USN

06ME63

# Sixth Semester B.E. Degree Examination, December 2011
## Modelling and Finite Element Analysis

Time: 3 hrs. Max. Marks:100

**Note:** ***Answer any FIVE full questions, selecting at least TWO questions from each part.***



## PART – A

1 a. Write the equilibrium equation for 3-D state of stress and state the terms involved. **(04 Marks)**

b. Solve the following system of equations by Gaussian elimination method :

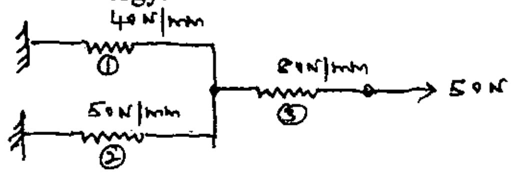
$x_1 + x_2 + x_3 = 6$

$x_1 - x_2 + 2x_3 = 5$

$x_1 + 2x_2 - x_3 = 2.$ **(08 Marks)**

c. Determine the displacements of holes of the spring system shown in the figure using principle of minimum potential energy. **(08 Marks)**

Fig.Q.1(c).




2 a. Explain the discretization process of a given domain based on element shapes number and size. **(06 Marks)**

b. Explain basic steps involved in FEM with the help of an example involving a structural member subjected to axial loads. **(08 Marks)**

c. Why FEA is widely accepted in engineering? List various applications of FEA in engineering. **(06 Marks)**

3 a. Derive interpolation model for 2-D simplex element in global co – ordinate system. **(10 Marks)**

b. What is an interpolation function? Write the interpolation functions for :

i) 1 – D linear element ; ii) 1 – D quadratic element.

iii) 2 – D linear element ; iv) 2 – D quadratic element.

v) 3 – D linear element. **(06 Marks)**

c. Explain "complete" and "conforming" elements. **(04 Marks)**

4 a. Derive shape function for 1 – D quadratic bar element in neutral co-ordinate system. **(08 Marks)**

b. Derive shape functions for CST element in NCS. **(08 Marks)**

c. What are shape functions and write their properties. (any two). **(04 Marks)**

## PART – B

5 a. Derive the body force load vector for 1 – D linear bar element. **(04 Marks)**

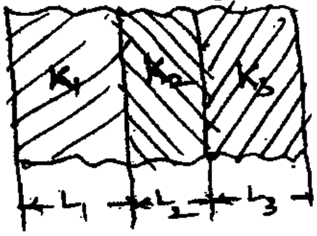
b. Derive the Jacobian matrix for CST element starting from shape function. **(06 Marks)**

c. Derive stiffness matrix for a beam element starting from shape function. **(10 Marks)**

6 a. Explain the various boundary conditions in steady state heat transfer problems with simple sketches. **(06 Marks)**

b. Derive stiffness matrix for 1 – D heat conduction problem using either functional approach or Galerkin's approach. **(08 Marks)**

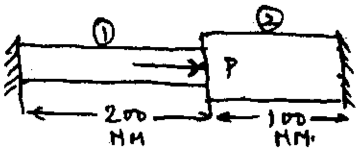
c. For the composite wall shown in the figure, derive the global stiffness matrix. **(06 Marks)**




Take
$A_1 = A_2 = A_3 = A$

Fig.Q.6(c)

7 a. The structured member shown in figure consists of two bars. An axial load of P = 200 kN is loaded as shown. Determine the following :
i) Element stiffness matricies.
ii) Global stiffness matrix.
iii) Global load vector.
iv) Nodal displacements.




i) Steel $A_1 = 1000\ mm^2$
$E_1 = 200$ GPa
ii) Bronze $A_2 = 2000\ mm^2$
$E_2 = 83$ GPa. **(08 Marks)**

b. For the truss system shown, determine the nodal displacements. Assume E = 210 GPa and A = 600 mm$^2$ for both elements. **(12 Marks)**

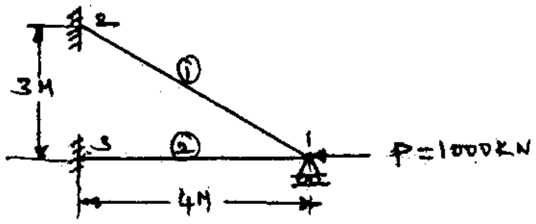



Fig.Q.7(b)

8 a. Determine the temperature distribution in 1 – D rectangular cross – section fin as shown in figure. Assume that convection heat loss occurs from the end of the fin. Take $k = \frac{3w}{Cm^{\circ}C}$, $h = \frac{0.1w}{Cm^{2\circ}C}$, $T_\infty = 20^{\circ}C$. Consider two elements **(10 Marks)**

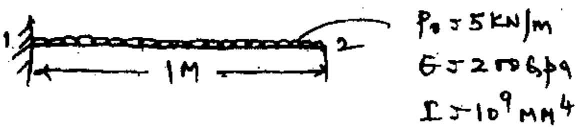



Fig.Q.8(a)

b. For the cantilever beam subjected to UDL as shown in Fig.Q.8(b), determine the deflections of the free end. Consider one element. **(10 Marks)**

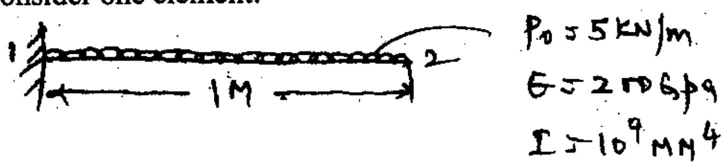



Fig.Q.8(b)

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