

## Unit 5 - Week 2: One dimensional Finite Element Analysis

### Course outline

How does an NPTEL online course work?

### MATLAB

#### Week 0: Prerequisite

#### Week 1: Variational Calculus and Minimization Problem

#### Week 2: One dimensional Finite Element Analysis

Lec 4: FEM steps: Explained with discrete linear springs; Gaussian Quadrature rule for integration

Lec 5: Solving one Ordinary Differential Equation using Linear Finite Element

Lec 6: Solving one Ordinary Differential Equation using Quadratic Finite Element

#### Quiz : Assignment 2

Feedback Form

Assignment Solution

#### Week 3: Structural Elements in One Dimensional FEM

#### Week 4: Structural Elements in One Dimensional FEM

#### Week 5: Structural Elements in One Dimensional FEM, and Generalized One Dimensional Finite Element Code in Computer Programming

#### Week 6: Brief Background of Tensor Calculus

#### Week 7: Two dimensional Scalar field problems

#### Week 8: Two dimensional Scalar field problems

#### Week 9: Two dimensional Scalar and Vector field problems

#### Week 10: Two dimensional Vector field and Eigen value problems

#### Week 11: Eigen value problems and Transient problem in 1D & 2D Scalar Valued Problems

#### Week 12: FEM formulation for 3D Elastic problem and challenges

Live session: Dr. Atanu Banerjee, Date : 16/12/2020  
Time : 3:15:00 PM

## Assignment 2

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

**Due on 2020-09-30, 23:59 IST.**

Answer the question from "a" to "b" (i.e 1 to 3) with the help of below statement:

The integration  $\int_{-5}^7 (x^3 + 2x^2) dx$  is solved with numerical integration.

(a) For numerical integration you can use two point Gaussian Quadrature rule. In  $[-1, 1]$  domain for two point Gaussian Quadrature two gauss points and corresponding weights are

$(\xi_1, w_1) = (-0.57735, 1)$ ;  
 $(\xi_2, w_2) = (0.57735, 1)$ ;

1) What is the value of integration when solved with two point Gaussian Quadrature rule?

No, the answer is incorrect.

Score: 0

Accepted Answers:  
(Type: Range) 10401,10406

2 points

(b) In  $[-1, 1]$  domain for three point Gaussian Quadrature three gauss points and corresponding weights are given as

$(\xi_1, w_1) = (-0.7745966, 0.55555)$ ;  
 $(\xi_2, w_2) = (0.77459663, 0.55555)$ ;  
 $(\xi_3, w_3) = (0.0, 0.8888888)$ ;

2) What is the value of integration when solved with three point Gaussian Quadrature rule?

No, the answer is incorrect.

Score: 0

Accepted Answers:  
(Type: Range) 17313,17319

2 points

3) In Gaussian Quadrature rule in the interval  $[-1, 1]$  the variable  $x$  is replaced with \_\_\_\_\_.

- A.  $1 + 6\xi$
- B.  $\xi$
- C.  $1 - 6\xi$
- D.  $6\xi$

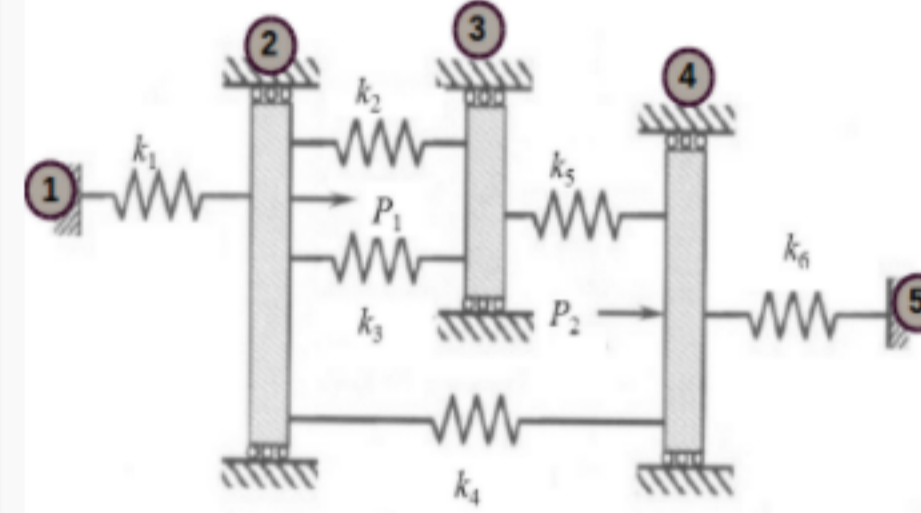
No, the answer is incorrect.

