BIRLA INSTITUTE OF TECHONOLOGY AND SCIENCE, PILANI

First Semester (2022-2023), Comprehensive Examination

Course: Finite Element Analysis (CE G619)

Date: 23rd Dec. 2022 | Total Marks: 90 | Duration: 2:00PM-5:00PM

Q.1. Find the approximate solution of the partial differential equation by (i) Galerkin method, (ii) Ritz method(integral) and (iii) Collocation method [Collocation point is (0.5,0.5)], Report the values of w at $x = 0.5$ and $y = 0.5$. Take one term solution in all cases using algebraic polynomial. [25]

$$\frac{\partial^4 w}{\partial x^4} + 2\frac{\partial^4 w}{\partial x^2 \partial y^2} + \frac{\partial^4 w}{\partial y^4} = 1.0\,, \qquad 0 < x < 1.0 \quad \text{and} \quad 0 < y < 1.0\,,$$

At $x = 0\,, w = 0$ and $\frac{\partial w}{\partial x} = 0$ At $y = 0\,, w = 0$ and $\frac{\partial w}{\partial y} = 0$

At $x = 1\,, w = 0$ and $\frac{\partial w}{\partial x} = 0$ At $y = 0\,, w = 0$ and $\frac{\partial w}{\partial y} = 0$

Q.2. The square plate having thickness(*h*) of 0.01m shown in **Fig.1** is subjected to in-plane uniformly distributed pressure on the right-hand edge. Find the weak form of the governing differential equations which governs the behaviour. Considering this full plate as one 5-noded element, using Modified Galerkin approach, find the net elemental equations and solve. Take E=210GPa and v=0.3. Consider this component to be a plane-stress component. [28]

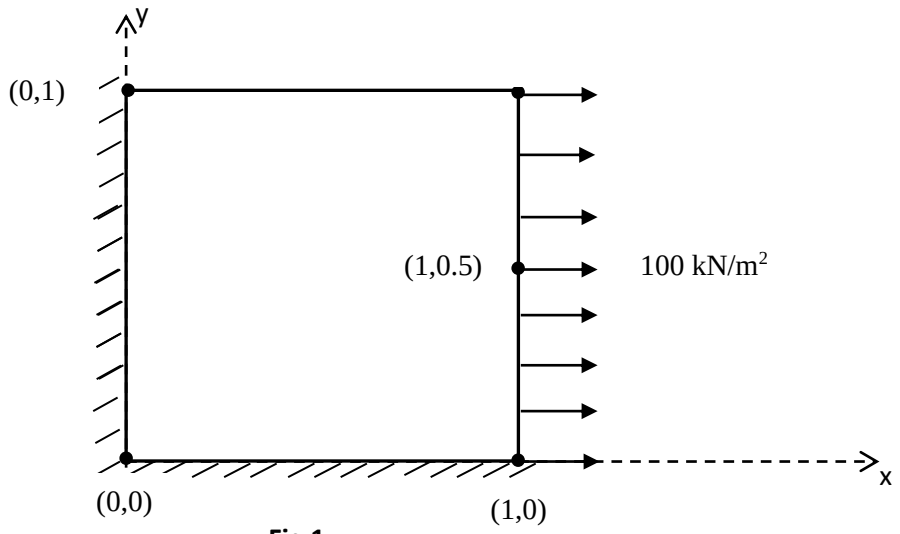

Fig.1

Q.3. The tapered cantilever beam shown in **Fig.2** is subjected to a uniformly distributed load. Derive the governing differential equations for beam bending in displacement form using 1st order shear deformation theory. Find the weak form of these equations. Using weak form Galerkin approach find the net elemental equations, considering whole beam to be one 2-noded beam element. Use reduced integration to evaluate the required components of the matrix. Solve these equations by taking E=205GPa, v=0.3, L=3m, d=100mm, width of the beam(b)=200mm, q=5kN/m and shear correction factor=5/6. [25]

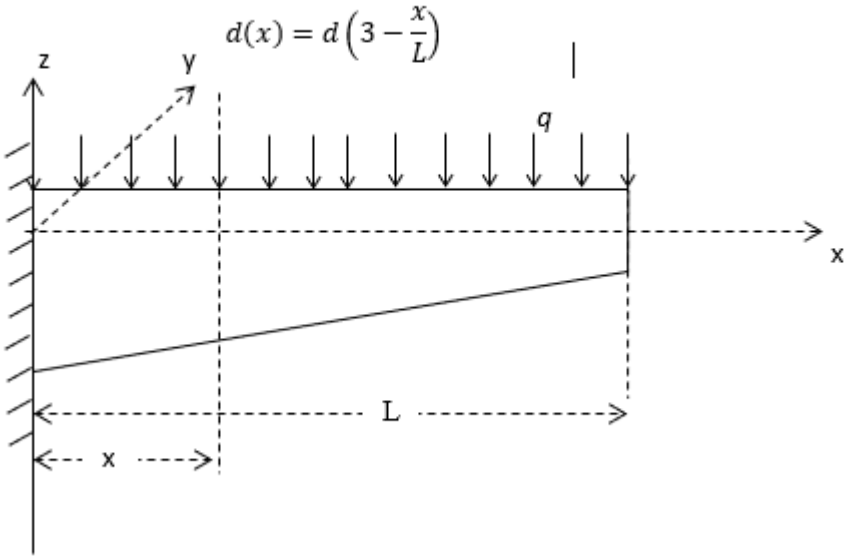

Fig.2

Q.4. Explain the following questions, [12]

(a) What is 1-D, 2-D and 3-D problem ?
(b) Write the difference between exact solution and approximate solutions.
(c) What is shear locking and why it is present ?
(d) What is strong form and weak form of a differential equation ?
(e) Write the steps in the finite element analysis.
(f) What is reduced integration and why it is necessary ?