(c) incompressible flows
(d) steady flow problems

No, the answer is incorrect.
Score: 0

Accepted Answers:
(a) three-dimensional flows

2) Which of the following statement is incorrect regarding stream function-vorticity method? *1 point*

(a) Stream function-vorticity method is used to eliminate the time derivative term.
(b) Stream function-vorticity method is used to eliminate the pressure term.
(c) Stream function-vorticity method has the demerit of artificiality in vorticity boundary condition.
(d) Stream function-vorticity method is employed only for two-dimensional problems.

No, the answer is incorrect.
Score: 0

Accepted Answers:
(a) Stream function-vorticity method is used to eliminate the time derivative term.

3) A staggered grid system is used mainly *1 point*

(a) to overcome the stability problem
(b) to enable treatment of flow domain of irregular shape
(c) to simplify grid generation
(d) to eliminate chequerboard oscillations in pressure

No, the answer is incorrect.
Score: 0

Accepted Answers:
(d) to eliminate chequerboard oscillations in pressure

4) *1 point*

Week 12

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Assignment Solution

Live Session - Sep 13,2018

In the stream function vorticity method, which of the following equations is solved to obtain the pressure field for two-dimensional laminar incompressible forced convective flow of a Newtonian fluid with constant properties?

(a) $\frac{\partial^2 p}{\partial x^2}+\frac{\partial^2 p}{\partial y^2}=2\rho\left[\frac{\partial u}{\partial x}\frac{\partial v}{\partial y}-\frac{\partial u}{\partial y}\frac{\partial v}{\partial x}\right]$

(b) $\frac{\partial^2 p}{\partial x^2}+\frac{\partial^2 p}{\partial y^2}=\frac{\rho}{2}\left[\frac{\partial u}{\partial x}\frac{\partial v}{\partial y}-\frac{\partial u}{\partial y}\frac{\partial v}{\partial x}\right]$

(c) $\frac{\partial^2 p}{\partial x^2}+\frac{\partial^2 p}{\partial y^2}=2\rho\left[\frac{\partial^2 u}{\partial x^2}-\frac{\partial^2 v}{\partial y^2}\right]$

(d) $\frac{\partial^2 p}{\partial x^2}+\frac{\partial^2 p}{\partial y^2}=\frac{\rho}{2}\left[\frac{\partial^2 u}{\partial x^2}-\frac{\partial^2 v}{\partial y^2}\right]$

- a
- b
- c
- d

No, the answer is incorrect.
Score: 0

Accepted Answers:
a

5) The SIMPLE algorithm starts *1 point*

- (a) with a guessed velocity field
- (b) with a guessed pressure field
- (c) with guessed values for both pressure and velocity field
- (d) with the solution for the values at the nodes adjacent to the known boundary.

No, the answer is incorrect.
Score: 0

Accepted Answers:
(b) with a guessed pressure field

6) *1 point*

The SIMPLE algorithm is semi-implicit because

(a) the velocity correction implicitly influence the pressure
(b) the pressure corrections at nearby locations alter the neighboring velocities
(c) of the presence of the term $\sum a_{nb}u_{nb}'$ in the velocity correction equation
(d) of the omission of the term $\sum a_{nb}u_{nb}'$ to avoid the influence of the pressure correction on the velocity.

- a
- b
- c
- d

No, the answer is incorrect.
Score: 0

Accepted Answers:
d

7) Which of the following statement is incorrect regarding pressure correction equation in SIMPLE algorithm? *1 point*

- (a) The pressure correction equation is an implicit indicator of satisfaction of mass conservation.
- (b) The pressure correction equation is derived by using the continuity equation.

(c) While deriving the pressure correction equation, the continuity equation is integrated over the staggered control volume.

(d) The solution is considered to be converged when the pressure correction is zero.

No, the answer is incorrect.
Score: 0

Accepted Answers:
(c) While deriving the pressure correction equation, the continuity equation is integrated over the staggered control volume.

