Unit 7 - Week 5: Parabolic Equations

Course outline

Assignment 5

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

Due on 2020-03-04, 23:59 IST.

1) Which among the following schemes is inconsistent while solving a 1D parabolic equation? *1 point*

- Crank-Nicolson Method
- Laasonen Method
- Dufort-Frankel Method
- Richardson Method

No, the answer is incorrect.
Score: 0
Accepted Answers:
Dufort-Frankel Method

2) The maximum time step that can be used to obtain a stable solution for a 1D unsteady heat conduction equation using FTCS method for $\Gamma = 3.6 \times 10^{-6} m^2/s$ and $\Delta x = 12mm$ is *1 point*

- 10 s
- 20 s
- 30 s
- 40 s

No, the answer is incorrect.
Score: 0
Accepted Answers:
20 s

3) The number of initial conditions required to solve a 1D parabolic equation using Richardson method is *0 points*

- 1
- 2
- 3
- 4

No, the answer is incorrect.
Score: 0
Accepted Answers:
2

4) The discretized form of the equation $\rho C_p \frac{\partial T}{\partial t} = k \frac{\partial^2 T}{\partial x^2}$ is $\alpha \left(T_i^{n+1} - T_i^n\right) = \beta \left(T_{i+1}^n - 2T_i^n + T_{i-1}^n\right)$. The value of α and β is *1 point*

- $\alpha = \rho C_p \Delta t, \quad \beta = k \Delta x^2$
- $\alpha = k \Delta x^2, \quad \beta = \rho C_p \Delta t$
- $\alpha = k \Delta t, \quad \beta = \rho C_p \Delta x^2$
- $\alpha = \rho C_p \Delta x^2, \quad \beta = k \Delta t$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\alpha = \rho C_p \Delta x^2, \quad \beta = k \Delta t$

5) For 3D unsteady diffusion equation, ADI method is *1 point*

- unconditionally stable
- conditionally stable with stability criteria less than 0.5
- conditionally stable with stability criteria less than 1.5
- unconditionally unstable

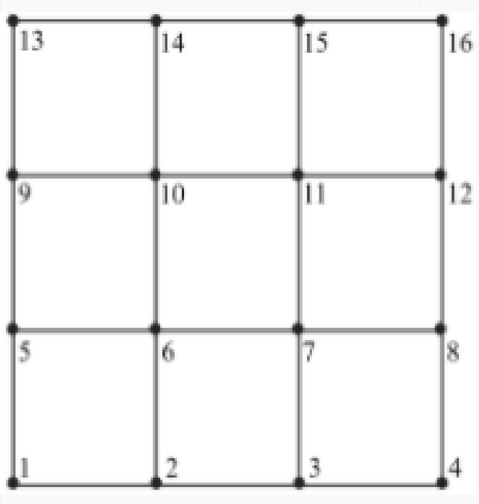
No, the answer is incorrect.
Score: 0
Accepted Answers:
conditionally stable with stability criteria less than 1.5

6) The equation $\frac{\partial u}{\partial t} - \frac{\partial^2 u}{\partial x^2} = 0$ has a truncation error of $-\frac{1}{2}\Delta t\,(1-\theta)\,\frac{\partial^2 u}{\partial t^2} - \frac{1}{12}\Delta x^2 \frac{\partial^4 u}{\partial x^4} + \mathcal{O}\left(\Delta t^2, \Delta x^4\right)$. The value of θ for which the truncation error reduces to $\mathcal{O}\left(\Delta t^2, \Delta x^4\right)$ is *1 point*

- $1 + \frac{\Delta x^2}{2\Delta t}$
- $1 + \frac{\Delta x^2}{4\Delta t}$
- $1 + \frac{\Delta x^2}{6\Delta t}$
- $1 + \frac{\Delta x^2}{8\Delta t}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$1 + \frac{\Delta x^2}{6\Delta t}$

7) The discretized form of $\frac{\partial \phi}{\partial t} = \Gamma\left(\frac{\partial^2 \phi}{\partial x^2} + \frac{\partial^2 \phi}{\partial y^2}\right)$ using Crank-Nicolson scheme for point 10 is (take $\Gamma = 0.2,\ \Delta t = 0.1,\ \Delta x = \Delta y = 0.1$) *1 point*



- $\phi_9^{n+1} + \phi_9^n + \phi_{11}^{n+1} + \phi_{11}^n - 5\phi_{10}^{n+1} - 3\phi_{10}^n + \phi_6^{n+1} + \phi_6^n + \phi_{14}^{n+1} + \phi_{14}^n = 0$
- $\phi_9^{n+1} + \phi_9^n + \phi_{11}^{n+1} + \phi_{11}^n + 3\phi_{10}^{n+1} + 5\phi_{10}^n + \phi_6^{n+1} + \phi_6^n + \phi_{14}^{n+1} + \phi_{14}^n = 0$
- $\phi_9^{n+1} - \phi_9^n + \phi_{11}^{n+1} - \phi_{11}^n - 5\phi_{10}^{n+1} + 3\phi_{10}^n + \phi_6^{n+1} - \phi_6^n + \phi_{14}^{n+1} - \phi_{14}^n = 0$
- $\phi_9^{n+1} - \phi_9^n + \phi_{11}^{n+1} - \phi_{11}^n + 3\phi_{10}^{n+1} - 5\phi_{10}^n + \phi_6^{n+1} - \phi_6^n + \phi_{14}^{n+1} - \phi_{14}^n = 0$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\phi_9^{n+1} + \phi_9^n + \phi_{11}^{n+1} + \phi_{11}^n - 5\phi_{10}^{n+1} - 3\phi_{10}^n + \phi_6^{n+1} + \phi_6^n + \phi_{14}^{n+1} + \phi_{14}^n = 0$

8) A long, thin rod with a length of 10 cm, has a fixed temperatures of 100°C at the left end and 50°C at the right end. The initial temperature of the rod is zero, with diffusion coefficient as $0.835 cm^2/s$. Using FTCS with $\Delta x = 2cm$ and $\Delta t = 0.1s$,the temperature at a distance of 2 cm from left end after 0.2 s is ______________°C.

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 3.9,4.2

1 point