Reg No.:_____ Name:_____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MAY 2019

**Course Code: CE466**

**Course Name: FINITE ELEMENT METHODS**

Max. Marks: 100 Duration: 3 Hours

**PART A**

***Answer any two full questions, each carries 15 marks.*** Marks

1 a) Explain the various steps involved in a finite element formulation. (10)

b) Discuss guidelines to be considered while choosing approximate functions in FEM. (5)

2 a) Explain principle of minimum potential energy. (5)

b) Explain steps in Gauss elimination solution procedure. (5)

c) Using Rayleigh-Ritz method, find the expression for stress for one-dimensional element of length L subjected to an axial force q/unit length. AE is same throughout. (5)

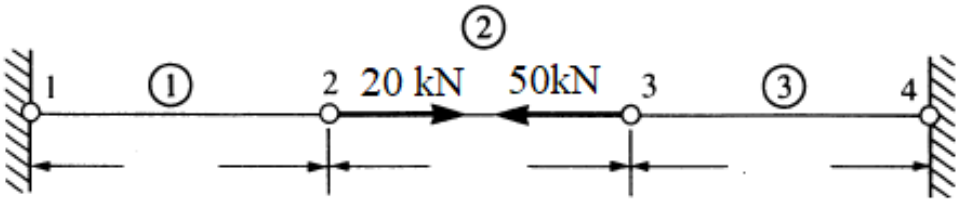
3 a) Using different weighted residual methods solve a cantilever bar problem subjected to uniformly varying axial load q($x$) =c$x$ where c is a constant. (6)

b) Discuss role of shape functions, their significance and properties in FEM. (9)

**PART B**

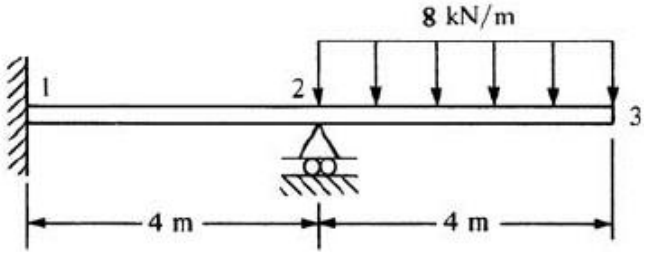
***Answer any two full questions, each carries 15 marks.***

4 a) For the bar assemblages shown in figure, determine the nodal displacements, the stresses in each element, and the reactions. Use the direct stiffness method E= 200GPa, A= $30 \times 10^{-4} m^2$, L=1m. (10)




b) Explain static condensation. (5)

5 a) Determine the displacements and the slopes at the nodes, the forces in each element, and the reactions of the beam shown in figure. Modulus of elasticity of beam, E = 210 GPa, moment of inertia of section = 4 x$10^{-4}$ $m^2$. (10)




b) Explain how displacement boundary conditions are specified in FEA. (5)

6 a) Derive 2-noded beam element and 3-noded bar element using interpolation functions. (10)

b) Discuss $C^0$ and $C^1$ elements giving examples. Which elements can trigonometric shape functions model? (5)

## PART C

***Answer any two full questions, each carries 20 marks.***

7 a) Derive shape function for bilinear plane rectangular element using Lagrangian interpolation function. (10)

b) What gives CST and LST elements their name? (5)

c) The cartesian coordinates of corner nodes of an quadrilateral element are given by (3,2), (9,4), (6,8), and (4,5). Derive an isoparametric mapping for this element and using this, determine the cartesian coordinates of the point defined by natural coordinates (0.6,0.8). (5)

8 a) Evaluate the following integral using two-point Gauss quadrature and compare with exact solution. (10)

$$\int_{-1}^{1} [3e^x + x^2 + \frac{1}{x+2}]\, dx$$

b) Explain different plate bending theories with elements used for each. (5)

c) Describe patch test and mention its importance. (5)

9 a) Define consistent nodal loads. Derive the consistent nodal load vector for CST element subjected to uniformly distributed surface force acting in the *x*-direction on one of the sides. (10)

b) Explain the concept of isoparametric formulation with the help of a 2-noded line element. (10)

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