Group Project, Part 1 – **Due Friday, Nov. 2 by 5:00pm – 5 points of 60 total**

General Instructions

This project will be done in groups of three, and so the first thing that we need to do is form those teams. You have 2 options to do this. Either option MUST be completed by the due date and time, or else you will not receive the 5 points and I'll still assign you a team.

OPTION 1: You and two classmates form your own team. ONE of your team members should send an email to me (kdcadwel@syr.edu) with the other two students cc'd in the email, stating your intention to be a team. You should also include web links to **4** different professional societies that chemical engineers often join in the USA. For 1 of these societies, locate their code of ethics and copy the text of it into the email as well.

OPTION 2: You leave formation of your team to me. YOU should send an email to me (kdcadwel@syr.edu) stating your intention that I choose your teammates (how exciting to meet new people!). You should also include web links to **2** different professional societies that chemical engineers often join in the USA. For 1 of these societies, locate their code of ethics and copy the text of it into the email as well.

I will send an email acknowledgement to all emails within 1 business day. If you don't get a reply from me – I didn't get your email. If you complete neither option by 5:00pm on Friday, November 2, you'll lose 5 points and I'll put you in a group of my choosing.

Additional Info:

- No, you may not form a pair and ask me to find your third. It's all three in together or I pick all three.
- No, you may not do this project solo. Engineers almost never work solo. If you're not a team-player, you're going to have to learn to be one.
- Absolutely **DO NOT** sign up yourself and your two classmates as a team without all agreeing upon the team first. I will not look kindly upon such an action.
- The full project will include analyzing an ethics case study, describing typical process units in layman's terms, working a complex problem, making a "poster" of that problem, and then participating in the poster presentations during the final lecture day **(Thursday, Dec. 6)**. The poster presentations will not be in front of the entire class, but rather in front of another team, so it should be low-stress.
- You will evaluate the quantity and quality of participation and work of your teammates and yourself as part of the project. This will affect each individual's project grade (that is, you may not get the same grade as your teammates). Should your contribution fall short, I reserve the right to lower an individual's overall score by up to two letter grades.
- I'm fairly sure we can all come up with that first professional society. To find others, consider fields closely related to chemical engineering, traditional specializations of chemical engineers, and likely collaborations. Also check out the student organization list on the LCS-PRIDE website.

General Instructions

Your team has been sent an ethical case study as an email attachment. This part of the project is an analysis of that case study and should follow the following steps:

1. Individually read through the case study once, so that you're familiar with the situation.

2. Individually watch either video listed below by Prof. Kristyn Masters of the University of Wisconsin-Madison Biomedical Engineering Department. There's no need to watch both (although it might be useful if between all three team members both got watched – they're similar but do differ in the detail). The controls on the video player don't show for some reason on all browsers, but if you keep clicking on the lower left-hand corner of the video panel you should eventually hit the "play" button.

   Research Ethics Video: **education.mrsec.wisc.edu/Edetc/research/career06.html**
   Design Ethics Video: **education.mrsec.wisc.edu/Edetc/research/designconsid01.html**

3. Individually read through the D.I.S.O.R.D.E.R. method (attached to email) for approaching an ethical problem. This is the framework your team will use to analyze the problem.

4. **As a team,** get together and proceed to use the D.I.S.O.R.D.E.R. method through the D.ecide step. As part of this step you should clearly defend your position by referring to earlier steps in the analysis. I expect that by doing this together you will come up with a more interesting and complete analysis of the problem. Have someone take notes for what you discuss for each step to make writing the report easier. *Note: You won't be able to do the final two steps (E.R.) since you won't know the effects of your choice in these hypothetical situations.*

The Report

Your team will write a report based upon the D.I.S.O.R.D.E.R. analysis of your case study. I expect that it will be around 1 page, 2 pages max in length, single-spaced. You do not need to write in full paragraph form, although you should write complete and grammatical sentences. If you wish to bullet each step, that is fine. The basic style/grammar guideline is that it should be easy for me to read and to understand your analysis.

On the O.ptions step, I expect that you will brainstorm **at least** 3 different options (more is better). They may be variations of one another, but none of these situations is black and white – I want **at least** 3 versions of gray.

Again, as part of the D.ecide step you should **clearly defend** your position by referring to earlier steps in the analysis.

