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

Question Paper Code: 52261

M.E. DEGREE EXAMINATION, JUNE 2016

Second Semester

Structural Engineering

15PSE201 - FINITE ELEMENT ANALYSIS FOR STRUCTURAL ENGINEERING

(Regulation 2015)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (5 x 1 = 5 Marks)

1. Numbering of nodes and elements is

   (a) [maximum node number] – [minimum node number] = Minimum
   (b) [maximum node number] – [minimum node number] = Maximum
   (c) [maximum node number] – [minimum node number] = Less than 1
   (d) [maximum node number] – [minimum node number] = greater than 1

2. The art of subdividing a structure into a convenient number of smaller components is known as

   (a) Maximization (b) Discretization
   (c) Minimization (d) Optimization

3. The number of nodes used for defining the geometry is same as of nodes used for defining the displacements id known as

   (a) Axisymmetric element (b) Isoparametric element
   (c) Symmetric element (d) Unsymmetrical element

4. The expression of shape function N and temperature function T for the one dimensional heat conduction problem is

(a) $T = N_1T_1 + N_2T_2$ (b) $T = N_1T_2 + N_2T_1$
(c) $T = 2N_1T_1 + N_2T_2$ (d) $T = N_1T_1 + 2N_2T_2$

5. _____ is a physical quantity that expresses the internal forces that neighboring particles of a continuous material exert on each other.

(a) stress (b) Strain (c) node (d) elements

PART B - (5 x 3 = 15 Marks)

6. Distinguish between node and elements.

7. Compare local and global co-ordinate system.

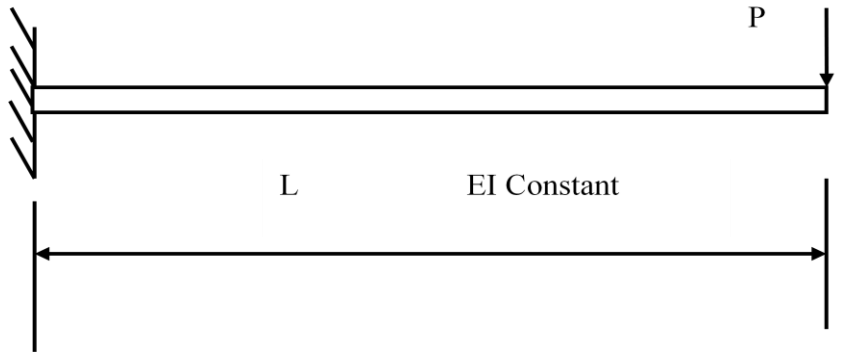
8. What is meant by plane stress and strain problems?

9. Write down two higher order elements.

10. Distinguish between material and geometric non linearity.

PART C - (5 x 16 = 80 Marks)

11. (a) A cantilever beam is loaded as shown in below figure. Find the maximum deflection and maximum bending moment by variational approach method using the function $Y = A\left\{1 - \cos\left(\frac{\pi x}{2l}\right)\right\}$. (16)



Or

(b) Find the deflection at the center of the fixed beam subjected to u.d.l load throughout its length. Used any one of the approximate method. (16)

12. (a) Derive the shape function for 4 noded rectangular elements with sides of 2*a* and 2*b*. Use natural co ordinate system. (16)

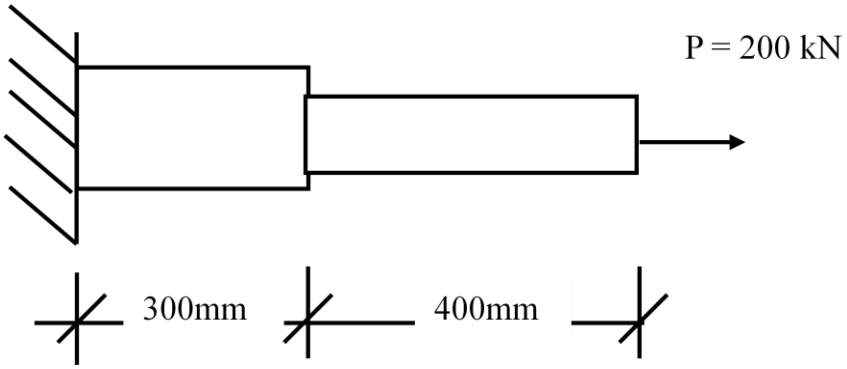
Or

(b) Consider the bar as shown in below figure. An axial load of 200 *kN* is applied at point *P*. Take A_1 = 2400 mm^2, A_2 = 600 mm^2, E_1 = 70x10^3 N/mm^2, E_2 = 200x10^3 N/mm^2. Calculate the following:

