UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program: B.Tech. Mechanical/ B.Tech. MSNT	**Semester – VII**
Subject (Course): Finite Element Analysis/ Finite Element Method	**Max. Marks : 100**
Course Code : ASEG 483/ IFEG 452	**Duration : 3 Hrs**
No. of page/s: 04	

Note: 1.Section A has Four (04) questions of 5 marks each.

2. Section B contains Four (4) Questions of 10 marks each.

3. Section C has Three (3) Questions of 20 marks each. Attempt any two questions.

4. Assume any missing data.

SECTION A

Q.1: In a plane strain problem, we have:

$\sigma_z = 20000$ psi, $\sigma_x = -10000$ psi, $E = 30 \times 10^6$ psi, $\nu = 0.3$

Determine the value of the σ_y.

Q.2: State and draw the linear and quadratic shape functions.

Q.3: Describe the various approaches for handling the boundary conditions in finite element analysis.

Q.4: A truss element, with local node numbers 1 and 2, is shown in Fig. 1.

a) What are the direction cosines *l* and *m* ?

b) If $\mathbf{q} = [0, 0.01, -0.025, -0.05]^T$ in., determine q_1' , q_2'.

c) Find the **k** matrix.

d) Find the stress in the element.

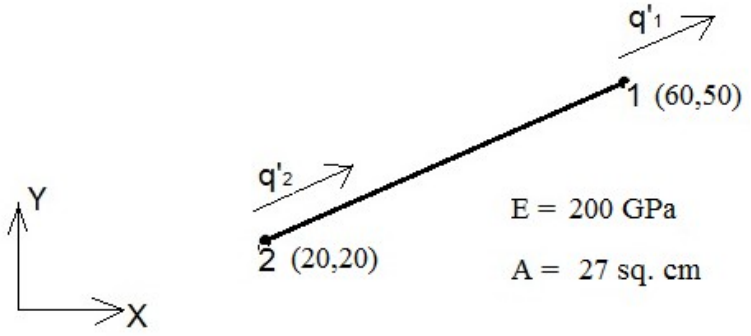

Fig.1: A truss element (Figure for Q.4)

SECTION B

Q.5: Give the finite element formulation for a four node quadrilateral element.

Q.6: For the beam loading shown in Fig. 2, determine the deflections and slopes at points A, B and C.

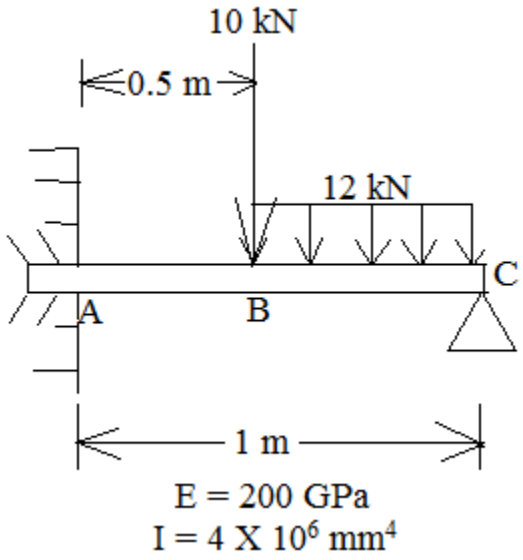

Fig.2: A loaded beam (Figure for Q. 6)

Q.7: Derive the expression of stiffness matrix for a beam element.

Q.8: Derive the expression of **B** matrix for a constant strain triangle element.

SECTION C

Q.9: Formulate and draw the shape functions for a three-noded beam element shown in Fig. 3. The third node 3 is at the center of the beam. Take length of beam as L.

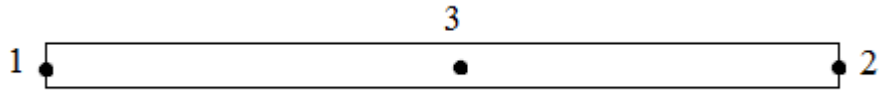

Fig.3: A three-noded beam element (Figure for Q.9)

Q.10: For the truss shown in Fig. 4, find out the following:

(a) Element stiffness matrix for each element

(b) Assemble the global stiffness matrix

(c) The degrees of freedom at vertices- A, B, C and D

(d) Stresses in elements AC and BC

(e) Reaction force at point B.

