EME 521 – MATHEMATICAL MODELING
COUPLED PROCESSES OF DEFORMATION, FLOW AND TRANSPORT

GROUP PRESENTATION RUBRIC

The only deliverable for the course will be a group presentation. This is to (i) encourage you to explore and to think critically and creatively about a particular solution method and (ii) to understand it sufficiently well that you can communicate and share your understanding with a student audience as a tutorial. The guidelines for this are as follows:

Participants will work either individually or preferentially in small groups to develop a tutorial presentation to communicate the principles of a prescribed numerical method of relevance to this class. These will be selected from the following *viz*:

1. SPH – Smoothed particle hydrodynamics
2. LBM – Lattice-Boltzmann Method
3. BEM – Boundary Element Methods
4. X-FEM – Extended Finite Element Method
5. DEM – Distinct Element Method
6. Level-Set Methods
7. Phase Field Methods
8. Lattice Methods
9. Peridynamics

See prior presentations on the course resources page: https://personal.ems.psu.edu/~fkd/courses/EGEE520/
And also access information on these various methods (i.e. Wikipedia, etc.).

Participants will select whether they wish to work alone or in a group, then select their preferred topic. The presentation should be for ~15 min for a single person and ~30-45 min for group presentations. Group presentations are preferred.

You should notify me (elsworth@psu.edu) of your group members and presentation topic by June 20th.

Presentations should be assembled, recorded then posted as a narrated video file before midnight on August 9th, Beijing Time.

Presentations should include:

1. **Introduction [10%]** Provide context to the method. How is it different from others we have discussed? In what situations does it perform best? Are there special features of note? Are there particular shortcomings?

2. **Historical Perspective [10%]** What are the origins of the method? When was it developed and by whom? Why was it developed? What significant evolution has it gone through?

3. **General Principles [20%]** Describe the physical basis of the method in as simple format as possible (e.g. our heuristic derivation of FEM for flow with Darcy's law).

4. **Governing Equations [20%]** Expand on the general principles and derive or define the governing equations. A physics-based rather than mathematics-based exposition will likely be preferred by your audience (*e.g.* our virtual work derivation for FEM for solid mechanics or isoparametric elements for FEM).

5. **Hand-Calculation Example [20%]** Complete a simple 1D or similar example that utilizes the general principles and governing equations and completes a simple calculation (*e.g.* the conductance/stiffness matrix for 1D simple or isoparametric elements for FEM).

6. **Numerical Example [10%]** Complete a simple numerical example if it is feasible to demonstrate the mothod (rather than the component matrices in #5 above). We have used hand calculations, EGEEfem, Matlab and Comsol in this mode.

7. **Example Applications [10%]** Chose some examples, maybe including animations – many of which are available online - to demonstrate the applicability of the method.