APL410-Assignment 1
Total: 20 marks
Due date: 22.10.24 (at the start of lecture)

Q1. Consider a rectangular plate of length L and height H. A mesh of m=10 elements along length and n=5 elements along H is used to discretize the plate. The bottom is fixed in y-direction while the top is pulled with a traction given as $t_2 = c\,t$ MPa and final time t_{max} is 50 seconds. To eliminate rigid body motion in x-direction, the bottom left node is fixed in the x-direction. Assume the plate to be isotropic and linear elastic with Young's modulus E and poisson's ratio ν.

The parameter values are:
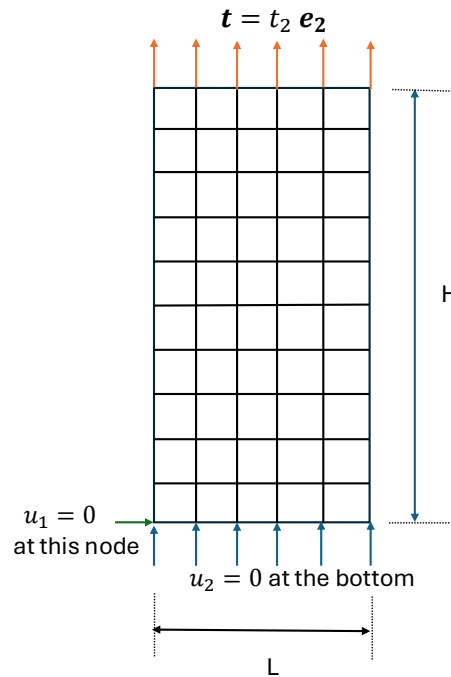E=100 + (xy) GPa (rounded to the nearest multiple of 10)
ν=0.33
L=20 + (xy) mm (rounded to the nearest multiple of 5)
H= 10 + (xy) mm (rounded to the nearest multiple of 5)
c=1 MPa/s,
where (xy) are the last 2 digits of your entry number.

Prepare a solution which includes the following:

(a) Write the weak form of the governing equation, the shape functions and the Gaussian integration scheme used. (5 points)

(b) Write the expressions for the elemental stiffness matrix and force vectors. Mention the size of the elemental and global stiffness matrix and force vector. Also mention how you have numbered the elements and nodes. (5 points)

(c) Show the contour plot of the displacement in the plate at t=25 and 50 seconds. Describe how you obtained it. (2.5 points)

(d) Show the contour plot of stress and strain of the plate at t=50 second. Describe how you obtained it. (2.5 points)

(e) Plot the load versus displacement curve and the stress versus strain curve. Describe how you obtained the two plots. For the displacement and the strain values in the plot, use the average of the nodal displacements at the top edge. (3 points)

(f) Plot the slop of the stress versus strain curve. (2 points)

Submit the working FEM code (preferably in MATLAB but also allowed in C++). Properly indent and comment the code, defining the variables and parameters used and the different steps involved to arrive at the submitted solution.

In case the code does not work, some partial marks may be awarded provided you comment the code properly as mentioned above and write the steps involved correctly to answer the above questions (subpart-wise). But make a sincere attempt at getting the code to work. That will improve your understanding.

Both the solution and the code will be checked for **plagiarism**. If there is unacceptable similarity between any two submission, both the submissions will be strongly penalized. You may discuss the problem with others if you cannot do it yourself but write your own solution and make sure you understand what you write. Also feel free to reach out to me if you want any clarification.