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

Unit 3 - Week 2

Course outline

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Week 2

- Lecture 6 : Euler-Lagrangian equation
- Lecture 7 : Approximate Solutions of Differential Equations
- Lecture 8 : Variational formulation
- Lecture 9 : Example of variational formulation and introduction to weighted residual method
- Lecture 10 : Weighted residual method (contd.)
- Quiz : Week 2 : Assignment 2
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Week 2 : Assignment 2

The due date for submitting this assignment has passed. **Due on 2018-08-15, 23:59 IST.**
As per our records you have not submitted this assignment.

1) *1 point*

For one dimensional, steady state heat conduction with source term s, the reduced form o governing equation is given by

$$\frac{d}{dx}\left(k\frac{dT}{dx}\right)+s=0$$

Let v is variation parameter such as δT. Therefore, the variation formulation for approximate solution o governing differential equation is given as:

$$\int\left(\frac{d}{dx}\left(k\frac{dT}{dx}\right)+s\right)vdx=0\,;$$

Consider the following statement:

Statement I: Variable for which variation appears on the boundary is called primary variable anc primary variable is T.

Statement II: Secondary variable for the given condition is specified the temperature at the boundary.

Statement III: Essential boundary condition specifies the primary variable.

Statement IV: Natural boundary condition is specifying by $k\frac{dT}{dx}$.

Select correct option:

- (a) Only I, II and III are correct.
- (b) Only I, III and IV are correct.
- (c) Only II and III are correct.
- (d) Only I and IV are correct.

No, the answer is incorrect.
Score: 0

Accepted Answers:
(b) Only I, III and IV are correct.

2) Consider the following statement regarding the approximate solution of differential equation through variation formulation: *1 point*
Statement I: Primary variable essentially specifies at the boundary.
Statement II: Secondary variable naturally satisfies the condition as it is included in governing equation already.
Statement III: Boundary condition for primary variable is called essential boundary condition and for secondary variable is called natural boundary condition. Select the correct statement regarding the above statements:

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(a) Only I and II are correct.
(b) Only II and III are correct.
(c) Only III and IV are correct.
(d) I, II and III are correct.

No, the answer is incorrect.
Score: 0

Accepted Answers:
(d) I, II and III are correct.

3) Choose among the following the condition that a trial function should NOT satisfy. *1 point*

(a) It should satisfy the essential boundary condition
(b) It should satisfy the natural boundary condition
(c) It should be continuous
(d) Derivatives of trial function must be square integrable

No, the answer is incorrect.
Score: 0

Accepted Answers:
(b) It should satisfy the natural boundary condition

4) Choose among the following the condition that a weighting function should satisfy *1 point*

(a) It should satisfy the essential boundary condition
(b) It should satisfy the homogeneous part of the essential boundary condition
(c) It should satisfy the homogeneous part of the natural boundary condition
(d) Derivatives of weighting function must be square integrable

No, the answer is incorrect.
Score: 0

Accepted Answers:
(b) It should satisfy the homogeneous part of the essential boundary condition

5) *1 point*

Consider the following heat conduction problem $(0 \le x \le 1)$:

$$\frac{d}{dx}\left(k\frac{dT}{dx}\right)+S=0$$

The boundary conditions specified are as follows: $T(1)=\sqrt{2}$, $\left(\frac{dT}{dx}\right)_{x=0}=0$

(a) $T=\sec\left(\frac{\pi x}{4}\right)$ is a valid trial function

(b) $T=\cos(\pi x)+\sec(\frac{\pi x}{4})$ is a valid trial function

Both $T=\sec\left(\frac{\pi x}{4}\right)$ and $T=\cos(\pi x)+\sec(\frac{\pi x}{4})$ are valid trial function

(d) Neither $T=\sec\left(\frac{\pi x}{4}\right)$ nor $T=\cos(\pi x)+\sec(\frac{\pi x}{4})$ is a valid trial function

No, the answer is incorrect.
Score: 0

Accepted Answers:

(a) $T=\sec\left(\frac{\pi x}{4}\right)$ is a valid trial function

6) Consider the following heat conduction problem $(0 \le x \le 1)$: **1 point**

$$\frac{d}{dx}\left(k\frac{dT}{dx}\right)+S=0$$

The boundary conditions specified are as follows: $T(1)=\sqrt{2}$, $\left(\frac{dT}{dx}\right)_{x=0}=0$

(a) $T = \operatorname{cosec}(\pi x)$ is a valid weighting function

(b) $T = \sin(\pi x)+\operatorname{cosec}(\pi x)$ is a valid weighting function

(c) Both $T = \operatorname{cosec}(\pi x)$ and $T = \sin(\pi x)+\operatorname{cosec}(\pi x)$ are valid weighting function

