Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**M.E Sem-II Remedial Examination December 2010**

**Subject code: 722001 Subject Name: Finite Element method**

**Date: 18 / 12 /2010 Time: 02.30 pm – 05.00 pm**

**Total Marks: 60**

## Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Draw neat and clean figures, wherever required.**

**Q.1** **(a)** Explain the steps involved in the finite element analysis. **06**

**(b)** Explain the terms: Constant strain triangle, Linear strain triangle and Quadratic strain triangle. **06**

**Q.2** **(a)** Derive the expressions for natural coordinates in a constant strain triangle element and show that they are nothing but area coordinates. **06**

**(b)** Derive the expressions for natural coordinates for a two noded element in terms of natural coordinate $L_1$ and $L_2$, when range is 0 to 1. **06**

**OR**

**(b)** Derive the expressions for natural coordinates for a two noded element in terms of natural coordinate $\xi$, when range is -1 to 1. **06**

**Q.3** **(a)** Derive the shape functions for a three noded bar element using polynomial form in local coordinates. **06**

**(b)** Write short note on 'Hermite Polynomial'. **06**

**OR**

**Q.3** **(a)** Explain the term 'shape functions'. Why polynomial terms are preferred for shape functions in finite element method? **06**

**(b)** Determine the shape functions for 4 noded rectangular elements using natural coordinate system. **06**

**Q.4** **(a)** Explain the term 'geometric isotropy / geometric Invariance'. Why polynomial shape functions should satisfy these requirements? How do you check a polynomial for this requirement? **08**

**(b)** Write short note on pre and post processors. **04**

**OR**

**Q.4** **(a)** Determine the strain matrix for a beam element. Use shape functions in natural coordinate form. **06**

**(b)** Enlist five commercially available finite element analysis packages and list the desirable features of those packages. **06**

**Q.5** Assemble Jacobian matrix and strain displacement matrix corresponding to the Gauss point (0.57735, 0.57735) for the element shown in fig. 1. Then indicate how you proceed to assemble element stiffness matrix. **12**

**OR**

**Q.5** Determine the nodal displacements at node 2, stresses in each material and support reaction in the bar shown in fig. 2, due to applied force p = 400 kN and temperature rise of $30^0$C. Given data $A_1 = 2400$ mm$^2$, $A_2 = 1200$ mm$^2$, $L_1 = 300$ mm, $L_2 = 400$ mm, $E_1 = 0.7 \times 10^5$ MPa, $E_2 = 2 \times 10^5$ MPa and $\alpha_1 = 22 \times 10^{-6}/c^0$, $\alpha_2 = 12 \times 10^{-6}/c^0$ **12**

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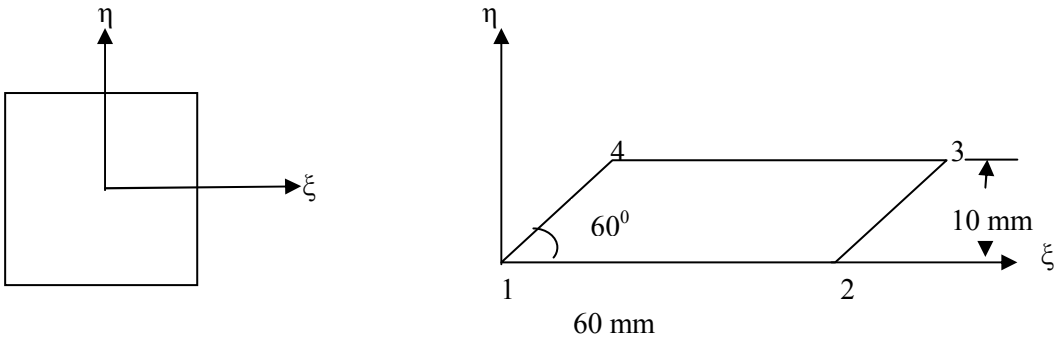


Fig. 1 (Q. 5)

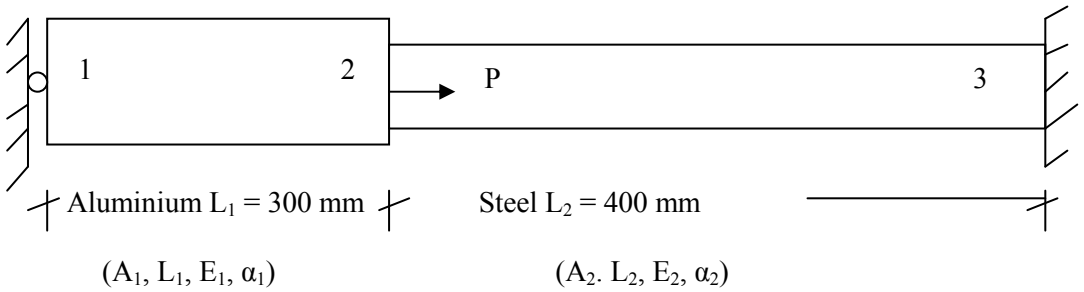


Fig. 2 (OR Q.5)