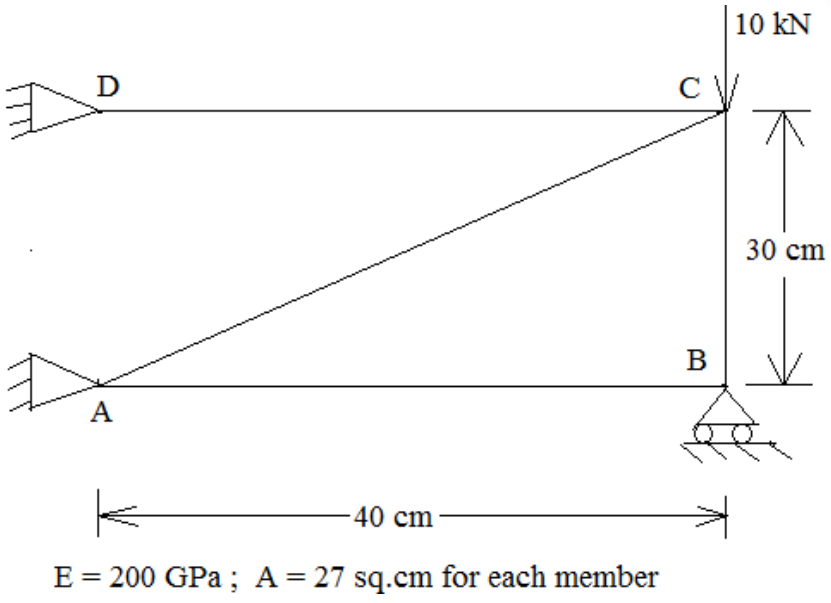

Fig. 4: A truss structure (Figure for Q.5)

Q.11: A bar of uniform cross-section is submerged in sea (Fig.5). The top end P of the bar is at a depth of 2000 m from the sea level and the bottom end Q is at the depth of 2002 m from the sea level. The bar is fixed at ends P and Q and is held stationary within the sea with some kind of mechanism. It is assumed that there is no disturbance due to flow of water. Using Rayleigh-Ritz method find the displacement at midpoint of the bar.

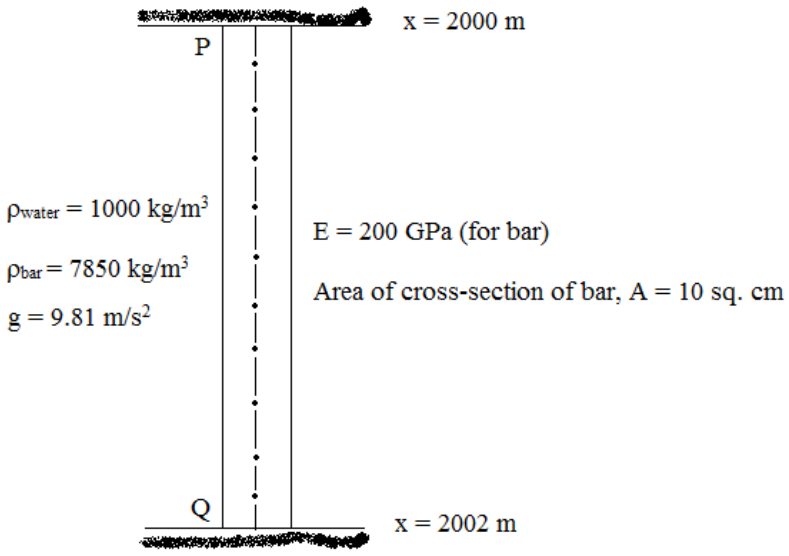

Fig.5: A bar submerged in sea (Figure for Q.11)