(d) Neither $T = \operatorname{cosec}(\pi x)$ nor $T = \sin(\pi x)+\operatorname{cosec}(\pi x)$ is a valid weighting function

No, the answer is incorrect.
Score: 0

Accepted Answers:

(d) Neither $T = \operatorname{cosec}(\pi x)$ nor $T = \sin(\pi x)+\operatorname{cosec}(\pi x)$ is a valid weighting function

7) **1 point**

Consider the following differential equation:

$\frac{d^2}{dx^2}\left[a(x)\frac{d^2y}{dx^2}\right]+b(x)=0$, for $0<x<L$; subject to the following boundary conditions: $y=0$ and $dy/dx=0$ at $x=0$; $\left[a(x)\frac{d^2y}{dx^2}\right]_{x=L}=A$, $\left[\frac{d}{dx}\left(a(x)\frac{d^2y}{dx^2}\right)\right]_{x=L}=0$.

(a) $y=0$ and $dy/dx=0$ at $x=0$ are essential boundary conditions

(b) $y=0$ at $x=0$ and $\left[a(x)\frac{d^2y}{dx^2}\right]_{x=L}=A$ are essential boundary conditions

(c) $dy/dx=0$ at $x=0$ and $\left[a(x)\frac{d^2y}{dx^2}\right]_{x=L}=A$ are essential boundary conditions

(d) $y=0$ at $x=0$ and $\left[\frac{d}{dx}\left(a(x)\frac{d^2y}{dx^2}\right)\right]_{x=L}=0$ are essential boundary conditions

No, the answer is incorrect.
Score: 0

Accepted Answers:

(a) $y=0$ and $dy/dx=0$ at $x=0$ are essential boundary conditions

8) **1 point**

Consider the following differential equation:

$\frac{d^2}{dx^2}\left[a(x)\frac{d^2y}{dx^2}\right]+b(x)=0$, for $0<x<L$; subject to the following boundary conditions: $y=0$ and $dy/dx=0$ at $x=0$; $\left[a(x)\frac{d^2y}{dx^2}\right]_{x=L}=A$, $\left[\frac{d}{dx}\left(a(x)\frac{d^2y}{dx^2}\right)\right]_{x=L}=0$.

(a) $y=0$ and $dy/dx=0$ at $x=0$ are natural boundary conditions

(b) $y=0$ at $x=0$ and $\left[a(x)\dfrac{d^2y}{dx^2}\right]_{x=L} = A$ are natural boundary conditions

(c) $\left[a(x)\dfrac{d^2y}{dx^2}\right]_{x=L} = A$ and $\left[\dfrac{d}{dx}\left(a(x)\dfrac{d^2y}{dx^2}\right)\right]_{x=L} = 0$ are natural boundary conditions

(d) $y=0$ at $x=0$ and $\left[\dfrac{d}{dx}\left(a(x)\dfrac{d^2y}{dx^2}\right)\right]_{x=L} = 0$ are essential boundary conditions

No, the answer is incorrect.
Score: 0

Accepted Answers:

(c) $\left[a(x)\dfrac{d^2y}{dx^2}\right]_{x=L} = A$ and $\left[\dfrac{d}{dx}\left(a(x)\dfrac{d^2y}{dx^2}\right)\right]_{x=L} = 0$ are natural boundary conditions

9) *1 point*

For a given function f, find the criteria for $u(x)$ such that functional:

$F(u) = \int_a^b f(x, u(x))dx$ has a critical value for a function u. For linear approximation, th necessary condition for critical value for functional F will be [Here, $f_u = \dfrac{\partial}{\partial u}$ and $f_x = \dfrac{\partial}{\partial x}$]

(a) $f_u(x, u(x)) = 0$ for $a < x < b$

(b) $f_x(x, u(x)) = 0$ for $a < x < b$

(c) $f_u(x, u^2(x)) = 0$ for $a < x < b$

(d) $f_x(x, u^2(x)) = 0$ for $a < x < b$

No, the answer is incorrect.
Score: 0

Accepted Answers:

(a) $f_u(x, u(x)) = 0$ for $a < x < b$

10) *1 point*

The function $u(x)$ leads to critical value for functional $F(u) = \int_0^{\pi} x^2 + u^2(x)dx$. If $u(x) = \sin x$ then

(a) $x = n\pi$ for $n \in z$

(b) $x = n\pi + (-1)^n \dfrac{\pi}{2}$ for $n \in z$

(c) $x = -n\pi - (-1)^n \dfrac{\pi}{2}$ for $n \in z$

(d) $x = -n\pi + (-1)^n \dfrac{\pi}{2}$ for $n \in z$

No, the answer is incorrect.
Score: 0

Accepted Answers:

(a) $x = n\pi$ for $n \in z$

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