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Question Paper Code : X 60855

B.E./B.Tech. DEGREE EXAMINATIONS, NOV./DEC. 2020
Sixth/Seventh Semester
Mechanical Engineering
ME 2353/10122 ME 605/ ME 63 – FINITE ELEMENT ANALYSIS
[Common to Automobile Engineering / Mechanical and Automation Engineering]
(Regulations 2008/2010)

Time : Three Hours Maximum : 100 Marks

Any missing data may be suitably assumed.
Answer ALL questions.

PART – A **(10×2=20 Marks)**

1. Distinguish between the Rayleigh-Ritz method and finite element method.
2. What do you understand by the term "piecewise continuous function" ?
3. Differentiate between global and local coordinates.
4. What are the types of problems treated as one dimensional problems ?
5. Write down the shape functions associated with the three noded linear triangular element and plot the variation of the same.
6. Give at least one example each for plane stress and plane strain analysis.
7. Consistent mass matrix gives accurate results than lumped mass matrix in dynamic analysis of bar element. Justify.
8. What type of analysis preferred in FEA when the structural member subjected to transient vibrations ?
9. Mention two natural boundary conditions as applied to thermal problems.
10. Define stream line.

PART – B **(5×16= 80 Marks)**

11. a) Solve the differential equation for a physical problem expressed as $\frac{d^2y}{dx^2} + 100 = 0, 0 \le x \le 10$ with boundary conditions as y(0) = 0 and y(10) = 0 using

i) point collocation method **(4)**

ii) sub domain collocation method **(4)**

iii) least squares method and **(4)**

iv) Galarkin's method. **(4)**

(OR)

b) A simply Supported beam subjected to uniformly distributed load over entire span and it is subjected to a point load at the centre of the span. Calculate the deflection using Rayleigh-Ritz method and compare with exact Solutions. **(16)**

12. a) Determine the maximum deflection and slope in the beam, loaded as shown in Fig. 1. Determine also the reactions at the supports. E = 200 GPa, $I = 20 \times 10^{-6}$ m^4 q = 5 kN/m and L = 1m. **(16)**

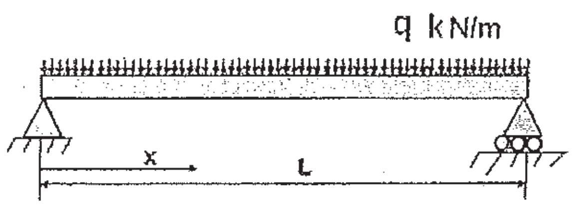

Fig. 1

(OR)

b) Derive using Lagrangian Polynomials the shape functions for a one dimensional three noded bar element. Plot the variation of the same. Hence derive the stiffness matrix and load vector. **(16)**

13. a) Establish the body force and traction force (uniformly distributed) vector for a lower order quadrilateral element. **(16)**

(OR)

b) i) Derive the expression for nodal vector in a CST element subjected to pressures P_{x1}, P_{y1} on side 1, P_{x2}, P_{y2} on side 2 and P_{x3}, P_{y3} on side 3 as shown in Fig.2. **(10)**

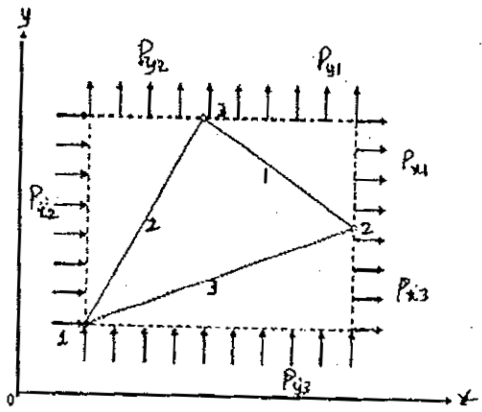

Fig. 2

ii) Establish any two shape functions corresponding to one corner node and one mid-node for an eight node quadrilateral element. **(6)**

14. a) Set up the system of equations governing the free transverse vibrations of a simply supported beam modeled by two finite elements. Determine the natural frequency of the system. **(16)**

(OR)

b) Find the eigen value and the corresponding eigen vector of $A = \begin{bmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$. **(16)**

15. a) Derive an expression for temperature function and shape function for one dimensional heat conduction element. **(16)**

(OR)

b) Derive the stiffness matrix and load vectors for fluid mechanics in two dimensional finite element. **(16)**