Total No. of Questions : 8]

SEAT No. :

P346

[Total No. of Pages : 5

[6003]-427

T.E. (Mechanical)

COMPUTER AIDED ENGINEERING

(2019 Pattern) (Semester-II) (302050)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) ***Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right side indicate full marks.***
4) ***Assume suiable data if neceessary.***

Q1) a) An axial load P=200 kN is applied on a stepped steel bar as shown Figure 1. $A_1 = 2000mm^2$; $A_2 = 800mm^2$; $E_1 = 70$ Gpa; $E_2 = 200$Gpa.

Formulate:

i) Element stiffness matrix $[k_1]$, $[k_2]$

ii) Global stiffness matrix [K]

Determine using elimination approach:

i) Nodal displacement vectors $[u_1]$,$[u_2]$,$[u_3]$

ii) Element Stresses $[\sigma_1]$, $[\sigma_2]$ **[12]**

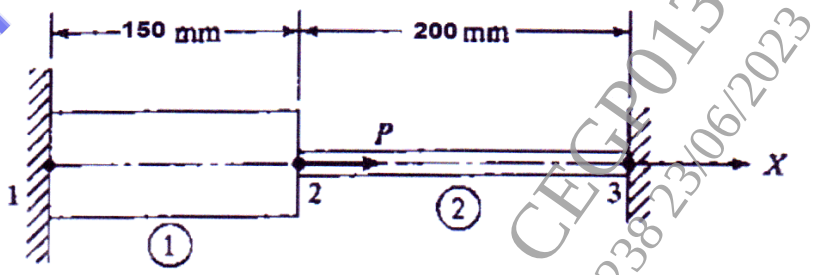

Figure 1

P.T.O.

b) An axial load of 400 KN is applied at 20 ºC to the rod as shown in Figure 2. The temperature is then raised to 50 ºC. **[6]**

Determine:

i) Global stiffness matrix

ii) Global load vectors

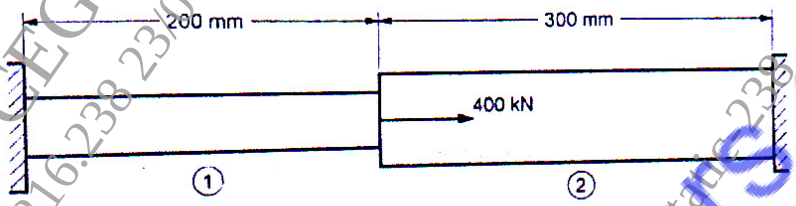

Figure 2

Property	Element 1	Element 2
Material	Aluminium	Steel
Modulus of Elasticity	70*GPa*	200*GPa*
Area	900 mm^2	1200mm^2
Coefficient of Thermal Expansion	2.3×10^{-6} per ºC	11.7×10^{-6} per ºC

OR

Q2) a) An axial load P=400 kN is applied on a stepped steel bar as shown Figure 3. The temperature rise of 30 ºC. Given: **[12]**

A_1= 2400 mm^2 A_2=1200 mm^2

l_1=300 mm l_2=400 mm

$E_1=0.7\times10^5$ N/mm^2 $E_2=2\times10^5 N/mm^2$

and $\alpha_1=22\times10^{-6}$/ºC $\alpha_2=12\times10^{-6}$/ºC

Formulate:

i) Element stiffness matrix $[k_1]$, $[k_2]$

ii) Global stiffness matrix [K]

iii) Global load vector [F]

Determine:

i) Nodal displacement at node 2 $[u_2]$

ii) Element Stresses $[\sigma_1]$, $[\sigma_2]$

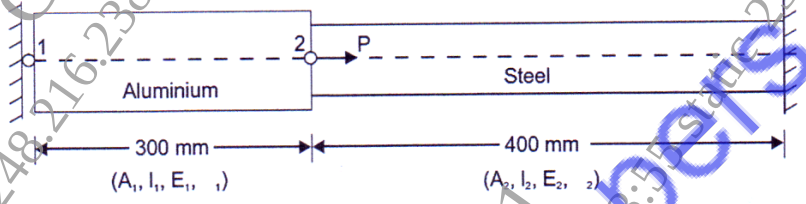

Figure 3

b) Derive element stiffness matrix for two noded (linear) bar element connected in series. **[6]**

Q3) a) A constant strian triangular element is defined by three nodes as shown in Figure 4. Evaluate the shape functions N_1,N_2, and N_3 at the interior point P (6,6). **[7]**

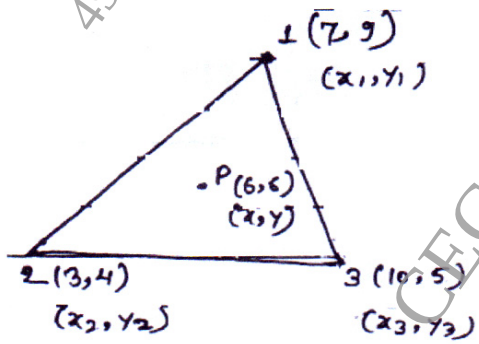

Figure 4

b) In a triangular element, the nodes 1,2 and 3 have cartesioan coordinates: (30,40), (14,70), and (80, 140) respectively. The displacement in mm at nodes 1,2 and 3 are (0.1,0.5), (0.6,0.5) and (0.4, 0.3) respectively. The point P within the element has cartesian coordinates (77, 96). **[10]**

For point. P, determine:

i) The natural coordinates

ii) The shape functions

iii) The displacement of point P

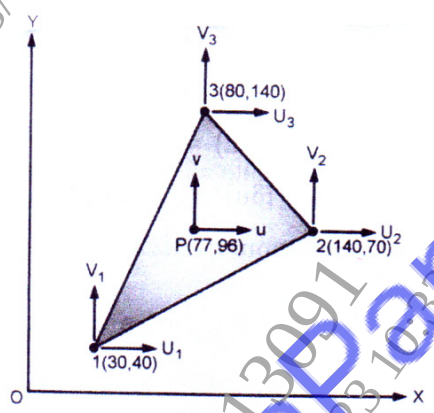

Figure 5

OR

Q4) a) What are the steps for interpretation of results during postprocessing in Computer Aided Engineering (CAE)? Suggest the modifications based on the interpretation of results during postprocessing in CAE. **[10]**

b) Write down the tricks for post processing in CAE. **[7]**

Q5) a) What are the different kinds of geometric non-linearities in CAE project? Explain with figures. **[9]**

b) Write down the comparison of linear and non-linear finite element analysis with reference to following characteristic points. **[8]**

i) Load-displacement and stress-stain relation

ii) Scalability and reversibility

iii) Computational scheme and solution time

iv) Superposition and user interaction with software

OR

Q6) a) Illustrate the concept of sturctural dynamics and acoustics finite element analysis used in Noise, Vibration and Harness (NVH) analysis. **[8]**

b) What is durability, reliability, and fatigue analysis? Explain S-N Curve with low cycle, high cycle, and infinite fatigue life. **[9]**

Q7) a) Elaborate the comparison of Explicit and Implicit method for following criteria: **[10]**

i) Common software

ii) Stability

iii) Computational speed/cost

iv) Maximum size of computational problem

v) Numerical scheme

vi) Handling nonlinearity

vii) Filtering of frequencies

b) Elaborate the use of finite element analysis in plastic injection of moulding in order to optimize the mold materials. **[8]**

OR

Q8) a) Elaborate the comparison between static, dynamic, and fatigue analysis. **[10]**

b) Illustrate the applications of Computer Aided Engineering in Computational Fluid Dynamics in following sectors. **[8]**

i) Aerospace Engineering

ii) Automobile Engineering

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