Total No. of Questions : 12]

SEAT No. :

P1532

[Total No. of Pages :5

[4759] - 44

B.E. (Mechanical)

FINITE ELEMENT METHODS

(Elective - III) (2008 Pattern) (402049) (Semester - II)

Time : 3 Hours] *[Max. Marks : 100*

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***Answer any three questions from each section.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right side indicate full marks.***
5) ***Use of Calculator is allowed.***
6) ***Assume suitable data, if necessary.***

SECTION - I

Q1) a) Explain in details difference between Finite Element Method and Finite Difference Method. **[8]**

b) Explain the principal of Minimum potential energy used in deriving element stiffness matrix and equations. **[8]**

OR

Q2) a) Explain the following terms: (any two) **[8]**

i) Elimination approach

ii) Penalty Approach

iii) Rayleigh-Ritz Method

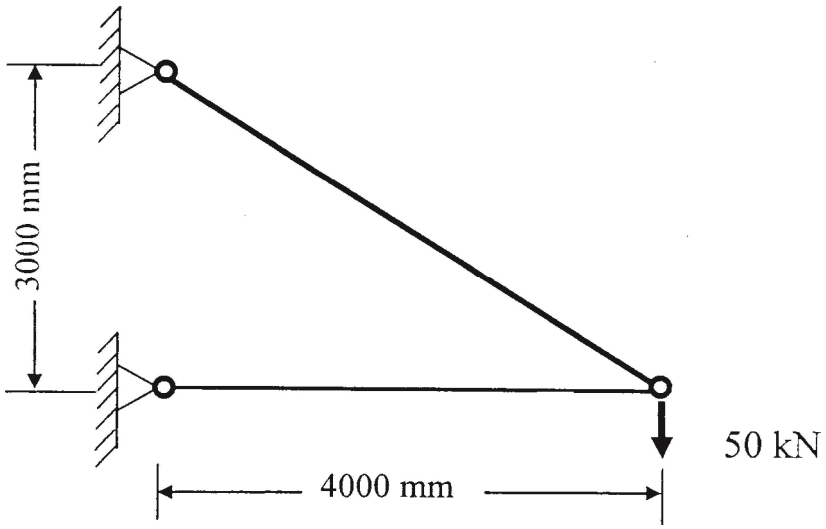
iv) Von-Mises stress

b) Describe in details the concept of Cholesky's decomposition, the banded skyline solutions to solve simultaneous equations. **[8]**

Q3) a) Explain assembly of global stiffness matrix for the banded and skyline solutions. **[6]**

b) A two member truss is as shown in fig. the cross sectional area of each member is 200 mm^2 and modulus of elasticity is 210 GPa. Determine the deflection, reactions and stresses in each of the members. Explain. **[12]**

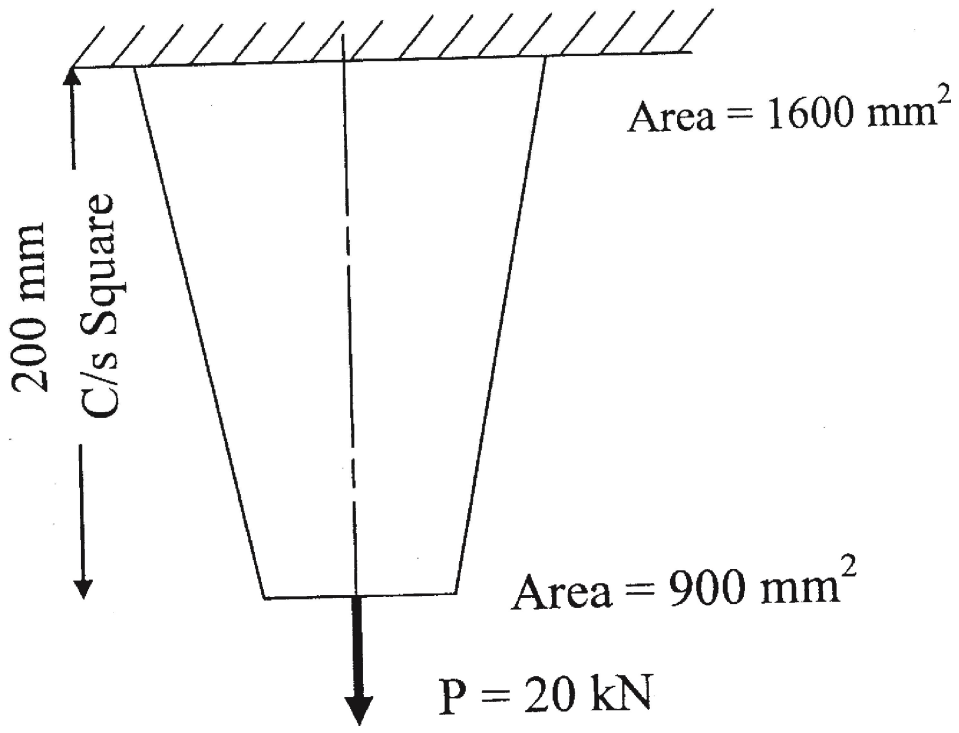
P.T.O.



