UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 5 Examination in Engineering: December 2020

Module Number: ME5302 **Module Name: Computer Aided Design**

[Three Hours]

[Answer **all** questions. All questions carry equal marks]

Q1. a) Derive the stiffness matrix for two node spring element. Use stiffness of the spring element as "k". State all the steps clearly.

[4.0 Marks]

b) The spring assemblage with arbitrarily numbered nodes is given in Figure Q1-b. A force of 5000 lb is applied at node 4 in the x direction. The spring constants are given in the figure. Nodes 1 and 2 are fixed, obtain;

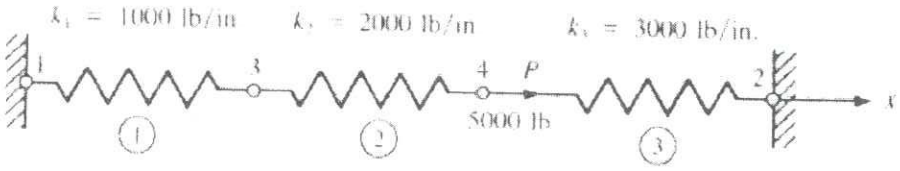

Figure Q1-b

i) the global stiffness matrix by using the concept of superposition.
ii) the displacements of nodes 3 and 4. State the boundary conditions clearly.
iii) the reaction forces at nodes 1 and 2.
iv) the forces in each spring.

[8.0 Marks]

Q2. a) Suppose that you are asked to purchase a CAD system for your organization. For the evaluation of the system, state the main points that you are going to evaluate under geometric modeling capabilities and explain them briefly.

[3.0 Marks]

b) Draw the flow chart of the Bresenham's algorithm for a line where the gradient of the line m is $0<m<1$, and the current point is (x_i, y_i).

[2.0 Marks]

c) Use the flow chart stated in b) and find consecutive five points for the line to be drawn from (10, 20) to (150, 125)mm on a display which is mapped to approximately 300mm in X direction and 250mm in Y direction. The resolution of the screen is 640X480.

[5.0 Marks]

d) Explain why the Bresenham's algorithm is more convenient to draw lines than digital differential analyzer (DDA) algorithm.

[2.0 Marks]

Q3 a) Find the equation for the Bezier curve for the given data points (1,1,0), (2,4,0), (5,5,0) and (4,2,0).

[3.0 Marks]

b) Find points on the curve at u=0, 1/3, 1/2 and 1.

c) Find the tangent to the curve at u=1/2. [3.0 Marks]

d) Plot the curve in the given graph sheet. [3.0 Marks]

Q4 a) "A Bezier curve is a polynomial of degree one less than the no of control points used." Discuss whether this statement is correct. [3.0 Marks]

b) Suppose that we join two Bezier curves of degree 2, using the control point sequences (P_0, P_1, P_2) and (P_2, P_3, P_4), respectively. What conditions must be satisfied by these five points to have C^1 continuity. [3.0 Marks]

c) Draw and label four points P_0, P_1, P_2 and P_3 such that the cubic Bezier curve P(u) derived from them is a simple, closed curve. Sketch the resulting curve freehand, as accurately as you can. [3.0 Marks]

d) Explain with the aid of a diagram, why it would be impossible to construct a simple, closed cubic Bezier curve that has C^1 continuity everywhere. [3.0 Marks]

Q5 a) Write the general homogeneous transformation matrix for reflection. Use that matrix and write the matrices for reflection through X=0 principal plane, reflection through X axis and reflection through the origin. [4.0 Marks]

b) Write the homogeneous transformation matrix to get the front view in orthographic projection. Use that matrix and find the coordinates of the points P, A, B, C, D, and E in front view seen from Z direction of the object shown in Figure Q5. [4.0 Marks]

c) Write the homogeneous transformation matrix to get the right view in orthographic projection. Use that matrix and find the coordinates of the points P, A, B, C, D, and E in right view of the object shown in Figure Q5. [4.0 Marks]

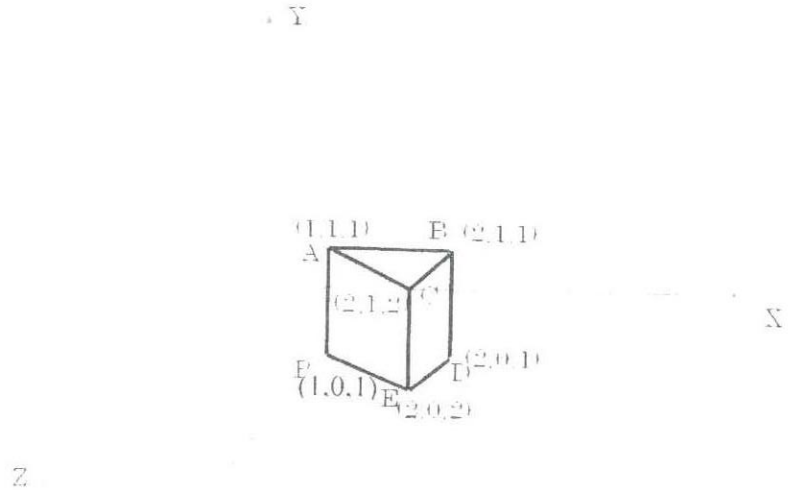

Figure Q5