Thermodynamics 1 DEN107

Problem Set 05 (due week 7, Mon 2012Feb20)

Insert the SEMS homework coverpage as 1st page; this question sheet with original signatures as the 2nd page; then attach your solutions in subsequent pages. Your solutions are due before 3.30 pm on Monday February 20th 2012 in the cabinet outside the SEMS office.

By signing below I certify that I will not obtain the teaching assistant's (TA) signature for students other than myself, and that I will not forge the TA's signature on this page. Violators will be prosecuted in accordance to QMUL procedures. Please fill in the five items below.

Student Surname:	
Student Forenames:	
Student ID (9 digits):	
Student signature:	
TA confirms tutorial attendance (signature):	

50% of the assignment grade will be deducted if the TA signature above is missing

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IMPORTANT NOTE TO ALL DEN107 STUDENTS: As I have said from the beginning of this module, understanding this material will require your patience for 2 months (about 8 weeks). We are now in week 6, therefore 2 weeks early in understanding the concepts. Please refrain from writing inflammatory comments in the forum. I will answer all your questions in class, because everyone needs to hear the answers to the questions you are posing. I encourage you to talk to 2nd, 3rd, 4th year engineering students and solicit their opinions. This is because I have great confidence that they will tell you the module will become clear in weeks 8-12 of the module, but not before.

Thank you for your patience so far. Please continue to work with the module. Come to the lectures, PSC, and study from the notes. The schedule of the module indicates the chapters you should be consulting from the textbook, but the textbook is only a backup to the notes.

Problem 1

Do problem 4-01 from the notes for T^{H}=910 K and T^{C}=360 K, and instead of DE^{H}=800 MJ do the problem for rates of energy, rates of entropy, and rate of work (power), assuming that rate of energy supplied by the hot reservoir is $D\dot{E}^{H}$ =900 kW.

Problem 2

Do problem 4-02 from the notes for T^{H}=291 K.

Problem 3

Do problem 4-06 from the notes for T^{C}=266 K.

Problem 4

Study the solution of problem 4-07 from the notes. In the next 2-3 weeks we will see how to evaluate terms like $D\dot{E}^{hw}$ and $D\dot{\Omega}^{hw}$ for systems like the hot water system in this problem from properties like energy, entropy and temperature of steam, from steam tables. No output in your solution required, just spend 30 minutes considering

the implications of the solution to this problem for the relative cost of electricity and hot water in your home. Consider what should be the ratio of prices per energy unit (e.g. kJ or kW.hr) of electricity to hot water? What is the price per kW.hr of electricity in your last electricity bill? What is the price per kW.hr of heating in your last gas-utility bill? If the gas company is not providing the price of gas per energy unit of consumed gas, consider calling them and asking for information that enables you to calculate the price of gas per energy unit in the gas. (I openly accuse the gas utility companies for hiding facts and for obfuscating the issue).

Problem 5

Do problem 5-03 from the notes for 0.2 kg of eggs and 0.5 kJ imparted by the paddle stirrer. Draw the thermodynamic states of the egg mixture on an energy-entropy diagram: (a) initial state; 9b) non equilibrium state immediately after the work is put in the mixture reversibly and adiabatically by the motor; (c) equilibrium state at same energy level as in (b); and (d) final state of the mixture in the bowl 8 hours later. Where did the entropy that left the system from (c) to (d) go?

Problem 6

Do problem 5-04 from the notes assuming the room is heated from 18 °C to 20 °C. The block diagram is shown in figure 6.3 (next page). Draw the energy and entropy arrows going out of machinery X and rewrite the negative signs in the equations accordingly.