OR

Q4) a) Explain solution of 2-Dimensional problems using Constant Strain Triangle (CST). **[6]**

b) Find the stresses and reaction at the support by modeling following system in two finite elements. Assume Modulus of Elasticity (E) = 210 GPA. **[12]**



Q5) Evaluate using 2 point Gaussians quadrature method. **[16]**

a) $I=\int_{-1}^{1}\left[x^2+\frac{1}{1+x}\right]dx$

b) $I=\int_{-1}^{1}\left[x+\cos\frac{\pi x}{2}\right]dx$

OR

Q6) a) Differentiate between higher order elements and refined mesh. **[8]**

b) Explain following terms: **[8]**

i) Isoparametric elements

ii) Subparametric elements

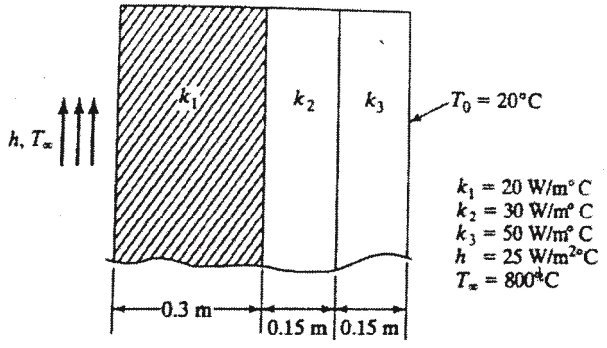
iii) Superparametric elements

iv) Patch test

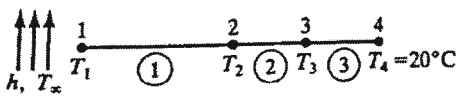
SECTION - II

Q7) a) Explain various steps involved in solution of 1D heat transfer problem using Finite Element Method. **[8]**

b) A composite wall consists of three materials as shown in fig. The outer temperature is T_o = 20 °C. Convection heat transfer takes place from inner surface of the wall with T_∞ = 800 °C and h = 25 W/m² °C. Determine the temperature distribution in the wall. **[10]**



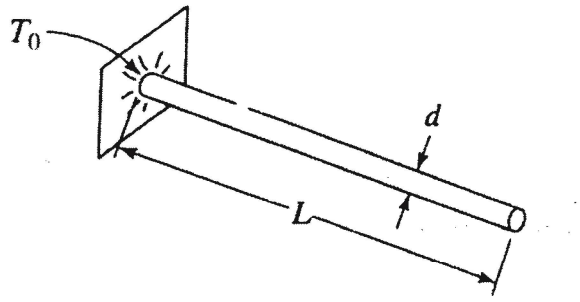
(a)



(b)

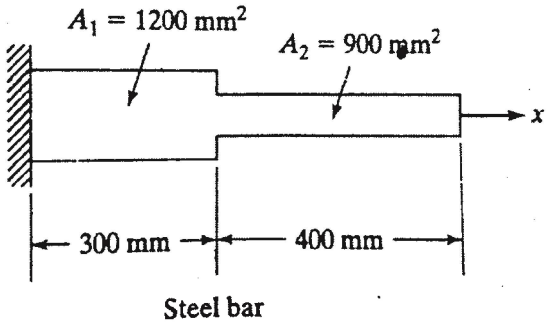
OR

Q8) A circular fin of 40mm diameter (d) is fixed to a base maintained at 50 °C(T_0) as shown in fig. the film is insulated on the surface except end face which is exposed to air at 25 °C. The length of the pin is 1000mm (L), the fin is made of metal with thermal conductivity of 37W/mK. If the convection heat coefficient with air is 15 W/m^{2}K. Find the temperature distribution at 250, 500, 750 and 1000mm from base. **[18]**



Q9) a) Explain lumped mass matrix and consistent mass matrix with suitable example. **[6]**

b) Find un-damped natural frequencies of longitudinal vibration of the stepped bar as shown fig. using consistent mass matrix. **[10]**



Assume Modulus of Elasticity E = 210 GPa and Density (ρ) = 7800 kg/m^3

OR

Q10) Determine the eigen values and natural frequencies of a system whose stiffness and mass matrices are given as below: **[16]**

$$[K]=\frac{2AE}{L}\begin{bmatrix}3 & -1\\ -1 & 1\end{bmatrix}$$

$$[M]=\frac{\rho AE}{12}\begin{bmatrix}6 & 1\\ 1 & 2\end{bmatrix}$$

Assume L = 250 mm, A = 200 mm^2, E = 210 GPa and ρ = 7800 kg/m^3.

Q11) a) Explain process of mesh generation. Comment on free meshing and mapped meshing. **[8]**

b) Write various steps involved to solve 1D heat transfer problem using Finite Element Method. **[8]**

OR

Q12) Write short notes on (any four): **[16]**

a) FEA packages.

b) Quality checks in meshing.

c) Modal analysis.

d) Equation solvers in FEA.

e) Boundary conditions.

f) Equation assembly.