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Courses » Computational Fluid Dynamics

Announcements **Course** Ask a Question Progress FAQ

Unit 6 - Week 5

Course outline

Week 5 Assignment

The due date for submitting this assignment has passed. **Due on 2018-09-12, 23:59 IST.**
As per our records you have not submitted this assignment.

1) *1 point*

Consider the problem of source-free heat conduction in an insulated rod whose ends are maintained at constant temperatures of 400K and 800K respectively. The one-dimensional problem sketched in Figure 1a is governed by $\frac{d}{dx}\left(k\frac{dT}{dx}\right)=0$. Thermal conductivity k equals 100 W/m.K, cross-sectional area A is 10×10^{-3} m^2 . The domain is divided into 4 equal control volumes as shown in Figure 1b. If the equations are discretized using finite volume method with a linear approximation to the temperature then the resulting algebraic equation for the node 4 is

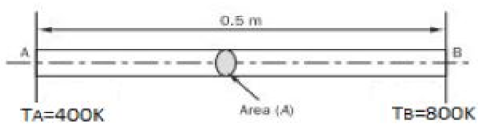

Figure 1a

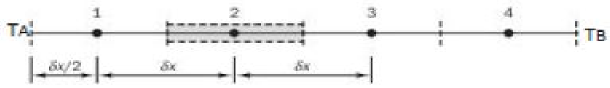

Figure 1b

(a) $8T_4 = 24T_3 + 1600$

(b) $24T_4 = 8T_3 + 12800$

(c) $8T_4 = 16T_3 - 12800$

(d) $24T_4 = 8T_3 - 1600$

No, the answer is incorrect.
Score: 0

Accepted Answers:
(b) $24T_4 = 8T_3 + 12800$

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Week 11
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2) ***0 points***

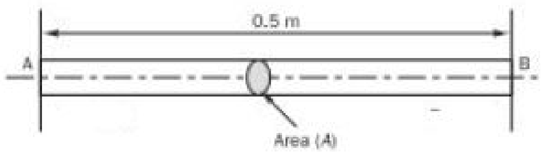

Figure 2a

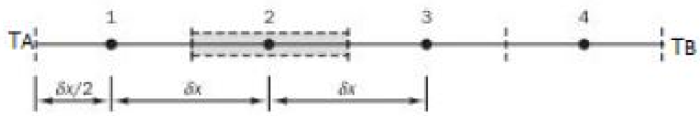

Figure 2b

- (a) 315°C
- (b) 326.67°C
- (c) 350°C
- (d) 367.67°C

No, the answer is incorrect.
Score: 0

Accepted Answers:
(b) 326.67°C

3) A numerical scheme is said to be stable if ***1 point***

- (a) there is no amplification of numerical perturbations due to the propagation of truncation errors
- (b) there is no reduction of numerical perturbations due to the propagation of truncation errors
- (c) there is no amplification of numerical perturbations due to the propagation of roundoff errors
- (d) there is no reduction of numerical perturbations due to the propagation of round-off errors

No, the answer is incorrect.
Score: 0

Accepted Answers:
(c) there is no amplification of numerical perturbations due to the propagation of roundoff errors

4) Consistency physically represents ***1 point***

- (a) Nullification of truncation error as the grid size and time step size tend to zero
- (b) Nullification of round off error as the grid size and time step size tend to zero
- (c) Nullification of discretization error as the grid size and time step size tend to zero
- (d) Nullification of discretization error

No, the answer is incorrect.
Score: 0

Accepted Answers:
(a) Nullification of truncation error as the grid size and time step size tend to zero

5) ***1 point***

While discretizing $\int_{w}^{e}\left\{\left(\rho C_p T\right)^{t+\Delta t}-\left(\rho C_p T\right)^{t}\right\}dx$ the simplest profile assumption is

- (a) Piecewise constant
- (b) Piecewise linear
- (c) Piecewise quadratic
- (d) Profile assumption is not necessary

No, the answer is incorrect.
Score: 0

Accepted Answers:
(a) Piecewise constant

6) Choose the correct statement *1 point*

- (a) Convergence means that in the limit as grid size and time size tends to zero, discretization error is nullified.
- (b) Convergence means that in the limit as grid size and time size tends to zero, round off err is nullified.
- (c) According to Lax equivalence theorem, for linear problem consistency and stability ensure convergence
- (d) According to Lax equivalence theorem, for non-linear problems consistency and stability ensures convergence

No, the answer is incorrect.
Score: 0

Accepted Answers:
(c) According to Lax equivalence theorem, for linear problem consistency and stability ensures convergence

7) *1 point*

For unsteady state heat conduction problem using finite volume discretization, integral term for temperature T with respect to time t presented as:

$I_T = \int_t^{t+\Delta t} T_p dt = \left[\theta T_p + (1-\theta)T_P^0\right]\Delta t$, temperature superscript 0 used for time t and no subscript used for time t+Δt, θ is the weighting parameter and $0 \le \theta \le 1$. Consider the following statements regarding this discretization.

(i) For θ=0 and 1, temperature integral transformed as implicit and explicit scheme respectively.

(ii) For θ=0.5, the scheme is called Crank Nicolson.

(iii) For θ=0 and 1, temperature integral transformed as explicit and implicit scheme respectively.

Which of the above statements are correct?

- (a) (i) and (ii) only
- (b) (ii) and (iii) only
- (c) (ii) only
- (d) (iii) only

No, the answer is incorrect.
Score: 0

Accepted Answers:
(b) (ii) and (iii) only

8) Consider the following statements regarding the discretization on unsteady state heat conduction problem: *0 points*
(i) Explicit scheme is conditionally stable
(ii) Fully implicit scheme is unconditionally unstable
(iii) Crank Nicolson scheme is unconditionally stable
Which of the above statements are correct?

- (a) (i) and (iii) only
- (b) (ii) and (iii) only
- (c) (i) only
- (d) (i), (ii) and (iii)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(d) (i), (ii) and (iii)

9) *1 point*

Consider one-dimensional transient heat conduction through a solid. Thermal conductivity of the solid is 10W/mK. Length of the solid is 2 cm and domain is divided into five equal parts for computation. Here $\rho c = 10 \times 10^6$ J/m^3/K. For explicit scheme, the maximum size of time step (in second) that can be used is

- (a) 8
- (b) 4
- (c) 2
- (d) 1

No, the answer is incorrect.
Score: 0

Accepted Answers:
(a) 8

10) *1 point*

Consider the solution of the following template 1 –D wave equation : $\frac{\partial u}{\partial t} + c\frac{\partial u}{\partial x} = 0$
Using a modified forward time central space (FTCS) scheme, in which the term u_i^n for time discretization is expressed as $u_i^n = \frac{1}{2}\left(u_{i+1}^n + u_{i-1}^n\right)$, where the index 'i' represents spatial discretization where as the superscript 'n' represents temporal discretization. The scheme is stable when

- (a) $\frac{c\Delta t}{\Delta x} \leq 1$
- (b) $\frac{c\Delta t}{\Delta x} \leq 2$
- (c) $\frac{c\Delta t}{(\Delta x)^2} \leq 1$
- (d) $\frac{c\Delta t}{(\Delta x)^2} \leq 2$

No, the answer is incorrect.
Score: 0

Accepted Answers:
(a) $\frac{c\Delta t}{\Delta x} \leq 1$

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