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

Question Paper Code: 42261

M.E. DEGREE EXAMINATION, NOVEMBER 2015

Second Semester

STRUCTURAL ENGINEERING

14PSE201 – FINITE ELEMENT ANALYSIS FOR STRUCTURAL ENGINEERING

(Regulation 2014)

Duration: Three hours | Maximum: 100 Marks

Answer ALL Questions.

PART A - (5 x 1 = 5 Marks)

1. Galarkin's method is also known as ______ method.

   (a) variational (b) weighted residual

   (c) analytical (d) experimental

2. The distributed force acting on the surface of the body is known as

   (a) traction force (b) body force (c) point load (d) none

3. A CST element is a ______ element.

   (a) 1D (b) 2D (c) 3D (d) multidimensional

4. The brick element contains

   (a) 4 nodes (b) 2 nodes (c) 7 nodes (d) 8 nodes

5. The expression of shape function *N* and temperature function, *T* for one dimensional heat conduction problem is

   (a) $T=N_1T_1+N_2T_2$ (b) $T=N_1T2+N_2T_1$

   (c) $T=N_1T_1-N_2T_2$ (d) $T=N_2T_2-N_1T_1$

PART - B (5 x 3 = 15 Marks)

6. Name the few weighted residual methods.
7. Write down the stiffness matrix for a 1*D* two nodded linear bar element.
8. Define iso-parametric element. What is the purpose providing of iso-parametric element?
9. Explain the different types of non linearity with structural engineering examples.
10. Name the 1*D*, 2*D* and 3*D* finite elements available in the commercial FEA software.

PART - C (5 x 16 = 80 Marks)

11. (a) Using Raleigh-Ritz method, obtain the deflection at the centre of a simply supported beam of span *L* subjected to uniformly distributed load over the entire span. (16)

Or

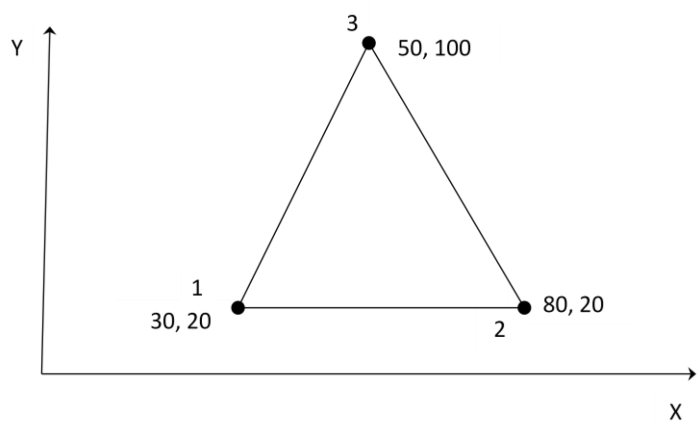
(b) (i) Solve the differential equation using Galerkin's method

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

With the boundary conditions *u* (0) = 0 and *u* (1) = 1. (10)

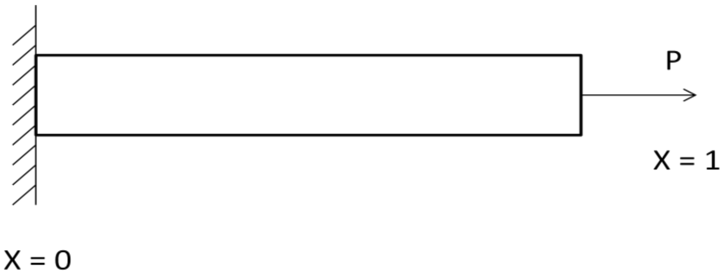
(ii) List out the general procedure for FEA problems. (6)

12. (a) Evaluate the element stiffness matrix for the plane stress element shown in below figure. Consider $E = 2.1 \times 10^5$, Poisson's ratio = 0.25 and element thickness = 10 *mm*. The co-ordinates are in *mm*. (16)

