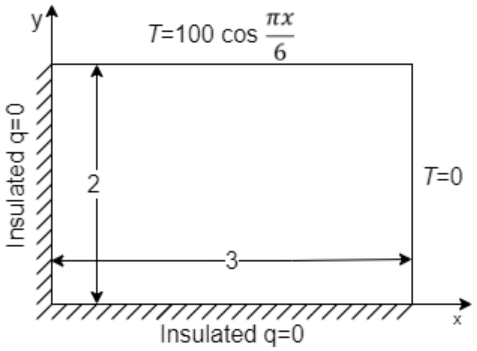
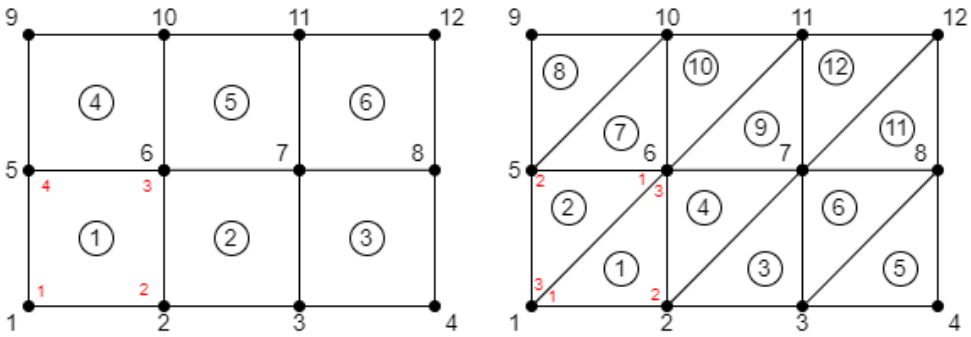
AEE 464 · Application of Finite Element Analysis in Aerospace Structures

Term Project

Due Date: July 5, 2022

Consider the steady-state heat conduction in a 3×2 isotropic rectangular domain. The origin is located at the bottom left corner. The boundary conditions are given on the figure. Left and bottom boundaries are insulated. Right boundary is kept at zero temperature. Moreover, on the top boundary, temperature of $100cos\frac{\pi x}{6}$ is maintained. Thermal conductivity is given as 1.0.





(a) Quadrilateral mesh (b) Triangular mesh

You are asked to determine the temperature distribution in the domain and the heat required at the boundary x=3 **using MATLAB** for both quadrilateral and triangular meshes given above. Global node numbers are highlighted with black numbers and elemental coordinate numbers are given with red numbers. Your code should be a generic code. A user input should be asked when you run the code for mesh selection (triangular or quadrilateral mesh). Set the user input in a way that 1 is for triangular and 2 is for quadrilateral mesh. In your MATLAB code, you should have followings:

- A matrix named as "coord" for nodal coordinates.
- A matrix named as "connectivity" for elemental connectivity.
- A matrix named as "bcs" indicating boundary condition.
- Functions named as "elem_ stiffness_ triangular" and "elem_ stiffness_ quad" for calculation of elemental conductance matrices for triangular and rectangular meshes, respectively. Assembly to global matrices should be done in these functions as well.

Present your solution in a report format. In your reports, you are asked to have the followings:

- A brief explanation of the problem.
- State the relations used to determine elemental matrices.
- Present global force vector.
- Present the nodal temperatures you found for both meshes with analytic results in a tabular form given below.

Node Number	**Quadrilateral Mesh**	**Triangular Mesh**	**Analytic**
1			
2			

Analytic Solution: $T(x,y) = 100\dfrac{cosh(\pi y/6)cos(\pi x/6)}{cosh(\pi/3)}$

- Visualize the temperature distribution on a 2-D contour plot for both meshes. You can use the "contourf" built-in function of MATLAB for contour plot presentation. (Bonus 10 pt)
- Create two plots of the nodal heat flux variation on right edge with respect to y-coordinates for both meshes. On your plots, please set the x axis as y-cooardinates and y axis as heat flux values. (Bonus 10 pt)

Upload your MATLAB codes and reports in a zipped format to ODTUClass. The project can be done either as individual or as group of two students.