Score: 0

Accepted Answers:  
A.  $1 + 6\xi$

2 points

Answer the question from "a" and "b" (i.e 4 to 11) with the help of below statement:



Consider the system of linear elastic springs attached between three bars and two supports as shown in Fig. Stiffness of the six springs are  $k_1 = 60 \text{ N/mm}$ ,  $k_2 = 80 \text{ N/mm}$ ,  $k_3 = 50 \text{ N/mm}$ ,  $k_4 = 150 \text{ N/mm}$ ,  $k_5 = 120 \text{ N/mm}$ , and  $k_6 = 180 \text{ N/mm}$ , where as the forces are  $P_1 = 100 \text{ N}$ ,  $P_2 = 80 \text{ N}$ .  $u_1, u_2, u_3, u_4$  and  $u_5$  are the displacements at the points 1, 2, 3, 4 and 5 respectively. If the finite element equation is given as  $[K]\{u\} = \{F\}$ , then answer the following.

(a) After imposition of the boundary condition we get the reduced stiffness matrix  $[K]$  and reduced load vector  $\{F\}$ , then answer the following:

4) What is size of the reduced stiffness matrix?

- A.  $5 \times 5$
- B.  $4 \times 4$
- C.  $3 \times 3$
- D.  $6 \times 6$

No, the answer is incorrect.

Score: 0

Accepted Answers:  
C.  $3 \times 3$

2 points

5) What is the value of element  $K(2,2)$  of the reduced stiffness matrix?

- A. 250 N/mm
- B. 150 N/mm
- C. 200 N/mm
- D. 260 N/mm

No, the answer is incorrect.

Score: 0

Accepted Answers:  
A. 250 N/mm

2 points

6) What is the value of element  $K(3,1)$  of the reduced stiffness matrix?

- A. 150 N/mm
- B. -150 N/mm
- C. 200 N/mm
- D. -120 N/mm

No, the answer is incorrect.

Score: 0

Accepted Answers:  
B. -150 N/mm

2 points

7) What is the value of element  $K(3,3)$  of the reduced stiffness matrix?

- A. 150 N/mm
- B. -130 N/mm
- C. 450 N/mm
- D. 120 N/mm

No, the answer is incorrect.

Score: 0

Accepted Answers:  
C. 450 N/mm

2 points

8) The reduced load vector  $\{F\}$  is \_\_\_\_\_.

- A.  $\begin{Bmatrix} 100 \\ 0 \\ 80 \end{Bmatrix}$
- B.  $\begin{Bmatrix} 0 \\ 100 \\ 80 \end{Bmatrix}$
- C.  $\begin{Bmatrix} 0 \\ 80 \\ 100 \end{Bmatrix}$
- D.  $\begin{Bmatrix} 100 \\ 80 \\ 0 \end{Bmatrix}$

No, the answer is incorrect.

Score: 0

Accepted Answers:  
A.  $\begin{Bmatrix} 100 \\ 0 \\ 80 \end{Bmatrix}$

2 points

(b) After solving the finite element equation

9) The value of displacement ( $u_2$ ) at the point 2 is \_\_\_\_\_ mm

No, the answer is incorrect.

Score: 0

Accepted Answers:  
(Type: Range) 0.90,0.92

2 points

10) The value of displacement ( $u_3$ ) at the point 3 is \_\_\_\_\_ mm.

No, the answer is incorrect.

Score: 0

Accepted Answers:  
(Type: Range) 0.79,0.81

2 points

11) The value of displacement ( $u_4$ ) at the point 4 is \_\_\_\_\_ mm.

No, the answer is incorrect.

Score: 0

Accepted Answers:  
(Type: Range) 0.68,0.71

2 points