Reg. No. : | | | | | | | | | | |

Question Paper Code: 22061

M.E. DEGREE EXAMINATION, OCTOBER 2014.

Second Semester

Structural Engineering

01PSE201 – FINITE ELEMENT ANALYSIS FOR STRUCTURAL ENGINEERING

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

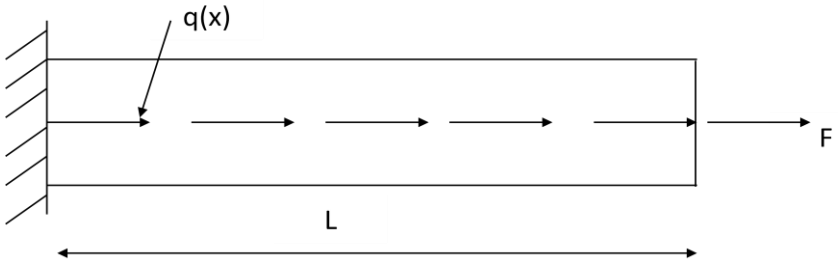
Answer ALL Questions.

PART A - (10 x 2 = 20 Marks)

1. Name the few weighted residual methods.
2. Write down the natural and essential boundary conditions in solving boundary value problem.
3. Write the shape function for the two nodded bar element.
4. What is the purpose of isoparametric elements?
5. Define “h” and “p” refinement method.
6. Define the term “ill – conditioned” elements.
7. Explain the different types of non linearity with structural engineering examples.
8. Define dynamic condensation.
9. Name the 1D, 2D, and 3D finite elements available in the commercial FEA software.
10. Name any four FEA softwares.

PART - B (5 x 14 = 70 Marks)

11. (a) Derive the element stiffness matrix and load vector from the fundamentals for the axially loaded bar given below using variational principles. The bar is subjected to uniformly distributed load q(x) and constant axial force F at its end.



The differential equation for the axially loaded bar is

$$\frac{d}{dx}\left(EA(x)\frac{du}{dx}\right)+q=0 \qquad 0<x<1$$

With the boundary conditions $u(0)=0$ and $EA(L)\dfrac{du(L)}{dx}=F$ (14)

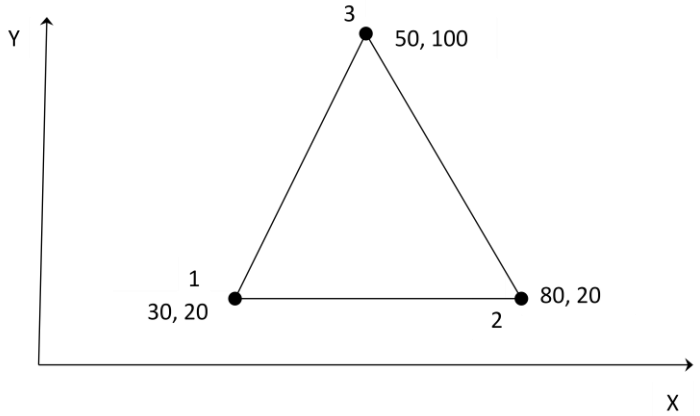
Or

(b) Solve the differential equation using Galerkin method

$$-\frac{d^2y}{dx^2}=-\sin(\pi x) \qquad 0<x<1$$

With the boundary conditions $u(0)=0$ and $u(1)=1$ (14)

12. (a) Evaluate the element stiffness matrix for the plane stress element shown in figure. Consider E = 2.1 x 10^5, Poisson's ratio = 0.25 and element thickness = 10 mm. The co-ordinates are in mm. (14)



Or

(b) Integrate the following function using Gaussian integration. Proper gauss points should be specified. The x limit is varying from 0 to 2, and y limit is varying from 1 to 3.

$$\int\int (xy)\, dx\, dy \qquad (14)$$

13. (a) Explain the h and p method of mesh refinement strategies adopted in the FEA softwares. (14)