(i) Nodal displacement at point P

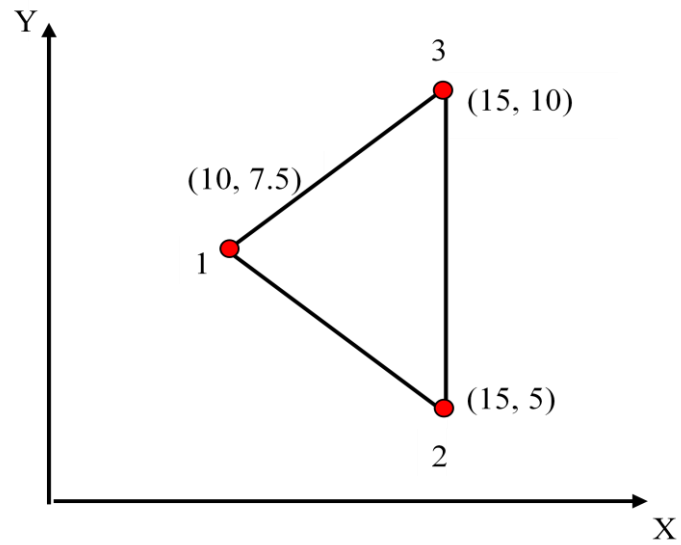
(ii) Stress in each material

(iii) Reaction force



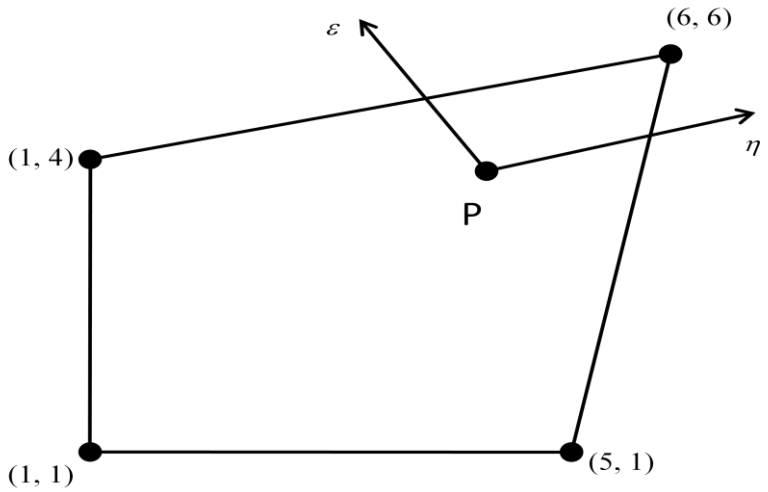
(16)

13. (a) Calculate the element stress σ_x, σ_y, τ_{xy} σ_1 and σ_2 and the principle angle Θ_p for the element as shown in below figure. The nodal displacements are: u_1 = 2.0*mm*, u_2 = 0.5*mm*, u_3 = 3.0*mm*, v_1 = 1.0*mm*, v_2 = 0.0*mm*, v_3 = 1.0*mm*. Take E = 2.1 x10^5 N/mm^2 and Poisson's ratio γ = 0.25. Assume plane stress condition. (16)



Or

(b) For the isoparametric four noded quadrilateral element as shown in below figure. Determine the Cartesian co-ordinates of point *P* which has local co-ordinates $\varepsilon = 0.5$, $\eta = 0.5$. (16)



14. (a) (i) Describe the *p* and *h* methods of mesh refinement. (8)

(ii) Explain ill-conditioned elements. (8)

Or

(b) (i) Elaborate the auto and adaptive mesh generation techniques. (8)

(ii) What is meant by error evaluation? Explain different types of error evaluation techniques in detail. (8)

15. (a) Derive the stiffness matrix for one dimensional heat conduction element. (16)

Or

(b) Enumerate the problems with material and geometric nonlinearity and explain about solution methods for nonlinear problems. (16)

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