Finally, be sure to clearly indicate which case study you are analyzing.

Turning in the Report

You will not hand in a paper copy of your report. Instead, you should save your report in **pdf format** and **upload it to TurnItIn** in Blackboard *(CEN 231 → Assignments → Team Project → Upload Part 2 HERE)*. TurnItIn is a plagiarism-checking program that compares your writing to online sources as well as other students' work here at SU and across the country.

Grading Rubric

You are not being graded upon the decision made in your analysis. There is no “right” or “wrong” answer (other than those which are clearly illegal). This is an exercise in using a systematic method to approach tough problems that don’t present with an obviously good choice. You are being graded in how well you perform this method and your ability to defend and communicate your decision.

Ethical Analysis (6 pts. possible)		
6 - 5	**4 - 3**	**2 - 0**
Each step in the analysis is fully considered. It’s clear that the problem is well understood. Options and their possible outcomes are fully described. Ideas presented in the analysis are clear and exhibit creativity in thought. Decision is thoroughly defended.	Analysis is mostly complete, but some steps are not completely fleshed out. Sufficient options are listed but their potential consequences are not fully described. Ideas are vague and do not exhibit ample creativity. A decision is made but only partly defended.	Analysis is incomplete, with only a superficial examination of the problem. Insufficient options are supplied, or their outcomes are unexplored. Only basic ideas are considered. A decision is made but defense is cursory or nonexistent.
Grammar & Organization (4 pts. possible)		
4	**3 - 2**	**1 - 0**
No significant grammatical errors. Analysis is clearly organized and generally easy to read and understand.	Contains minor grammatical errors. Some portions of analysis are confusing due to poor organization or writing style.	Contains major grammatical errors or is generally difficult to read and/or understand

Organizing our thoughts through "D.I.S.O.R.D.E.R."

- Dilemma – *define it.*
- Information – *acquire it.*
- Stakeholders – *identify them.*
- Options – *explore them.*
- Rights/Rules/Results – *consider them.*
- Decision – *make one.*
- Effects – *evaluate them.*
- Review & Reconsider

From Lisa Newton's essay "Doing Good and Avoiding Evil" posted at: http://www.rit.edu/~692awww/resources/manuals/dgae1p6.html

Using the DISORDER Ethical Problem-Solving Framework

The D.I.S.O.R.D.E.R. slide provides a mnemonic device to help you think through ethical dilemmas, which are typically complex and ambiguous, in a structured way. Below is further explanation of the D.I.S.O.R.D.E.R. acronym:

1. ***Define the dilemma.***
   Oftentimes this is the most challenging step. What is the ethical problem that you are facing? What conflicts make the situation difficult to deal with?

2. ***Acquire any necessary information.***
   Second, we have to conduct empirical inquiries as appropriate, discover the facts, and get as much information as we can. What questions do you need to ask in order to acquire more information? What sources do you need to go to in order to obtain this information?

3. ***Identify the stakeholders.***
   Who is (or might be) affected by this dilemma or the decisions you make regarding this problem? Part of the work of sorting out the stakeholders is to make sure that all whose interests are really affected are taken into account. Another part of the work is to see that non-stakeholders who seek to attach themselves to a decision are excluded from influencing the decision.

4. ***Explore the options and the reasons to select one over another.***
   What alternatives are really open to you, and what are the probable outcomes of each? What, in this situation, is it possible, and reasonable, for you to do? And what will be the likely results of each of those choices? Which of the outcomes on the list are totally unacceptable? They should be eliminated, and the rest left for further consideration at a later stage. The emphasis here should be on identifying the reasons why one option is better (more ethically justifiable) than another.

5. ***What are the rules and rights involved in this dilemma?***
   Review the rights of the various participants, as legally protected rights, in our system, trump, or override, considerations of right outcome. We must also respect moral (usually legally enforced) rules that are held to be valid regardless of the consequences.

6. ***Make a decision.***
   Although ethical dilemmas are challenging, it is important not to get trapped in an endless loop of discussion. At some point, a decision must be made. Remember that your point of view will be most defensible if you've considered possible alternatives and can explain why they are less acceptable.

7. ***Evaluate the effects of the decision***
   You need to follow up, to find out what results your decision has had.

