ME 476 2nd Law Analysis **Spring 2008**

HW1: Exergy Choices and Engineering Ethics

Due: Upload to METU-Online by 17.00, 25 Feb. 2008

I. Background: Decisions made by engineers directly impact not only their career, company and clients, but also society and the environment. Often a decision that is best for their company and client is not best for society and the environment, and the engineer faces an ethical dilemma as to how they should act. Employers are increasingly demanding that new engineering graduates have the ability to effectively deal with these ethical dilemmas, and therefore ethics is becoming an increasingly important part of an engineering education.

I am part of a small group of instructors that has been asked to determine how well we (METU Mechanical Engineering Department) teach engineering ethics and ethics in general. Our initial task is ***not*** to teach engineering ethics or suggest changes to our program. Rather our first task is simply to understand how much our students know about ethics. After we understand what is happening right now, we will then suggest changes to our program if required. Your grade for this assignment is not based on whether you know "engineering ethics" or answer "correctly." Rather it is based on you whether I think you put reasonable thought and effort into this assignment.

2nd Law Analysis is the study of *exergy* (the ability to do work) and *exergy* transformations, losses, and destruction. While exergy is very important to modern society, it also creates many problems. The demand for electricity (an efficient and economical form of exergy transfer) in Turkey is growing at approximately 8% per year, which is one of the fastest growth rates in the world. Under a worst-case-scenario, the demand for electricity in Turkey will exceed supply by 2012. Based on current economics, in addition to investing in wind, solar, and hydroelectric, the Turkish government feels that it is critical to also invest in new coal, nuclear, and/or natural gas power plants. Engineers will play a critical role in determining which exergy sources Turkey uses in the future.

II. Assignment: Before meeting with your group, think about the following 4 items. Then meet with your group and share your ideas. Try to work toward an agreement within your group on each of these items:

1. What are the benefits to society of having more electricity? For example, compare living in a poor society without access to electricity to living in a rich society with reliable access to affordable electricity. In what ways does electricity improve the quality of life in the rich society? *Be specific*.
2. Brain storm on different criteria with which different exergy sources can be compared. Examples are given in the table below.
3. Make a table summarizing the different criteria similar to the following table. For each line, based on your current knowledge, rank each exergy option with 1 being the best option and 3 being the worst option. The line for capital costs (construction costs) is shown as an example, where a nuclear power plant is the most expensive to build (3) and natural gas power plants are the cheapest (1). *Important: I am very interested in your group agreeing on each ranking. I am not interested in the ranking being correct.*

	Coal	Nuclear	Natural Gas
Capital Cost (***Example***)	***2***	***3***	***1***
Fuel Cost			
Exergy Security*			
Pollution			
Global Warming			
…			
…			

**Exergy security refers to depending on other countries for your energy needs.*

4. Consider the following two options. For simplicity, assume that other options are not available (e.g., renewable exergy, increasing exergy efficiency, etc).

    a. Increase electricity supply by investing in new coal, nuclear and/or natural gas power plants. This will of course result in any problems you noted above.

    b. Not invest in new coal, nuclear and/or natural gas power plants. Therefore, due to Turkey's increasing population electricity consumption per person must decrease, possibly through blackouts and/or decreased standards of living.

    As an engineer, which option do you think is best? If you choose a), would you suggest investing in coal, nuclear or natural gas? ***Discuss why.***

III. Deliverables (*i.e., to be turned in)*: Using a word process (e.g., Word), write a 1-2 page short memo summarizing what you consider the most important ideas from your group's discussion using the following format:

To:	Yrd. Doç. Dr. D. Baker
From:	List each of your group member's name and student number
Date:	Today's Date
Subject:	Exergy Choices and Engineering Ethics (*Important: Use Exergy and not Energy here)*

This is the body of the memo. Here you should summarize the most important ideas from your discussions. You must specifically include the following items in your memo:

1. *Benefits of electricity to society.*
2. *Table ranking coal, nuclear and natural gas for different criteria (like the table above).*
3. *For item II.4 above, which option do you think is best? Discuss how your group arrived at this conclusion. If you work for a company that builds coal, nuclear and/or gas power plants, do you think your answer is **ethical** for your company? for Turkey? for the environment? Discuss. This is the most important part of the assignment.*

Important: Describing how/why you arrived at your answer to part 3 is much more important than the actual answer; e.g., one group may decide to invest in nuclear energy while another group may decide not to invest in any coal, nuclear, or natural energy, and both can receive full credit *if they describe how/why they reached this conclusion.* A group that fails to describe how/why they reached their conclusion will not receive full credit.

The entire document should be about 1-2 pages depending on font size, margins spacing, etc. A short insightful memo summarizing your thoughts is much better than a long poorly organized memo. Upload this email to METU-Online (online.metu.edu.tr). I should receive 1 email per group. Do not email these to me or give me a print out. I will post all of these files on the class webpage so that we can share all of our ideas.

IV. Grading: This is worth 1 normal HW and will be nominally graded as follows:

4/10	• You complete the assignment by yourself (-6 pts for not discussing with other people). • Your group emailed their file to me instead of uploading it to METU-Online.
7/15	• You work in a group that was not assigned to you (I want you to discuss your ideas with people who are not necessarily your friends) or is less than 4 people. • You turned in the assignment late.
10/10	You completed the assignment with your assigned group of 4 or more people and convinced me that you put a lot of thought into the assignment.

I will deduct points if you do not follow the specified format (i.e., not a Word or PDF file, not in the requested memo format, etc) or obviously put little effort into the assignment. Note that this memo format requested is a professional form of communication. Does your work look professional?