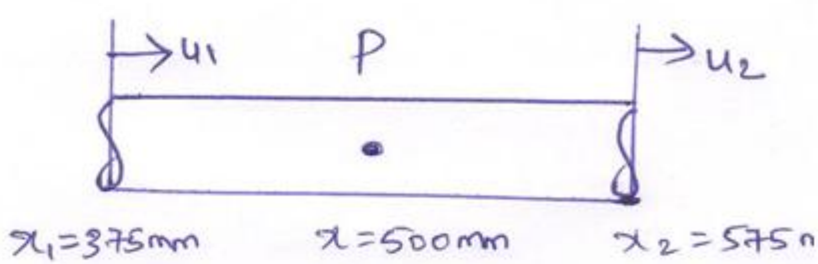


Or

(b) A bar of uniform cross section is clamped at one end and left free at the other end and it is subjected to a uniform axial load *P* as shown in below figure. Calculate the displacement and stress in a bar using two terms polynomial. How do you evaluate earth quake forces as per codal provisions? (16)

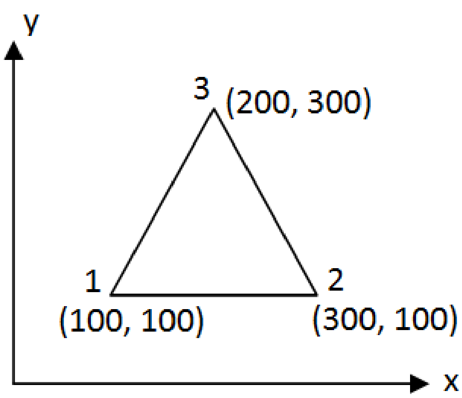


13. (a) Consider a bar as shown in below figure and having A = 750mm^2, E = 2 x $10^5 mm^2$. If μ_1 = 0.5mm and μ_2 =0.625mm. Calculate the following (i) Displacement at point, P (ii) Strain (iii) Stress (iv) Element stiffness matrix (v) Strain energy u. (16)



Or

(b) Determine the stiffness for the CST element shown in below figure. Assume plane stress condition. Take μ = 0.25, E = 2 x10^5 N/mm^2 and t = 20 mm. Co-ordinates are in mm. (16)



14. (a) Briefly explain the adaptive mesh generation techniques with suitable examples. (16)

Or

(b) Write short note on the following

(i) *P* and *H* methods of refinement (8)

(ii) Ill conditioned elements (8)

15. (a) An axial load of 4×10^5 *N* is applied at 30^o *C* to the rod as shown in below figure. The temperature is then raised to 60^o *C*. Calculate

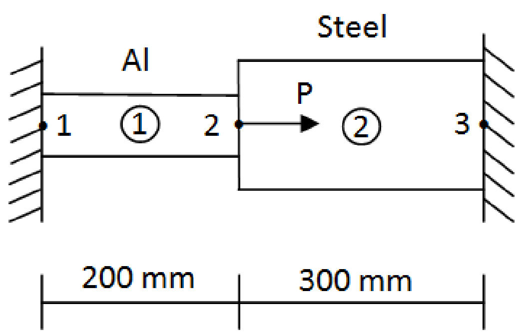
(i) Nodal displacements

(ii) Stresses in each material

(iii) Reactions at each nodal point.

For Aluminium $A_1 = 1000\ mm^2$; $E_1 = 0.7 \times 10^5\ N/mm^2$; $\alpha_1 = 23 \times 10^{-6}\ /^oC$

For Steel $A_2 = 1500\ mm^2$; $E_2 = 2 \times 10^5\ N/mm^2$; $\alpha_2 = 12 \times 10^{-6}\ /^oC$ (16)



Or

(b) (i) Explain any one method of handling geometric non-linearity . (8)

(ii) Explain characteristic polynomial technique of Eigen value–Eigen vector evaluation. (8)

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