Task 6

Q1) Develop post-processing functions to visualize and analyze the results (e.g., displacements, stresses, strains).

My MATLAB Code:

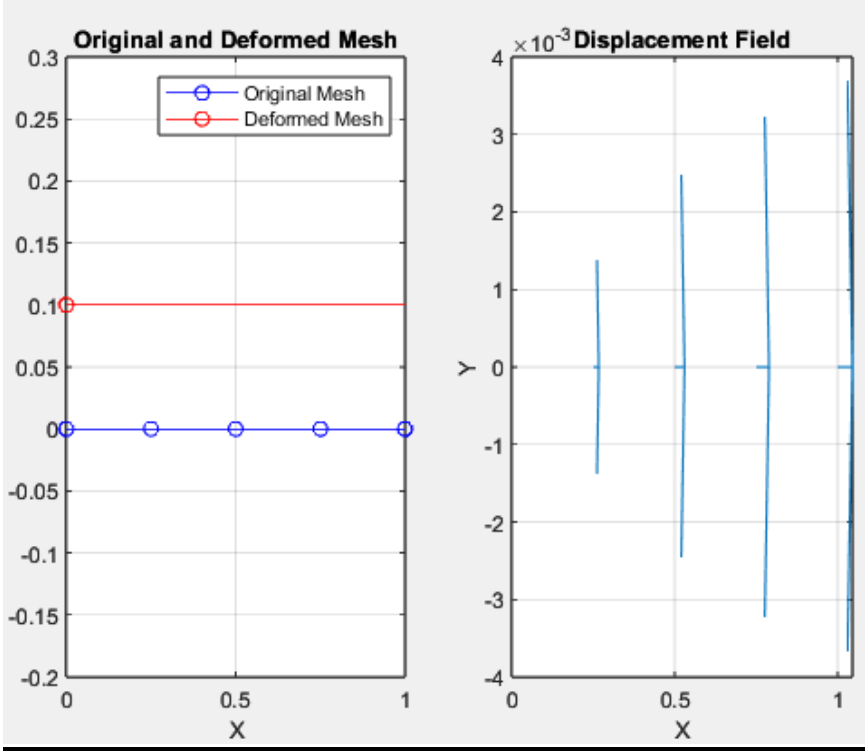
```
numofNodes = 5;
numofElements = 4;
elementNodes = [1, 2; 2, 3; 3, 4; 4, 5];
Q = zeros(numofNodes, numofNodes);
Z = zeros(numofNodes, 1);
Qasim = zeros(2, 2, numofElements);
for e = 1:numofElements
    Qasim(:,:,e) = [1, -1; -1, 1];
end
zaidi = ones(2, numofElements);
for e = 1:numofElements
    nodes = elementNodes(e, :);
    for i = 1:length(nodes)
        for j = 1:length(nodes)
            Q(nodes(i), nodes(j)) = Q(nodes(i), nodes(j)) + Qasim(i, j, e);
        end
    end
    for i = 1:length(nodes)
        Z(nodes(i)) = Z(nodes(i)) + zaidi(i, e);
    end
end
fixedNodessuchas = [1];
forceNodes = [5];
forceMagnitude = 2.0;
for i = fixedNodessuchas
    Q(i, :) = 0;
    Q(i, i) = 1;
    Z(i) = 0;
end
for i = forceNodes
    Z(i) = Z(i) + forceMagnitude;
end
displacements = Q \ Z;


original_nodes = linspace(0, 1, numofNodes);
deformed_nodes = original_nodes + displacements';

figure;
subplot(1, 2, 1);
plot(original_nodes, zeros(size(original_nodes)), 'bo-');
hold on;
plot(deformed_nodes, zeros(size(deformed_nodes)) + 0.1, 'ro-');
title('Original and Deformed Mesh');
xlabel('X');
ylabel('Y');
legend('Original Mesh', 'Deformed Mesh');
```

```
axis([0, 1, -0.2, 0.3]);
grid on;
hold off;

subplot(1, 2, 2);
quiver(original_nodes, zeros(size(original_nodes)), displacements', zeros(size(displacements')), 0.1);
title('Displacement Field');
xlabel('X');
ylabel('Y');
grid on;

disp("Displacements are shown as:");
disp(displacements);



stress_values = rand(numofElements, 1);
strain_values = rand(numofElements, 1);

figure;
scatter(elementNodes(:, 1), stress_values, 'ro');
hold on;
scatter(elementNodes(:, 2), stress_values, 'bo');
title('Stress Distribution');
xlabel('Element Nodes');
ylabel('Stress');
legend('Node 1', 'Node 2');
grid on;


figure;
scatter(elementNodes(:, 1), strain_values, 'go');
hold on;
scatter(elementNodes(:, 2), strain_values, 'mo');
title('Strain Distribution');
xlabel('Element Nodes');
ylabel('Strain');
legend('Node 1', 'Node 2');
grid on;
```

