ME 260: Structural Optimization: Size, Shape, and Topology		
Assigned: Sep. 3, 2021	Quiz 2	Due: Sep. 7, 2021

Question 1 (4 points)

You are asked to verify the following energy theorems using planar truss finite element code. Assume a truss of any geometry (topology, shape, and size), material properties, and boundary conditions (loads and fixed vertices).

a) Clayperson's theorem ("At static equilibrium, the work done by the external forces is equal to twice the strain energy.")
b) Unit virtual load method to find a particular degree of freedom
c) Maxwell's reciprocity theorem ("When we apply a unit load at degree of freedom A, then the value of another degree of freedom, say B, will be same as the value of degree of freedom A when you apply a unit load at degree of freedom B.")
d) Maxwell's theorem for trusses (" $\sum_{\text{tension}} l_i p_i + \sum_{\text{compression}} l_j p_j = \text{constant}$ for fixed boundary conditions that include loading points, loads, and fixed points)

Question 2 (5 points)

Use the truss finite element code to simulate an interesting planar truss. It should have at least 20 vertices and at least two vertices with external applied loads. Submit the four data files, deformed geometry of the truss, and the results (including x and y displacements of all vertices, internal forces in all members, axial stress in all members, Maxwell constant, and the volume.

Question 3 (9 points)

a) Assume the boundary conditions (loads and fixed points) that you used in Question 2 and try to intuitively design the best truss for 30% volume using the interactive truss design code focusing only on the topology and shape and not size (i.e., you do not need to change the areas of cross-section are material properties or load values in this code):
https://mecheng.iisc.ac.in/suresh/me260/Matlab/TrussInteractiveDesign.zip.
b) Simulate the truss you designed using truss finite element code and compare its performance with the truss you came up with in Question 2 in terms of mean compliance and extreme axial stress (both tensile and compressive).