Assignment 7

The due date for submitting this assignment has passed. As per our records you have not submitted this assignment. Due on 2018-09-19, 23:59 IST.

1) Which of the following statement(s) is(are) correct?

Statement 1: In finite element method (FEM), the potential at any point can be calculated using the field values at global nodes while in finite-difference method (FDM) the potential can only be calculated at grid points.

Statement 2: The memory consumption is low in FDM as compared to FEM.

Statement 3: The FDM is more difficult to use while handling material discontinuities compared to FEM.

Statement 4: The FEM mesh offers same discretisation error as FDM grid for same grid size.

- Only statement 1 is correct.
- Only statement 2 is correct.
- Only statement 3 is correct.
- Only statement 4 is correct.
- Only statements 1 and 2 are correct.
- Only statements 1 and 3 are correct.
- Only statements 1 and 4 are correct.
- Only statements 2 and 3 are correct.
- Only statements 2 and 4 are correct.
- Only statements 3 and 4 are correct.
- Only statements 1, 2, and 3 are correct.
- Only statements 1, 2, and 4 are correct.
- Only statements 1, 3, and 4 are correct.
- Only statements 2, 3, and 4 are correct.
- All the statements are correct.

No, the answer is incorrect.

Score: 0

Accepted Answers:

- Only statements 1, 2, and 3 are correct.
FEM?

Statement 1: The element-size must be fine enough so that basis functions can adequately represent the electromagnetic fields.

Statement 2: As mesh size gets smaller, the computational time increases.

Statement 3: Along the curved domain, it is easier to conform quadrilateral elements than triangular elements.

Statement 4: Mesh is locally refined to resolve small features or abruptly varying fields.

- Only statement 1 is correct.
- Only statement 2 is correct.
- Only statement 3 is correct.
- Only statement 4 is correct.
- Only statements 1 and 2 are correct.
- Only statements 1 and 3 are correct.
- Only statements 1 and 4 are correct.
- Only statements 2 and 3 are correct.
- Only statements 2 and 4 are correct.
- Only statements 3 and 4 are correct.
- All the statements are correct.

No, the answer is incorrect.

Score: 0

Accepted Answers:

Only statements 1, 2, and 4 are correct.

3) Which of the following is(are) commercial FEM package(s)?

- COMSOL Multiphysics Electromagnetics Module.
- HFSS.
- Both (a) and (b).
- None of the above.

No, the answer is incorrect.

Score: 0

Accepted Answers:

Both (a) and (b).

4) Which of the following is(are) the correct statement(s) in case of FEM?

Statement 1: The distribution of the primary unknown quantity inside an element is interpolated based on the values at the nodes, provided nodal elements are used.

Statement 2: The number of interpolation functions to be used per element should be equal to the number of nodes that belong to the element.

Statement 3: The interpolating polynomials may not be continuous within the element.

Statement 4: The interpolating polynomials should be complete such that they must consist of the lower order terms.

- Only statement 1 is correct.
Only statement 2 is correct.

Only statement 3 is correct.

Only statement 4 is correct.

Only statements 1 and 2 are correct.

Only statements 1 and 3 are correct.

Only statements 1 and 4 are correct.

Only statements 2 and 3 are correct.

Only statements 2 and 4 are correct.

Only statements 3 and 4 are correct.

Only statements 1, 2, and 3 are correct.

Only statements 1, 2, and 4 are correct.

Only statements 1, 3, and 4 are correct.

Only statements 2, 3, and 4 are correct.

All the statements are correct.

None of the statements are correct.

No, the answer is incorrect.

Score: 0

Accepted Answers:

Only statements 1, 2, and 4 are correct.

5) Find the Euler equation of the functional \( \int_a^b \cos(x \frac{dy}{dx}) \, dx \).

\[
x \frac{dy}{dx} \cos(x \frac{dy}{dx}) + \sin(x \frac{dy}{dx}) = 0
\]

\[
x \frac{dy}{dx} \sin(x \frac{dy}{dx}) + \sin(x \frac{dy}{dx}) = 0
\]

\[
x \frac{dy}{dx} \cos(x \frac{dy}{dx}) - \cos(x \frac{dy}{dx}) = 0
\]

None of the above.

No, the answer is incorrect.

Score: 0

Accepted Answers:

\( x \frac{dy}{dx} \cos(x \frac{dy}{dx}) + \sin(x \frac{dy}{dx}) = 0 \)

6) The partial differential equation

\[
2\partial_{xx} \phi(x, y) + 3\partial_{xy} \phi(x, y) + \partial_{yy} \phi(x, y) - \partial_x \phi(x, y) + 5\partial_y \phi(x, y) - \phi(x, y) = 0
\]

can be classified as

Elliptic.

Hyperbolic.

Parabolic.

None of these.

No, the answer is incorrect.

