Reg. No. :

Question Paper Code : 61062

M.E. DEGREE EXAMINATION, MAY/JUNE 2017.

Second Semester

Structural Engineering

ST 7201 — FINITE ELEMENT ANALYSIS

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is discretization?
2. Mention the basic steps involved in Galerkins methods.
3. Draw a mode shape of beam element.
4. Sketch a typical truss element showing local and global transformation.
5. Define plain strain with suitable example.
6. What is the significance of Jacobian transformation?
7. What are the types of Eigen value problems?
8. What is meant by transverse vibration?
9. Give the governing equation for torsion problems.
10. List the applications of potential flow.

PART B — (5 × 13 = 65 marks)

11. (a) Find the solution of the problem using Rayleigh Ritz method by considering a two term solution as $y(x) = C_1 x(1-x) + C_2 x^2(1-x)$.

Or

(b) Solve the following system of equation using Gauss elimination method.

$x_1 - x_2 + x_3 = 1$

$-3x_1 + 2x_2 - 3x_3 = -6$

$2x_1 - 5x_2 + 4x_3 = 5.$

12. (a) Consider the bar shown below subjected to axial force P= 40 kN applied at the free end. Determine the nodal displacement, stresses in each element and reaction forces.

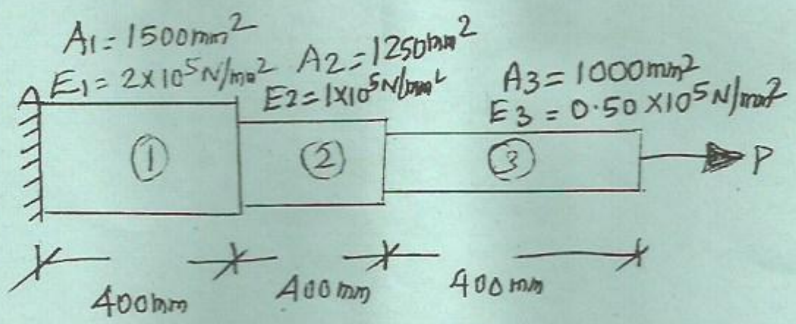

Fig.12(a)

Or

(b) Determine the displacement and slopes at the nodes for the beam shown below in Fig.12(b). Take $k = 200\ kN/m$ $E = 70\ GPa$ and $1 = 2\times10^{-4} m^4$.

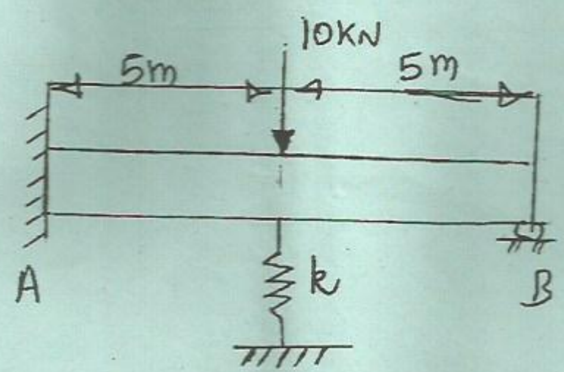

Fig. (12(b))

13. (a) A two noded line element with one translational degree of freedom is subjected uniformly varying load of intensity P1 at node 1 and P2 at node 2. Evaluate nodal load vector using numerical integration.

Or

(b) Determine the Jacobian matrix for the following quadrilateral element at $x = 4.35$ mm and $y = 3\ mm$.

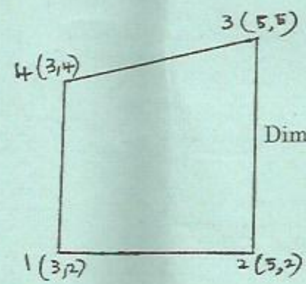

Fig.13(b).

14. (a) Derive the finite equation for the time - dependent stress analysis of one dimensional bar.

Or

(b) Determine the Eigen values and Eigen vectors for the stepped bars shown below in Fig. Q.14(b)

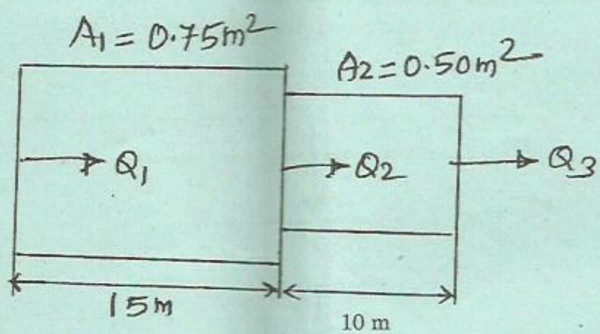

Fig. 14(b)

15. (a) The temperature at four corners of a four-noded rectangle arte T1, T2, T3, T4. Determine the consistent load vector for a 2D analysis, aimed to determine the thermal stresses.

Or

(b) A wall of 0.5m thickness having thermal conductivity of 1.2W/mK. The wall is to be insulated with a material of thickness 0.05m having an average thermal conductivity of 0.30W/mK. The inner surface temperature is 1000°C and outside of the insulated is exposed to atmospheric air at 30°C with heat transfer coefficient of 35W/m²K. Calculate the nodal temperatures.

PART C — (1 × 15 = 15 marks)

16. (a) Obtain the global stiffness matrix for the plate shown below, taking two triangular elements. Assume plain stress condition.

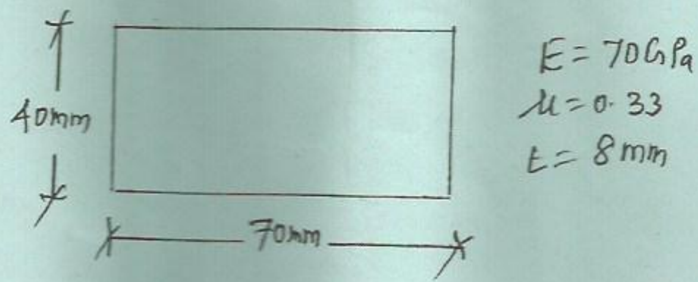

Fig. 15(a)

Or

(b) Consider a uniform cross section bar shown below having length L made up of material whose Young's modulus and density is given by E and ρ. Estimate the natural frequencies of axial vibration of the bar using both consistent and lumped mass matrices.

Fig. 15(b)