Assignment No. 3
CEE 546: Air Quality Control
Due Wednesday March 08, 2017, during lecture

Solve the following problems and show how you were able to arrive at the solutions. Describe and justify the assumptions that were made to solve the problems, if all of the information is not provided in the problem statement. You are welcome to work in groups but your final solutions and interpretation of your results are to be prepared individually. Provide a brief interpretation (not reiterating results) consisting of 3-5 sentences of your results for problem no. 2 (5 pt. per problem).

1) (70 pt) Use the manuscript that you selected to discuss with your colleagues in CEE546.
   a. (30 pt) Provide a critical but supportive review of the manuscript and then describe how the manuscript relates to CEE 546. Maximum length of your review is 2 pages. Please type it and use 1.5 line spacing, 1” margins, and 11 point font. I will determine the scores for your summary. Provide only the review on March 08, 2017.
   b. (40 pt) Plan to give a 10 minute presentation (plus 5 minutes of questions and discussion) of the article using PowerPoint format after Spring Break. The scores for the presentations will be determined by all members of the class using the form described at: http://aqes.cee.illinois.edu/classes/CEE546/Project/presentation%20critique.pdf. PowerPoint slides will be provided no less than 2 hr before the presentation and the score for the presentation will be provided after the presentations are given.

2) (55 pt) Assume that you have decided to warm your indoor environment by operating a space heater that burns propane with air instead of using an electrical heater due to the decreasing price of propane compared to electricity. The exhaust from the heater is emitted directly into your home. The heater operates adiabatically at an equivalence ratio ($\phi$) of 0.90. You are concerned about possible NO emissions into your home because of your recent discussions about air quality. Assume you can preheat your combustion air and fuel to 400 K and 350 K, respectively, with no NOx in the combustion air. Total pressure is 101 kPa.
   a. (30 pt) Plot the NO concentration (ppm$_v$) in the gas stream that is emitted from the combustor at actual conditions for gas residence times ranging from 0.001 to 5 sec. Plot NO concentration (ppm$_v$) on the ordinate and residence time (sec) on the abscissa using linear scales. Make a second plot of NO concentration (ppm$_v$) on the ordinate and residence time (sec) on the abscissa using log scales.
   b. (20 pt) Compare your results with the National Ambient Air Quality Standard (NAAQS) for NO$_x$ and the AP-42 emission factor for industrial boilers, that burn natural gas (2,240 kg NO$_2$/10$^6$ m$^3$ of natural gas burned, see Table 15.2 in lecture notes).