Score: 0

Accepted Answers:

Hyperbolic.
7) Which of the following can be a set of linear basis functions inside a one-dimensional element in the range $0 \leq x \leq 1$?

None of the above.

No, the answer is incorrect.
Score: 0

Accepted Answers:

8) Find the inner-product $\langle u(x), v(x) \rangle$ of the functions
\begin{align*}
u &= x + 2 \\
v &= x^2 - 2x - 3
\end{align*}
in the interval $0 < x < 1$. 

1 point
9) A one-dimensional domain is discretised with 3 linear elements having 2 local nodes. There are 4 global degrees of freedom. Which of the following represents the material matrix? \( \begin{bmatrix} X & 0 & 0 & 0 \\ X & 0 & 0 & X \\ 0 & X & 0 & 0 \\ X & 0 & X & X \end{bmatrix} \) or \( \begin{bmatrix} X & X & 0 & 0 \\ X & X & X & 0 \\ 0 & X & X & X \\ 0 & 0 & X & X \end{bmatrix} \) or \( \begin{bmatrix} X & 0 & 0 & 0 \\ 0 & X & X & 0 \\ 0 & X & X & X \\ 0 & 0 & 0 & X \end{bmatrix} \) or None of the above.

No, the answer is incorrect.

Score: 0

Accepted Answers:
\( \begin{bmatrix} X & X & 0 & 0 \\ X & X & X & 0 \\ 0 & X & X & X \\ 0 & 0 & X & X \end{bmatrix} \)

10) Consider the finite element mesh consisting of two non-overlapping finite triangular elements.
Which of the following represent the global coefficient matrix?

\[
\begin{bmatrix}
C^{(2)}_{11} & C^{(2)}_{12} & 0 & 0 & 0 \\
C^{(2)}_{21} & C^{(2)}_{22} & 0 & 0 & 0 \\
C^{(2)}_{31} & C^{(2)}_{32} & C^{(1)}_{32} & C^{(1)}_{13} & 0 \\
0 & 0 & C^{(2)}_{22} & C^{(1)}_{23} & 0 \\
0 & 0 & 0 & C^{(1)}_{32} & C^{(1)}_{33} \\
\end{bmatrix}
\]

\[
\begin{bmatrix}
C^{(2)}_{11} & C^{(2)}_{12} & C^{(2)}_{13} & 0 & 0 \\
C^{(2)}_{21} & C^{(2)}_{22} & C^{(2)}_{23} & 0 & 0 \\
C^{(2)}_{31} & C^{(2)}_{32} & C^{(1)}_{33} & C^{(1)}_{32} & C^{(1)}_{13} \\
0 & 0 & C^{(1)}_{21} & C^{(2)}_{22} & C^{(1)}_{23} \\
0 & 0 & C^{(1)}_{31} & C^{(1)}_{32} & C^{(1)}_{33} \\
\end{bmatrix}
\]

\[
\begin{bmatrix}
C^{(2)}_{11} & C^{(2)}_{12} & C^{(2)}_{13} & 0 & 0 \\
C^{(2)}_{21} & C^{(2)}_{22} & C^{(2)}_{23} & 0 & 0 \\
C^{(2)}_{31} & C^{(2)}_{32} & C^{(1)}_{33} + C^{(1)}_{11} & C^{(1)}_{12} & C^{(1)}_{13} \\
0 & 0 & C^{(1)}_{21} & C^{(1)}_{22} & C^{(1)}_{23} \\
0 & 0 & C^{(1)}_{31} & C^{(1)}_{32} & C^{(1)}_{33} \\
\end{bmatrix}
\]

None of the above.

No, the answer is incorrect.
Score: 0
Accepted Answers:
Which of the following can be a set of quadratic basis functions inside a one dimensional element in the range $0 \leq x \leq 1$?

\[
\begin{bmatrix}
C_{11}^{(2)} & C_{12}^{(2)} & C_{13}^{(2)} & 0 & 0 \\
C_{21}^{(2)} & C_{22}^{(2)} & C_{23}^{(2)} & 0 & 0 \\
C_{31}^{(2)} & C_{32}^{(2)} & C_{33}^{(2)} + C_{11}^{(1)} & C_{12}^{(1)} & C_{13}^{(1)} \\
0 & 0 & C_{21}^{(1)} & C_{22}^{(1)} & C_{23}^{(1)} \\
0 & 0 & C_{31}^{(1)} & C_{32}^{(1)} & C_{33}^{(1)}
\end{bmatrix}
\]

No, the answer is incorrect.
Score: 0
Accepted Answers:
12) If $L$ is a positive-definite, self-adjoint operator and $L\Phi = g$ has a solution $\Phi_0$, then the functional $I$ is

$$I = \langle L\Phi, \Phi \rangle - 2\langle \Phi, g \rangle$$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$I = \langle L\Phi, \Phi \rangle - 2\langle \Phi, g \rangle$