Alternative Grade Requirements for MET 422

In my early years of teaching MET 422, I used a grading scheme that awarded C to every student who could work eight core problems flawlessly. Each problem type had to be competed completely correct or no credit was accrued. Multiple attempts were allowed but the specifics of each core problem changed in subsequent attempts. In those days final grades allowed +/- increments and higher, C+, B-, B, B+, A-, and A, grades were awarded to students who choose to demonstrate proficiency in non-core problems. Each equivalent of one non-core problem raised the grade by one +/- increment. Partial credit was allowed in non-core problems but only the highest grade on a specific non-core problem type was recorded.

I am willing to implement some elements of this scheme this year as an ***alternative grading system***, because there are students who may need an alternative to pass MET 422. Implementation will not change the current rank-in-class method for those who do not elect the alternate system. Indeed, everyone will remain in the rank-in-class method, but everyone has the option to demonstrate competency to receive a C via the alternative system.

I am undecided about offering the non-core feature to improve a grade. I am also undecided as to the alternative system implementation details but suffice it to say that if you are concerned about passing MET 422 make certain that you can work all the core problems flawlessly. A way of assessing your achievement will be made available to you; however, it will probably NOT include multiple attempts - certainly not unlimited attempts. Also, all demonstration of competency must be completed by the end of Final Exam week.

The minimum expectations for an alternate grading scheme in MET 422 to receive a final grade of C requires the student demonstrate mastery of all the following so-called *core problems*.

1. Derive a V-distribution in laminar flow be it in rectilinear, cylindrical, or spherical coordinates
2. Calculate a drag force for a common, selected geometry using the correlations in Chpt 3
3. Use Ergun's Equation to calculate the P drop across a packed bed for an incompressible fluid
4. Determine the required superficial velocity needed to achieve a given void fraction in a fluidized bed
5. Use the Expanded Bernoulli Equation to size a pump.
6. Find the total heat loss through a composite wall and find each intermediate interfacial temperature be it in rectilinear or cylindrical coordinates
7. Find h and Q for natural and forced convection settings using the correlations in Chpt 8
8. Solve for net heat flux in radiation heat transfer enclosures using an electrical analog and Kirchhoff Loops.

Non-core topics of possible additional credit towards a B or A are listed below. Partial credit is typically allowed but only the highest score in each problem category counts.

a. Derive a T-distribution within a solid be it in rectilinear, cylindrical, or spherical coordinates
b. Convert the Equations of Change to dimensionless form to determine dimensionless groups
c. Use the Buckingham Pi theory to determine dimensionless groups
d. Use Ergun's Equation to calculate P drops across a packed bed for a compressible fluid
e. Solve for the time-to-drain a ladle using the Expanded Bernoulli Equation
f. Use the Product Solution Method in Chapter 9 to find T(t, 3D's) for $1/8^{th}$- , ¼-, and semi-infinite and fully bounded solids.
g. Solve 1D USS HC and 2D SS HC problems with fixed T, zero and fixed flux, and convection BC's.
h. Determine radiation heat loss through zero-flux opening using the radiation Transfer Factor
i. Determined the mass transfer coefficient and calculate a surface dissolution rate be it for a plate, cylinder, or sphere.

This scheme does not change the traditional rank-in-class method of grading. It simply offers a second path for students who are in jeopardy of failing the class. Demonstrating mastery of the core problems will assure a passing grade. Again, D's are rarely assigned as a final grade.

There is no definite way to determine a final grade before the final exam; however, it would behoove every student to master the core topics. Students in no danger of failing are already likely competent in the core problem set. Therefore, if you are not competent in the core set, it would be wise to become competent so you can be assured of receiving a passing grade. The final exam composition is undecided at this time but will certainly include topics from both the core and non-core categories above.

The above list of competencies is intended to include all competencies delivered in MET 422 and compare closely with the Course Outcomes in the MET 422 Syllabus listed below.

COURSE OUTCOMES

- Students are expected to write Newton's Law, Fourier's Law, and Fick's Law and describe the analogies among them.
- Students will perform shell balances for momentum, heat, and mass transfer and obtain the differential equation describing the velocity, temperature, and concentration gradient.
- Students are expected to understand the difference between Newtonian and non-Newtonian flows.
- Students will be able to reduce the Equations of Continuity and Change for rectangular, cylindrical, and spherical coordinates to the terms applicable for a specified condition.
- Students will be able to derive from linear, steady-state flow distributions in laminar flow volumetric and average flow equations.
- Students will be able solve ladle draining and incompressible pumping problems involving all five terms in the Overall Energy Balance.
- Students provided a set of independent variables upon which a dependent variable depends will reduce the set to a dimensionless set using Buckingham Pi Theory.
- Students will be able to design packed and fluidized beds for given system for uniform particles given their density, shape, and size and the fluid's rheolgical properties.
- Students must determine the modes of heat transfer (conduction, convection, and radiation) and describe the governing equations for each mode.
- Students are expected to calculate the heat transfer rate for convective heat transfer given heat transfer correlation and its pertinent parameters.
- Students will determine heat loss from radiative systems using Kirchhoff Loop electric analog solution method.
- Students will solve 1D USS and 2D SS heat transfer and mass transfer problems using spreadsheets.
- Students will determine the concentration dependency of diffusivity.
- Students will be able to derive differential equations describing diffusion through a stagnant gas film, a moving gas stream, and a falling liquid film.
- Students will describe the mathematical similarities between turbulent convective heat transfer and turbulent diffusion including the correspondence between dimensionless groups.