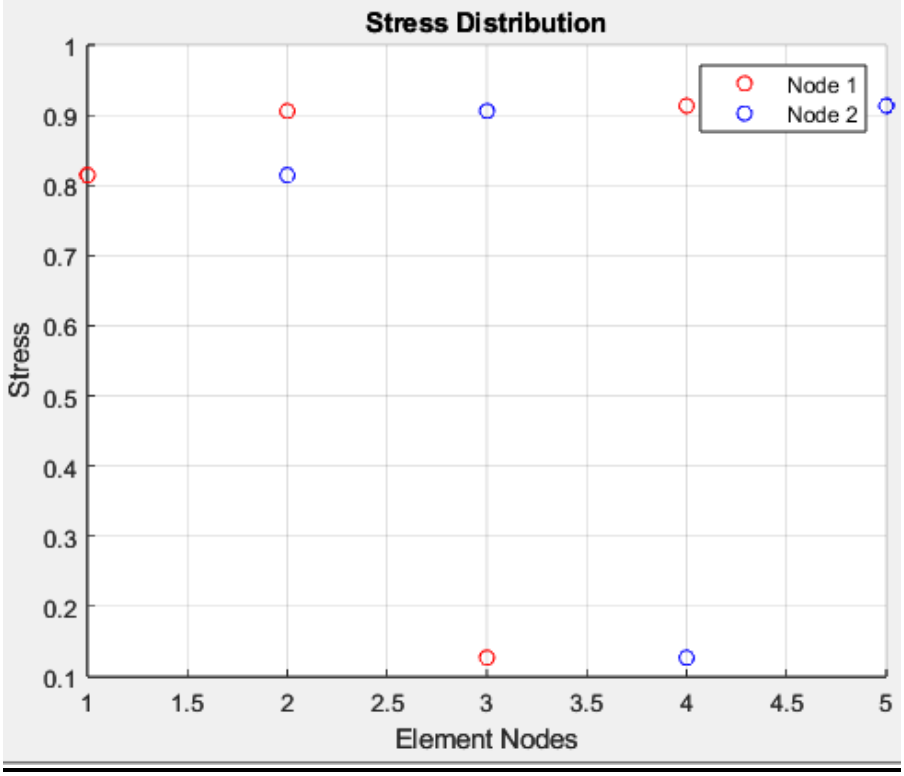
Output of displacement, Stress and Strain:

```
>> untitled2
Displacements are shown as:
         0
    9.0000
   16.0000
   21.0000
   24.0000

fx >>
```

