OCD011

UNIVERSITY OF BOLTON

OFF CAMPUS DIVISION

STUDY WORLD LANKA CAMPUS

BENG(HONS) MECHANICAL ENGINEERING

SEMESTER 1 EXAMINATION 2018/2019

FINITE ELEMENT & DIFFERENCE SOLUTIONS

MODULE NO AME6006

Date: 23rd September 2018 **Time: 9:00am – 11:00 am**

INSTRUCTIONS TO CANDIDATES:

Answer all Questions
All questions carry equal marks.

Electronic calculators may be used provided that data and program storage memory is cleaned prior to the examination.

Each question is worth 25 marks, make sure to include all the papers which you write on.

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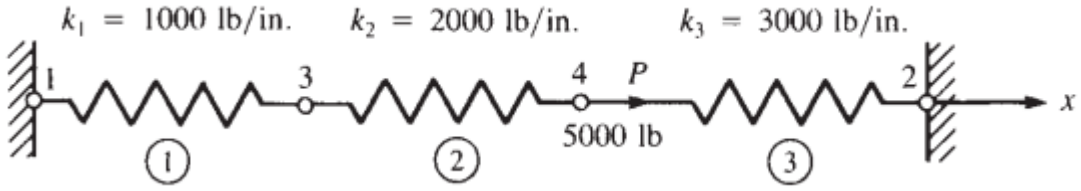
Question 1

The spring constants are given in the figure. Nodes 1 and 2 are fixed. The spring assemblage is given in the figure below. Using direct stiffness matrix method solve for:

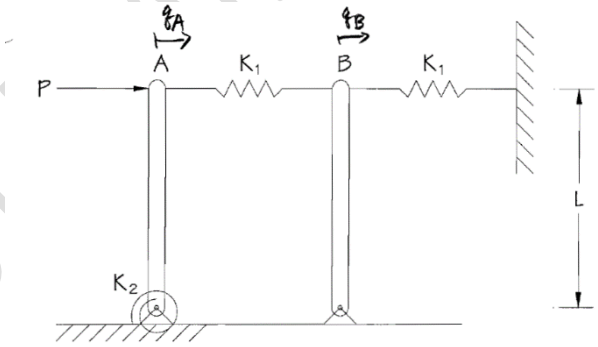


(a) the global stiffness matrix,
(b) the displacements of nodes 3 and 4,
(c) the reaction forces at nodes 1 and 2,

(25 Marks)

Question 2

Use the principle of minimum potential energy to solve the spring problems shown below. Solve for internal strain energy and the external potential energy in the system. Thus, solve for q_A and obtain a solution using P, k_1 and K_2



(25 marks)

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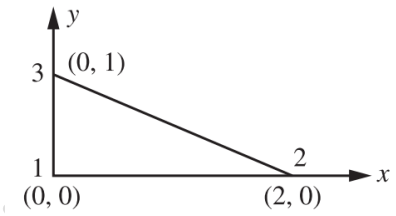
Question 3

The coordinates are in units of inches. Assume plane stress conditions. Let E =30 x 10^6 psi, v = 0.25, and thickness t = 1 in. Use iso-parametric characterization. Solve for B matrix, then using [B] matrix evaluate stiffness matrix.

$$[B] = \frac{1}{2A}\begin{bmatrix} \beta_i & 0 & \beta_j & 0 & \beta_m & 0 \\ 0 & \gamma_i & 0 & \gamma_j & 0 & \gamma_m \\ \gamma_i & \beta_i & \gamma_j & \beta_j & \gamma_m & \beta_m \end{bmatrix}$$

Stress–strain matrix for plane strain condition:

$$[D] = \frac{E}{(1+v)(1-2v)}\begin{bmatrix} 1-v & v & 0 \\ v & 1-v & 0 \\ 0 & 0 & \frac{1-2v}{2} \end{bmatrix}$$



(25 Marks)

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Question 4

Describe 5 out of the given 8 conditions/theorems of the following with your own words. Use illustrations if necessary.

1. Plane Stress Condition:
2. Plane Strain Condition:
3. Eigenvalues:
4. Stress Invariants:
5. Shape Function:
6. Gaussian Quadrature:
7. Types of meshes and mesh optimizing techniques
8. Delaunay Triangularization and it's properties

(25 marks)

END OF QUESTIONS