8. ***Review the situation and reconsider the decision***
   The trouble with ethical dilemmas, as opposed to ethics as a discipline, is that the real solution is empirical, day to day, trial and error. So, finally, you have to review the situation and reconsider the decision, with an eye toward revision. Nothing, in human affairs, is ever set in stone. We make our decisions, usually, for today, knowing that the decision will probably produce a new situation, with its own new dilemmas, and we will have to take on the whole problem again.

This case study was adapted from a collection of engineering ethics case studies edited by Michael S. Pritchard of the Center for the Study of Ethics in Society, Western Michigan University, 1992, funded by the National Science Foundation Grant No. DIR-8820837

CASE – THE DEADLINE

Ruskin Manufacturing has guaranteed LMNO Products that it will deliver the complete order of a dozen small machines by the 10th of the month, a Friday. LMNO had already extended its deadline once. This time, it insists, the date must be met. LMNO needs these machines as they're behind on filling their own orders. Tim Vinson, the new head of quality control at Ruskin, had been confident the deadline would be met. But on the 8th he learns that a new component of the machines is in short supply and the necessary inventory cannot be acquired before the extended deadline. He thinks of several options:

1) Approve breaking up and regrinding the remaining supply of the old component that was being replaced. This could probably be accomplished in time, but it would be close.

2) Approve using the old component in place of the new one. The machine would still function well, and it would be unlikely that LMNO would ever detect the difference. Although LMNO would not be getting exactly what it ordered, the machine would still meet minimal safety and durability standards.

Tim decides to consult with Mara Davidson, the chief design engineer for this machine. Mara says, "I don't have a good answer for you. There's no time to come up with a completely satisfactory alternative. You could regrind, but given the time frame you might get a lot of impurities, or you might not – it's iffy. You could just use the old components, but we redesigned those for a reason. About 5% of the old components fail after the first few months of operation, necessitating shut-down for part replacement. I don't think either is a good choice, and I don't want this decision hanging over *my* head. I did the design work, this is your problem. Maybe you should call Arnold."

Arnold Peterson is Vice President of Product Engineering. Years ago, like Tim Vinson, Arnold served as head of quality control. Tim is somewhat uneasy about calling Arnold for two reasons. First, Tim feels responsible for not seeing the problem earlier and he is reluctant to admit failure to the Vice President of Product Engineering. Second, he wonders if Arnold would really want to be bothered by something like this. He might simply tell Tim that the problem is his to solve -- somehow. Still, Tim is not comfortable with the idea of just resolving the problem by himself.

Hesitant to take matters in his own hands, Tim calls Arnold. Irritated, Arnold says, "You're supposed to take care of these things yourself, Tim. I don't want to hear about stuff like this." Arnold continued, "Look, I know that you haven't been at this very long. But LMNO doesn't need or want to hear about all the little details and potential issues. They're already annoyed that we're late with this order. They don't even know that we've redesigned this part, and they already have a couple of our machines with the old component that they've never complained about. Just get the order over there somehow."

What should Tim do?

General Instructions

In Mass & Energy Balances and other courses, your professors often talk about various process units without ever clearly explaining what each one is. That can be very confusing. I would like for your team to investigate 3 process units and provide an "undergraduate level" description of each one. The point here isn't to give me a bunch of equations that currently don't mean much to you, but rather for you to actually understand what each of these units accomplishes on a conceptual basis.

Team α's units are: heat exchanger, nozzle, rotameter

The Process Unit Descriptions

Your team will write a description of each unit that is approximately ½ - 1 page in length. This need not be in paragraph format – bullet points are fine. You may also include photographs or drawings. **You should begin a new page for each description.**

In the description you should clearly explain, at the level of one of your fellow students, the purpose of your particular unit. This description will be comprised of answers to some or all of the following questions:

- What does the unit generally do?
- What changes in the input(s) does the unit accomplish toward the output(s)?
- Could the unit be classified as a separation unit, a mixer, a reactor, a splitter, a combination, or none of those?
- In what kinds of processes or industries is the unit commonly used?
- Any interesting details?