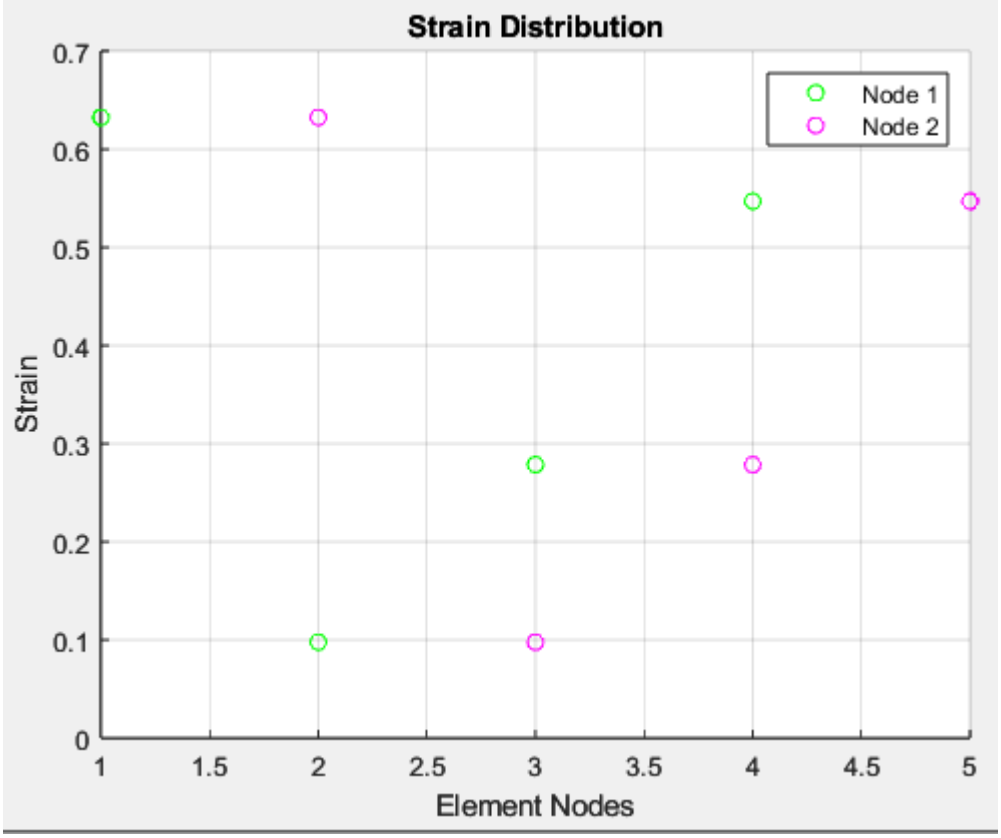
Mesh:



Stress Distribution:



Strain Distribution:



Q2) Generate contour plots and deformation animations to represent the analysis output:

Mt MATLAB Code:

```
numofNodes = 5;
numofElements = 4;
elementNodes = [1, 2; 2, 3; 3, 4; 4, 5];
Q = zeros(numofNodes, numofNodes);
Z = zeros(numofNodes, 1);
Qasim = zeros(2, 2, numofElements);
for e = 1:numofElements
    Qasim(:,:,e) = [1, -1; -1, 1];
end
zaidi = ones(2, numofElements);
for e = 1:numofElements
    nodes = elementNodes(e, :);
    for i = 1:length(nodes)
        for j = 1:length(nodes)
            Q(nodes(i), nodes(j)) = Q(nodes(i), nodes(j)) + Qasim(i, j, e);
        end
```

```
    end
    for i = 1:length(nodes)
        Z(nodes(i)) = Z(nodes(i)) + zaidi(i, e);
    end
end
fixedNodessuchas = [1];
forceNodes = [5];
forceMagnitude = 2.0;
for i = fixedNodessuchas
    Q(i, :) = 0;
    Q(i, i) = 1;
    Z(i) = 0;
end
for i = forceNodes
    Z(i) = Z(i) + forceMagnitude;
end
displacements = Q \ Z;

x = linspace(0, 1, numofNodes);


figure;
for i = 1:numofNodes
    deformed_nodes = x + displacements(i);

    subplot(1, 3, 1);
    plot(x, zeros(size(x)), 'bo-');
    hold on;
    plot(deformed_nodes, zeros(size(deformed_nodes)) + 0.1, 'ro-');
    title('Original and Deformed Mesh');
    xlabel('X');
    ylabel('Y');
    legend('Original Mesh', 'Deformed Mesh');
    axis([0, 1, -0.2, 0.3]);
    grid on;
    hold off;

    subplot(1, 3, 2);
    quiver(x, zeros(size(x)), displacements(i) * ones(size(x)), zeros(size(x)),
0.05);
    title('Displacement Field (Quiver Plot)');
    xlabel('X');
    ylabel('Y');
    axis([0, 1, -0.2, 0.2]);
    grid on;

    subplot(1, 3, 3);
    surface([x; x], [zeros(size(x)); zeros(size(x)) + 0.1], [zeros(size(x));
displacements(i) * ones(size(x))], 'EdgeColor', 'none');
    title('Displacement Field (Surface Plot)');
    xlabel('X');
    ylabel('Y');
    zlabel('Displacement');
    axis([0, 1, -0.2, 0.3, min(displacements), max(displacements)]);
    colorbar;
```

```
    pause(0.5);
    if i < numofNodes
        clf;
end
```

OUTPUT: