B.E. Mechanical Engineering Seven Semester

ME7012 - Elective-I : Finite Element Methods

P. Pages : 3 **GUG/W/18/1841**

Time : Three Hours * 1 4 4 0 * Max. Marks : 80

Notes : 1. All questions carry equal marks.
2. Answer Question 1 or 2, 3 or 4, 5 or 6, and 7 or 8.
3. Illustrate your answers wherever necessary with the help of neat sketches.
4. Use of non-programmable calculator is allowed.

1. a) Explain with a suitable example **8**
i) Singular and non singular Matrix ii) Inverse of Matrix

b) Find using Gauss-Jordan Method, **8**
solution of following set of equations.

$x + y + z = 9;$

$2x - 3y + 4z = 13;$

$3x + 4y + 5z = 40$

c) Describe shape functions for Linear bar element. **4**

OR

2. a) Use Rayleigh - Ritz method to determine stresses and displacements in the elastic bar shown in fig. Q 2a. Length of bar = L = 1000 mm, **12**
C/s area of bar = A = 100 mm^2
P = 10 kN.

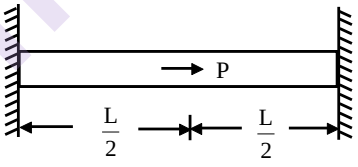


Fig. Q. 2 (a)

b) Explain **8**
i) Steps in FEM. ii) Plane strain and plane stress condition.

3. For the steel wire & aluminium wire of length 2m and 4m respectively shown in fig Q 3 ; Find stresses in each wire. **20**

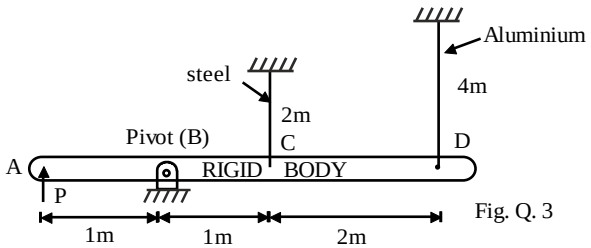


Fig. Q. 3

$E_{steel} = 200\,GPa$ $P = 20\ kN(\text{upwards})$

$E_{aluminum} = 70\,GPa$

$A_{steel} = 100\ mm^2$

$A_{al} = 150\ mm^2$

OR

4. a) For the truss shown in fig Q. 4 find stress in each member and support Reactions. **16**
Take A = 100 mm^2 and E = 200 GPa for all members.

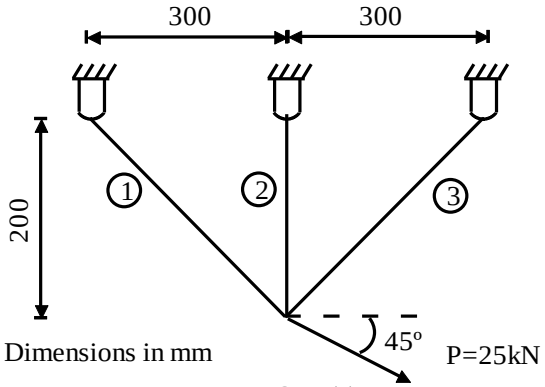


Fig. Q. 4 (a)

b) What do you understand by Isoparametric representation. **4**

5. a) Describe various terms in stiffness matrix of CST element. **6**

b) For a CST element shown in fig Q 5 b, find x & y coordinates of P if **8**
$N_1 = 0.2$ and $N_2 = 0.45$ at P Hence find Areas of Δ1P3, Δ1P2 & Δ3P2. Also find area of CST element 3 (4,8)

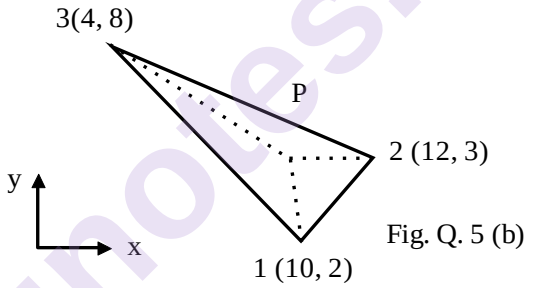
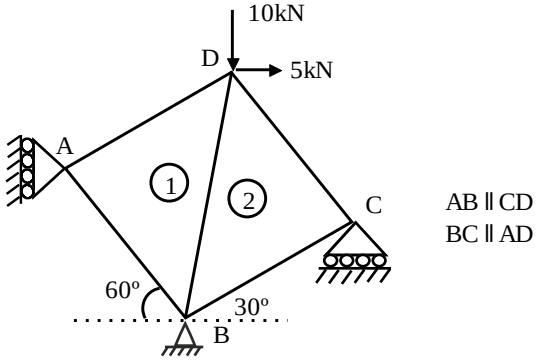


Fig. Q. 5 (b)

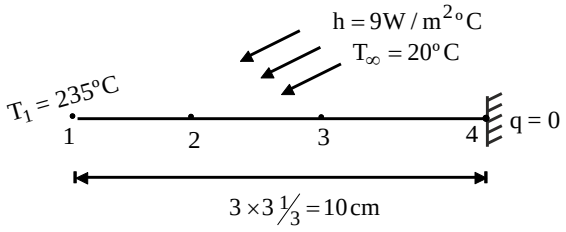
c) In fig Q 5 b, if **6**
$q_1 = 0.001$; $q_2 = 0.003$
$q_3 = -0.002$; $q_4 = 0.005$; $q_5 = 0.03$;
$q_6 = -0.007$.
Find strain in the element

OR

6. For a plate of thickness 20 mm described in fig Q. 6b. Take **20**
AB = BC = CD = AD = 30 mm; E = 200 GPa $\gamma = 0.3$. Find strain & stress in each of the element & support Reactions.



7. A metallic fin with thermal conductivity $K = 360\ W/m\ ^oC$, 0.1cm thick, and 10 cm long, extends from a plane wall whose temperature is 235ºC. Determine the temperature distribution and amount of heat transferred from the fin to the air at 20ºC, with h = 9 W/m^2 ºC. Take width of fin to be 1 m. **20**



OR

8. a) Determine the angle of twist in degrees at the steps, the maximum shear stress in each section and the reactions at the walls of a stepped circular bar shown in fig Q10. **12**
$E_{aluminum}$ = 80 GPa, E_{brass} = 105 GPa.

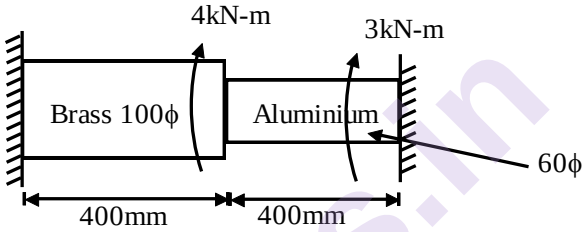


Fig. Q. 8 a

b) Write short notes on **any two.** **8**

i) Applications of FEM.
ii) 2 D elements in FEM.
iii) Discretization
iv) Quadratic Bar Element.

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