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

Question Paper Code: 32261

M.E. DEGREE EXAMINATION, NOVEMBER 2015

Second Semester

Structural Engineering

01PSE201 – FINITE ELEMENT ANALYSIS FOR STRUCTURAL ENGINEERING

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

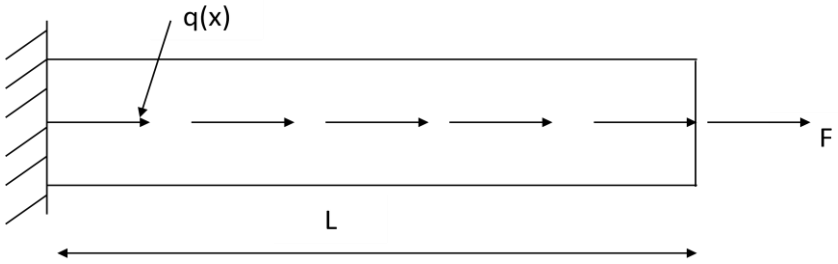
Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1. List the advantages of finite element method over other methods of analysis.
2. Write down the natural and essential boundary conditions in solving boundary value problem.
3. Write down the stiffness matrix for a ID two nodded linear bar element.
4. Define plane strain.
5. Define “h” and “p” refinement method.
6. Define discretisation errors.
7. Explain briefly about material non-linearity.
8. Define dynamic condensation.
9. Name any four software packages used for finite element method of structural analysis.
10. Name the 1D, 2D and 3D finite elements available in the commercial FEA software.

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) Derive an expression for the shape function for a the constant triangular element. (14)

Or

(b) The nodal coordinates of a three nodded triangular element are (10, 7.5), (15, 5) and (15, 10) respectively. The coordinates are given in millimeters. Assume plane stress conditions. Let E = 210 *GPa*, θ= 0.25 and t = 10*mm*. Evaluate the stiffness matrix for the element. (14)

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

Or

(b) Explain the following

(i) Adaptive meshing techniques (6)

(ii) Error evaluation (4)

(iii) Ill conditioned elements. (4)

14. (a) Explain Eigen value extraction and application to thermal analysis problem. (14)

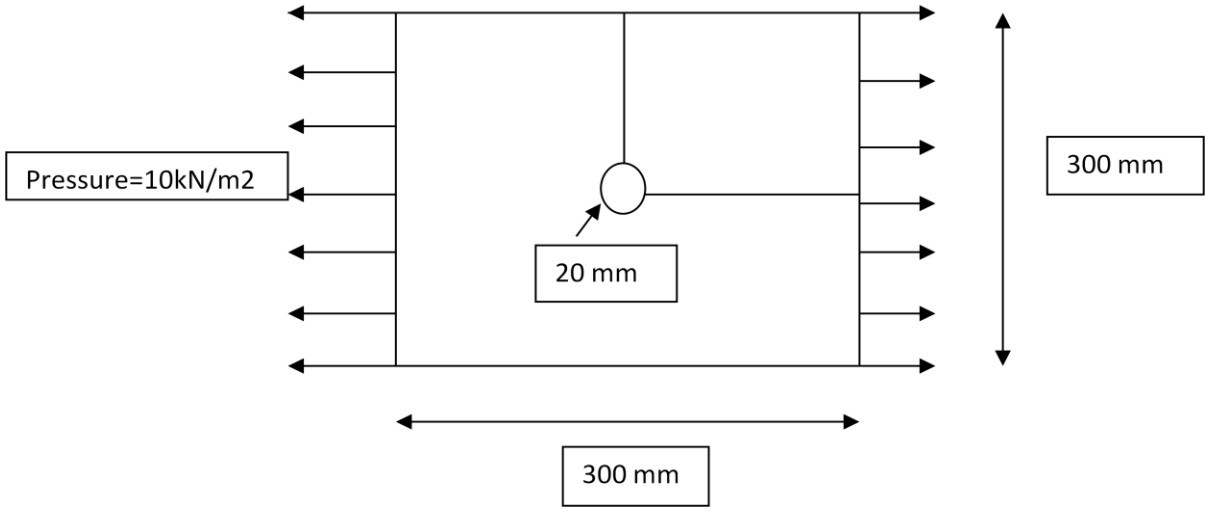
Or

(b) A steel rod of 2 *cm* in length and thermal conductivity $k = 50 W/m^oC$ is exposed at one end to a constant temperature of 320^oC. The other end is an ambient air temperature of 20^oC with a convection co-efficient of $h = 100\ W/m^{2o}C$. Determine the temperature at midpoint of the rod. (14)

15. (a) Briefly explain the steps involved in the structural modeling and analysis using any Finite element software. (14)

Or

(b) A plate with small centre hole (20*mm* diameter) is subjected to a tensile load of intensity $10 kN/m^2$. The size of the plate is 300*mm* x 300*mm*. The thickness of the plate is 6*mm*. 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 provided. (14)



PART - C (1 x 10 = 10 Marks)

16. (a) Explain material and geometric nonlinearity and its method of treatments. (10)

Or

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

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