Homework #5 (group) – Tuesday, March 20 by 4:00 pm

5290 exercises (individual) – Tuesday, March 20 by 4:00 pm

extra credit (individual) – Thursday, March 22 by 4:00 pm

Homework Submission

- For this assignment, the 4200-portion of the homework is to be worked as a group assignment and submitted as a group in class or by dropping off at my office (room 831). If you use EES for this assignment, then print a copy of the code and solution and include with the homework.
- MEEM 5290 problems are always to be worked and submitted individually.
- Bonus problems are always to be worked and submitted individually.
- **At the end of each problem, rank your confidence in the answer from 1 to 5; 5 being very confident and 1 being 'a guess'.**
- PLEASE include the course number (MEEM4200, MEEM5290) in the subject line of any email correspondence.

Homework #5 - due Tuesday, March 20 by 4:00 pm

1. Weston 3.7
2. Weston 3.9
3. Weston 3.19
4. Weston 3.30
5. A fuel oil burned in a steam generator has a composition which may be represented by $C_{14}H_{30}$. A dry-basis flue-gas analysis shows the following volumetric composition:

   CO_2 11.226%,
   O_2 4.145%,
   CO 0.863%, and
   N_2 83.766%.

   Write the complete combustion equation for 1 mol of fuel and calculate:

   (a) the air-to-fuel ratio by mass,
   (b) the excess air in percent, and
   (c) the mass of water vapor in the flue gases per unit mass of fuel.

   Homework #5 – 5290 only

6. Weston 3.33
7. A chemically correct mixture of gaseous methane and air at 77 °F is admitted into a nozzle where it is completely combusted. Calculate the nozzle exit velocity in feet per second if the exit temperature is 2000 K.

extra credit (individual) – Thursday, March 22 by 4:00 pm

8. Purified syngas derived from coal ($3CO + H_2 + 3.76N_2$) is used to generate power in an open Brayton cycle. 100 000 standard cubic feet per minute this syngas enters a gas turbine combustion chamber at 440°F, where it burns adiabatically in 150% theoretical air. The exhaust products drive a gas turbine and leaves at 1160°F. Calculate the thermal power input to the turbine in MW_{th}.