Final Project for ME 245

Design a 3D object of your choice that is or can be used in practical heat transfer application. Mesh it with hexahedron elements and conduct both steady-state and transient FEM analysis. We are only focusing on conduction heat transfer with convection heat transfer at the boundaries.

Write a project report that includes:

1) The motivation of your study (i.e., what drives you to investigate the object you choose?)
2) What are the parameters of your model and why do you choose them? What are the assumptions?
3) Schematic figure(s) of your model.
4) Derivation of the theoretical analysis of a further simplified model (e.g. a chunk of meat can be simplified as a cube).
5) Numerical analysis (with codes attached as the supplementary information).
6) Comparison and visualization (only for the numerical solution) of the numerical and theoretical results.
7) What is your conclusion from this study? Are the conclusions obtained from the numerical and theoretical analysis the same? If not, what is the cause of the difference? What can you do to improve the theoretical model?

You may be creative when choosing the project. One example is when cooking steak, how will the fat/protein ratio decide the cooking time if I want the same doneness? If considering other heat-related factors, such as the evaporation of the water inside the meat at above the boiling point, what is the optimal condition (temperature & cooking time & fat/protein ratio, etc.) for a desired doneness and juiciness? For a certain fat/protein ratio, do we want the one with more evenly distributed fat or more concentrated fat? The evenly distributed case can be approximated as a multi-layered composite structure. Another example would be how you can bake turkey in the oven. (Apologies if you are a vegetarian or vegan. You may use an example of any vegetable of your choice, e.g., defrosting frozen veggies using a microwave oven or a steamer).

If you are not a big fan of food, you may think of other industrial applications. For example, you may compare the efficiency of concentric fins against that of spiral fins along a pipe. Or heat transfer in a knitted fiber system or a 2D lattice as is shown in Fig. 1. If your project is scientifically innovative or includes complex network (like the fiber network or 2D lattice), you may simplify it to a 1D or 2D model.

You may email me your idea of the project before April 28th.

Please submit your project by 11:59 PM on May 18th to the Blackboard.

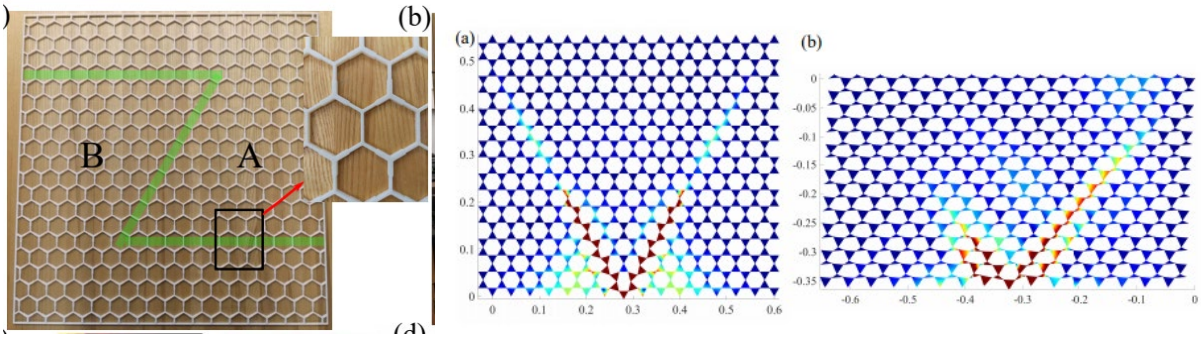

Figure 1. Examples of 2D lattices. The first one is a hexagonal lattice. The second one is a regular Kagome lattice. The third one is a topological Kagome lattice.