A **minimum of two credible sources** is required for each unit, and should be listed as a footnote at the bottom of the page. I would suggest trying Perry's and the Visual Encyclopedia of Chemical Engineering Equipment (on LCS servers at G:\LCS\CEE, double click !Che_Encyclopedia.exe to start the program) to start. Other sources, including textbooks and other credible online sources, would also be good. Use that search page that Annie the Librarian set up for us in Blackboard! **All images must be cited directly below the image.**

Turning in the Process Unit Descriptions

You will not hand in a paper copy of your descriptions. Instead, you should save all of the descriptions into a single document, and then save the document in **pdf format** and **upload it to TurnItIn** in Blackboard *(CEN 231 → Assignments → Team Project → Upload Part 3 HERE)*.

Multiple teams have the same process units. I will award a bonus point to the team with the best description for each unit, and upload these descriptions to Blackboard so that students can get a better idea of the units they'll encounter in future courses.

Grading Rubric

Process Description (6 pts. possible)		
6 - 5	**4 - 3**	**2 - 0**
What each unit accomplishes is clearly described in terms that are appropriate for sophomore engineering students. Clear examples of unit use are provided. Descriptions are informative and interesting.	The gist of the workings of each unit is provided but without much interesting detail. The description level is not quite right (a little too technical, perhaps.	The purpose of one or more units is incompletely or unclearly described. The description level is inappropriate (too technical, most likely)
Grammar, Organization, References (4 pts. possible)		
4	**3 - 2**	**1 - 0**
No significant grammatical errors. Description is clearly organized and generally easy to read and understand. At least 2 credible sources for each unit. Figures properly cited.	Contains minor grammatical errors. Some portions of description are confusing due to poor organization or writing style. Some sources missing or figure sources not cited directly.	Contains major grammatical errors or is generally difficult to read and/or understand. Few or no sources cited.

General Instructions

Your team has been given a complex, multi-step mass and energy balance problem. You will solve this problem together and then together create a "poster" to show and explain how you did this. During the final lecture on Thursday, Dec. 6 you will each individually present your poster to your fellow students as well as visit other teams' posters to view their presentations. Finally, you will individually submit a survey rating the participation of you and your team members. Remember that you may receive a lower grade than your teammates if I determine that you did not fulfill a sufficient role in the project.

Part 4: The Solution (15 pts.) – due to my mailbox by 5:00pm on Dec. 6

A complete problem solution requires (1) a fully-labeled process flow diagram of the initial problem statement, including appropriate units for each known or unknown indicated; (2) detailed solution procedure worked out step-by-step; (3) properly citing any references used in the problem solution such as tables in Felder & Rousseau, data from CRC or Perry's, etc.; (4) final answers to all questions posed; (5) a summary statement of the key strategies utilized to solve the problem, e.g. "we broke the full problem into 3 parts, solving the first part with a general mass balance…" **You will submit a neatly handwritten or typed solution directly to me, including a print-out of any spreadsheet or equation solver programs used.** Please include guiding sentences such as "Now that we found the product mass flow rate, we can use this information to calculate the volumetric flow rate…" You very much want me to be able to clearly follow your solution.

I HIGHLY recommend that you finish the solution by Tuesday, December 4 AT THE ABSOLUTE LATEST in order to have plenty of time to prepare your poster presentation.

Part 5: The "Poster" (9 pts.) – due on Dec. 6 in class & posted by 5:00pm

You will make and print a slide (Powerpoint) presentation that includes all of the slides listed below. You should use the MathType function (not Equation Editor) in Powerpoint for professional representation of all equations. I recommend that your slides have a white background with dark type. Black/gray/white slides are just fine, I know not everyone has access to a color printer and you will not be docked for this. A 32-point font or close to it should be large enough to be visible to poster reviewers.

Required Slides – 16 slides maximum (suggested # per section)

- Original problem statement (1-2 slides)
- Fully labeled process flow diagram (1 slide)
- Detailed solution procedure (3-11 slides)
- Final answers (1-2 slide)
- Summary of solution strategy (1 slide)
- List of references, names of team members (1 slide)

Finally, **one team member must submit a pdf-format copy of your slides to Blackboard's TurnItIn** by 5:00pm on Thursday, Dec. 6, as this is what I will grade. I will acknowledge successful file uploads with an email.