8) **1 point**

The stream function-vorticity equation for a two-dimensional unsteady flow with constant fluid properties is

(a) $\frac{\partial \xi}{\partial t}+u\frac{\partial \xi}{\partial x}+v\frac{\partial \xi}{\partial y}=\mu\left(\frac{\partial^2 \xi}{\partial x^2}+\frac{\partial^2 \xi}{\partial y^2}\right)$ and $\frac{\partial^2 \psi}{\partial x^2}+\frac{\partial^2 \psi}{\partial y^2}=\xi$

(b) $\frac{\partial \xi}{\partial t}+u\frac{\partial \xi}{\partial x}+v\frac{\partial \xi}{\partial y}=\mu\left(\frac{\partial^2 \xi}{\partial x^2}+\frac{\partial^2 \xi}{\partial y^2}\right)$ and $\frac{\partial^2 \psi}{\partial x^2}+\frac{\partial^2 \psi}{\partial y^2}=-\xi$

(c) $\frac{\partial \psi}{\partial t}+u\frac{\partial \psi}{\partial x}+v\frac{\partial \psi}{\partial y}=\mu\left(\frac{\partial^2 \psi}{\partial x^2}+\frac{\partial^2 \psi}{\partial y^2}\right)$ and $\frac{\partial^2 \xi}{\partial x^2}+\frac{\partial^2 \xi}{\partial y^2}=\psi$

(d) $\frac{\partial \psi}{\partial t}+u\frac{\partial \psi}{\partial x}+v\frac{\partial \psi}{\partial y}=\mu\left(\frac{\partial^2 \psi}{\partial x^2}+\frac{\partial^2 \psi}{\partial y^2}\right)$ and $\frac{\partial^2 \xi}{\partial x^2}+\frac{\partial^2 \xi}{\partial y^2}=-\psi$

a
b
c
d

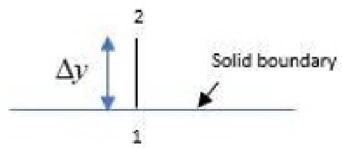
No, the answer is incorrect.
Score: 0

Accepted Answers:
b

9) **1 point**

At the solid boundary shown below, the stream function is constant. If slip bounda condition exists at the solid boundary with a slip velocity of u_s at the solid boundary ar slip length of l then what will be the expression for the vorticity boundary condition at in terms of stream function at 1 and 2? (Use Navier's slip boundary condition :

$u_s = l\left.\frac{\partial u}{\partial y}\right|_{solid}$)



(a) $\xi_1 = \frac{\psi_1+\psi_2}{l\Delta y+\frac{(\Delta y)^2}{2}}$

(b) $\xi_1 = \frac{\psi_1-\psi_2}{l\Delta y+\frac{(\Delta y)^2}{2}}$

(c) $\xi_1 = \frac{\psi_1+\psi_2}{l(\Delta y)^2}$

(d) $\xi_1 = \frac{\psi_1-\psi_2}{l(\Delta y)^2}$

a
b

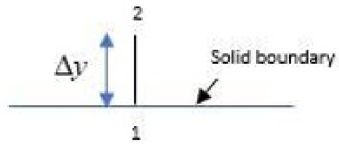
- c
- d

No, the answer is incorrect.
Score: 0

Accepted Answers:
b

10) *1 point*

At the solid boundary shown below, the stream function is constant. If no-slip bou... condition exists at the solid boundary then what will be the value of vorticity at 1 if th... values of stream function at 1 and 2 are respectively $20 m^2/s$ and $10 m^2/s$ and $\Delta y = 0.$...



(a) $1000\ s^{-1}$
(b) $2000\ s^{-1}$
(c) $3000\ s^{-1}$
(d) $4000\ s^{-1}$

- a
- b
- c
- d

No, the answer is incorrect.
Score: 0

Accepted Answers:
b

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