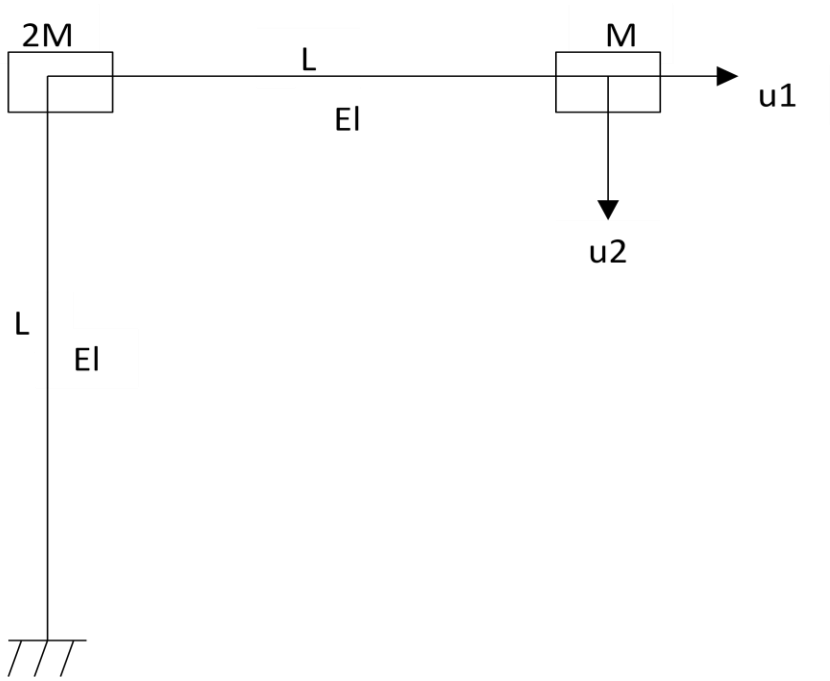
Or

(b) Explain (i) Adaptive meshing techniques (6)
(ii) Error evaluation (4)
(iii) Ill conditioned elements. (4)

14. (a) Explain (i) Newton Raphson and (ii) Modified Newton Raphson solution algorithms used in solving non – linear FEA problems. (14)

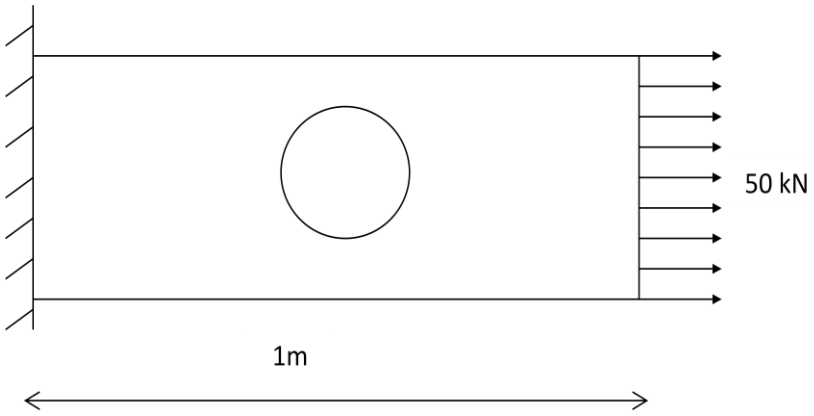
Or

(b) Determine the Eigen values and Eigen vectors for the framed structure shown in the figure given below.



The mass matrix, $m = \begin{bmatrix} 3m & 0 \\ 0 & m \end{bmatrix}$; The stiffness matrix, $k = \frac{6EI}{7L^3}\begin{bmatrix} 8 & -3 \\ -3 & 2 \end{bmatrix}$. (14)

15. (a) Plate with small centre hole (5mm diameter) is subjected to 50kN tensile load (refer figure). Thickness of the plate is 6mm and width of the plate is 50mm. Take E = 210 GPa and Poisson's ratio = 0.3. How will you solve this problem using finite element software (ANSYS)? Detailed steps should be discussed. (14)



Or

(b) Explain about the modeling of different axisymmetic structures with neat sketches. (14)

PART - C (1 x 10 = 10 Marks)

16. (a) Specify stress, strain tensors and constitutive relationship for plane stress and plane strain cases. Give suitable examples for both plane stress and plane strain problems. (10)

Or

(b) Briefly explain the steps involved in the structural modeling and analysis using any finite element software. (10)