Part 6: The Presentation (6 pts.) – to be done in class on Dec. 6

The final lecture period on Thursday, December 6 will be dedicated to presenting your posters. I will provide posterboards and easels, tacks, and refreshments. There is no need to dress up, these will be informal presentations. Each team member should expect to present the problem once on their own, although it is fine for another team member to offer limited assistance if they get “stuck”. Details on the logistics of who will review each poster will be provided that day. Reviewers will fill out a feedback sheet for each poster they visit, to be turned in to me. Reviewers are encouraged to ask questions about the problem and its solution. *Full points will be awarded for attending the poster session, presenting the poster once each, and turning in feedback sheets.*

Part 7: The Teamwork Survey (5 pts.) – due in class on Dec. 6

Each team member will evaluate the participation of individuals in the group, including themselves. I may choose to lower the grade of any team members who are not pulling their weight in the project. That’s not to say that each member needs to do 33.33% of the work, merely that all should contribute significantly. *Full points will be awarded for completing this survey, but I may choose to lower the grade of poorly-contributing team members by up to 2 letter grades on the <u>full project</u>.*

Grading Rubrics

Part 4: Solution (15 pts. possible)		
12-15	**6-11**	**0-5**
Solution is correct or perhaps contains minor error. Procedure is easy to follow and reasoning is well described. All required parts of the written solution are complete.	Solution contains several minor errors. One or two of required parts (not including the solution procedure itself) are incomplete. Solution procedure is fairly clear.	Solution procedure is incomplete or involves major errors. Solution procedure is difficult to follow. Missing parts of required written solution.
Part 5: Poster (9 pts. possible) – GRADED FROM ELECTRONIC COPY		
8-9	**6-7**	**0-5**
All required slides included. Slides have visual appeal, large font, use MathType for equations. The slides are not too crowded and organization of slides make solution procedure easy to follow.	One or two slides missing. Slides lack visual appeal but are otherwise easy to read. Slides may be overcrowded or unusually ordered, making some parts of the solution procedure unclear.	Numerous required slides are absent. Slides are difficult to read due to font size, overcrowding, or lack of organization. Solution procedure is not presented in such a manner as to be understood.

Individual Survey of Team Participation
(to be submitted to Dr. Cadwell in class on Dec. 6)

For rows 1-2, please rate yourself and your teammates on the scale of

1 – poor   2 – needs improvement   3 – sufficient   4 – above average   5 – excellent

For row 3, estimate the percentage of effort expended by you and your teammates for the entire project combined (ethics, process units, problem solution, poster preparation). The total must add to 100%. If you and your teammates split different parts between yourselves, that is just fine.

Write in your name and your team members' names!	You:	Teammate 1:	Teammate 2:
1. Team skills of member: easy to work with, well-organized, encouraged contributions from all members, made efforts to meet in timely manner with group. (1-5)			
2. Quality of work (1-5)			
3. Total effort on entire team project (%)			

Double-check that all of your percentages in row 3 add to 100%!

Comments: Optional – If you'd like to make further explanation of your team's workings, please include that here.

PROBLEM – TOLUENE SYNTHESIS

Benzene reacts with methyl chloride to form toluene and hydrochloric acid. Methyl chloride and 300.% excess benzene are fed to a reactor. The product of the reaction is sent to a unit that chills and separates the unreacted methyl chloride and hydrochloric acid from the benzene and toluene.

Both the methyl chloride and hydrochloric acid leave the separator as gases. A mixture of benzene/toluene leaves the separator at 50.°C and 0.30 atm, under which conditions it is partially vaporized. If the ratio of moles in the vapor portion of benzene/toluene mixture to the moles in the liquid portion is 0.14, find:

a) the percent conversion of both methyl chloride and benzene;
b) the composition and molar flow rates of both the liquid and vapor portions of the benzene/toluene mixture exiting the separator;
c) the heat transfer in the chiller, in kW.

Hints:

- *Draw a fully label the process flow diagram FIRST.*
- *You may find a DOF analysis to be helpful…or not. It's up to you.*
- *If there are reactions in your problem, write out the balanced chemical reactions.*
- *If there are gas streams in your problem, determine which are likely to behave as ideal gases and which are not.*
- *Decide if there is vapor-liquid equilibrium involved in your problem.*
- *Do mass balances first, then any energy balances if necessary.*
- *Clearly state any and all assumptions.*
- *WRITE COMPLETE UNITS THROUGHOUT THE SOLUTION. You will not regret it.*