Total No. of Questions : 10]

SEAT No. :

P3879

[Total No. of Pages : 4

[5561]-535

B.E.(Mechanical)

FINITE ELEMENT ANALYSIS

(2015Pattern) (Semester - I) (End Sem.) (Elective - I) (402044A)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) *Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.*
2) *Neat diagrams must be drawn wherever necessary.*
3) *Figures to the right side indicate full marks.*
4) *Assume suitable data if necessary.*

Q1) a) Explain the concept of FEM briefly and outline the procedure. **[6]**

b) Explain the properties of stiffness matrix. **[4]**

OR

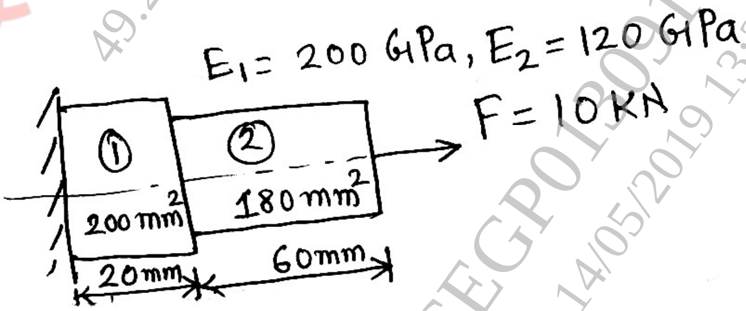
Q2) a) Write short note on **[4]**

i) Essential Boundary Conditions

ii) Natural Boundary Conditions

b) Derive element stiffness matrix for two noded (linear) bar element using Principle of Minimum Potential Energy Method. **[6]**

Q3) a) A stepped bar is made of two materials joined together as shown in fig. The bar is subjected to an axial pull of 10kN. Determine the displacements of each of the section using 1D spar element. **[6]**



b) Explain the term geometric isotropy. Why polynomial shape functions should satisfy these requirements? **[4]**

OR

P.T.O.

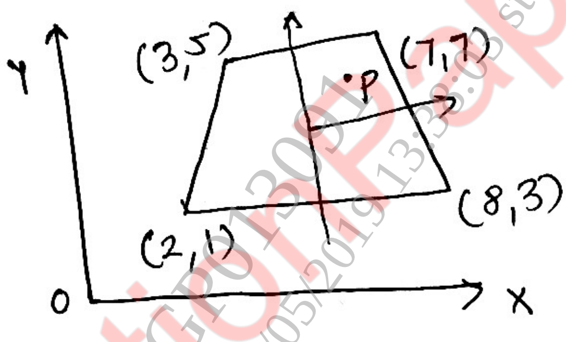
Q4) a) The triangular element has nodal co-ordinates (13,1), (25,6) and (13,3) for nodes 1,2 and 3 respectively. The x-co-ordinate of interior point P is 20 and y - co-ordinate is 6. Determine the shape functions at nodes 1,2 and 3. **[6]**

b) Write a note on plane stress formulations. **[4]**

Q5) a) Explain the terms isoparametric, subparametric and superparametric elements. **[6]**

b) State and explain the three basic laws on which isoparamteric concept is developed. **[6]**

c) Determine the cartesian co-ordinate of the point P ($\zeta = 0.5$, $\eta = 0.6$) show in fig. **[6]**



OR

Q6) a) Write short note on **[8]**

i) Substructuring

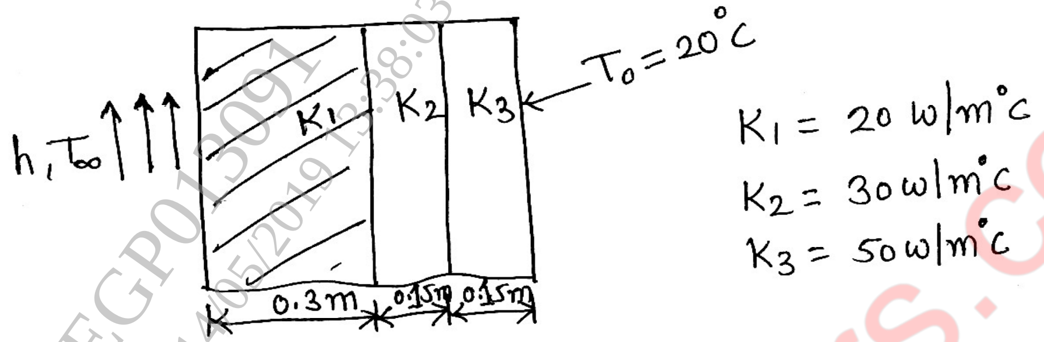
ii) Sub-modeling

b) Evaluate the following integrals. Use three point Gaussian quadrature method **[10]**

i) $\int_{-1}^{1} \left[3^x - 4x\right] dx$

ii) $\int_{-1}^{1} \left[2 + x + x^2\right] dx$

Q7) a) A composite wall consists of three materials a shown in fig. the outer temperature is $T_0 = 20°C$. Convection heat transfer takes place on the inner surface of the wall with $T_\infty = 800°C$ and $h = 25 W/m^2 °C$. Determine the temperature distribution in the wall. **[10]**



b) Derive elements stiffness matrix formulation for one dimensional steady state Heat Conduction problems. **[6]**

OR

Q8) a) A metallic fin. with thermal conductivity 360 W/m°C, 0.1 cm thick and 10 cm long extends from a plane wall whose temperature is 235 °C. Determine the temperature distribution and amount of heat transferred from the fin to the air at 20°C with heat transfer coefficient of 9 W/m^2 °C. Take the width of the fin to be 1m. **[10]**

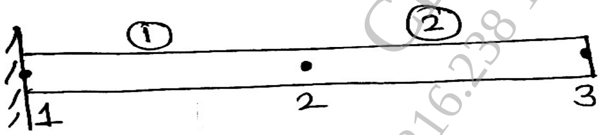
b) Derive FEA stiffness matrix for pin fin heat transfer problem. **[6]**

Q9) a) Write down consistent and lumped mass matrices for following elements **[6]**

i) Bar Element

ii) Beam Element

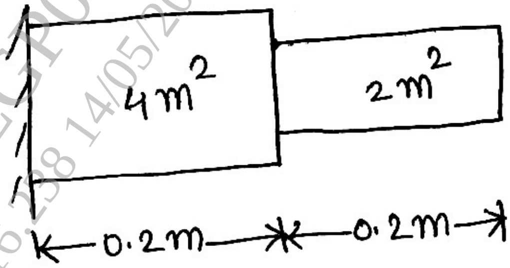
b) Consider a uniform cross-sectional bar of length L made up of a material whose Young's modulus and density are given by E and ρ. Estimate the natural frequencies of axial vibration of the bar using lumped mass matrix. Use two element mesh. **[10]**



OR

Q10) a) What is meant by Eigen Values and Eigen Vector? How it is related to Modal analysis of structures? **[6]**

b) Find the natural frequencies of longitudinal vibrations of the stepped shaft of areas 2 m^2 and 4 m^2 and of equal lengths 0.2m, when it is constrained at one end as shown in fig. $E = 2.1 \times 10^{11}$ N/m^2 and density $= 7.8 \times 10^3$ kg/m^3. **[10]**



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