

# LIST OF PROJECTS

- 1) You must choose 2 (two) projects from list A, 3 (three) projects from list B and 1 (one) from list C and rank all of them in one list by order of preference.

**Bioengineering and Biomedical option students:** Choose 2 (two) projects from lists A and D, 3 (three) from lists B and E and 1 (one) from lists C and F and rank all of them in one list by order of preference. *If you are pre-med or biotech option and you choose from list A, B or C, you need to clarify why and eventually discuss it with me.*

- 2) Instead of a project from lists C or F you can propose one of your own.
  - a. A good source for other projects is the Ulmann Encyclopedia of Chemical Technology (Library). Another source for more recent and exciting ideas is to browse Journals like Chemical Engineering Science or Industrial and Engineering Chemistry Research Journal (Engineering Library). It is full of new chemistries for processes, some with fundamental chemistry and others more on the process engineering side.
  - b. You can also go to <http://www.innocentive.com>, where several challenges are posted. These challenges, if solved, pay some good money. You are welcome to use any of them (Current open or already closed ones), as long as they will have my approval
  - c. Another site is <http://www.yet2.com/app/about/home>.

The instructor will determine the groups. Make sure you submit the list of choices and briefly (*briefly please*) explain how “hot” you are for each of your choices. **There is no guarantee you will get any of your choices, but at least your preferences will be known and hopefully taken into account.**

- **Not happy with any of the projects offered and cannot come up with one yourself? Come to my office.**
- **If you are going to Graduate School and want a different preparatory experience see me in my office.**

## SUGGESTIONS

You can ask not to be with somebody in your group, but you need to submit reasons. You can also ask to be in a group with somebody and you are free to beg, but the request may be denied. In the working environment you do not choose each other and that is the skill we want to make you practice in this class.

**However, do not get fooled by the idea that working with your friend is good, especially if you are good friends but have different attitudes towards work.** Friends may decide to have an attack of “senioritis”, be too much party animals, or have too many job interviews, or get bored with the project, or they are taking too many classes, etc., and you may end up stuck with having to do the work without telling the instructor what is going on out of loyalty.

## **LIST A**

- *New Technology for Gas separations*  
This project is to evaluate a new method to process natural gas. We are looking at removal of H<sub>2</sub>S, CO<sub>2</sub>, and separating higher MW hydrocarbons. It is a confidential project (a confidentiality agreement is required). And you may get a patent if it works!!
- *Zero Energy Homes*  
In this project, you will identify different possible means of designing homes that are energetically self-sufficient. You will make use of all energy sources and sinks available (solar, ground, wind, etc).
- *Measures to make Norman a Green City*  
In this project, you will identify all possible measures that the City of Norman can take to reduce the carbon footprint. You will evaluate each carbon emission reduction measure in terms of their cost ( \$/Ton CO<sub>2</sub> reduction).
- 
- *Biorefineries and Value added chemicals from biomass*  
Biorefinery is a complex of processes that is intended to produce a variety of products, from fuels to chemical commodities, including polymers. This project will propose a general structure of a biorefinery and select the best location in the US. Value added products from biomass will be investigated. This project started in 08.
- *Heat Exchanger Network Retrofit*  
In this project, we will use a recently developed technique as well as others to solve heat exchanger retrofit problems realistically.
- *Genetic Algorithms for Process Optimization*  
These genetic algorithms will be hooked to a simulator to perform optimization. We will also perform heat exchanger network retrofit using these algorithms.

## **LIST B**

- *Progressive crude distillation*  
This is a expired patent for crude fractionation that is now being commercialized by Technip. Several companies are excited by this concept that promises large energy savings. This project , a continuation of what was done in 08, will evaluate these claims.
- *Water Management (for pollution prevention)*  
Water is extensively used in plants for all kind of washing and scrubbing processes. Usually, fresh water is used and disposed of sending it to an end-of-pipe treatment facility. Water, however, can be diluted and reused and water treatment does not have to be end-of-pipe. Ultimately, in certain cases, plants can operate in a “zero-liquid-discharge” model.
- *New petroleum distillation technologies*  
This project is to evaluate a new crude distillation technology. It is a confidential project (a confidentiality agreement is required). And you may get a patent if it works!!
- *Design of LNG facilities*  
This project was attempted twice. We want to extend the design in several aspects. Should ethane and heavier hydrocarbons be recovered in origin and transported separately, or sent to destination and separated in the receiving facility.
- *Pipeline Leak Detection*  
This project is about implementing a methodology to detect leaks, their size and location in gas and oil pipelines on real time.

- Refinery Operations Planning  
In this project you will build a model for the planning of refinery operations, namely what crudes to buy and how to run the different units to meet a specific uncertain demand.
- Pipeline Network design  
Methods to design pipelines are based on fluid flow simulation under different conditions (Flow, temperature, pressure) and they are repeated for different diameters. The task in this project is to work on the design of pipeline networks under growing and uncertain gas demand at different demand locations. The intention is to be able to incorporate practical details, regulations and other detailed engineering issues to the design.
- Use of membranes in Gas conditioning  
Membrane networks can be used to remove undesirable components from natural gas (N<sub>2</sub>, CO<sub>2</sub>, H<sub>2</sub>S, etc) and also separate some more valuable hydrocarbons (C<sub>2</sub>, C<sub>3</sub>, etc) from methane. This project will provide a method for the design of these membrane networks.
- Planning models for the Energy Industry  
In this project, we intend to evaluate the use of different technologies to produce biofuels. We will not look at the chemistry. Rather, we will look at the whole supply chain, including crops, harvesting, transportation, storage, plants locations, product distribution, etc. We will look at how these compete

## LIST C

- Dewvaporation  
The dewvaporation process was recently developed in Arizona State University. In this process, air is humidified by a falling film of saline water. On the top of the tower, the wet air is heated by an external source and then flown downwards to help heating up the internal stream. Use this idea to separate Ethanol-water streams as they come out from fermentors. Compare it with regular distillation.
- Instrumentation positioning for fault detection  
Process faults are responsible for losses as well as for accidents. Detecting a process fault before it takes place is done by looking at measurements. In this project a technique to determine what to measure for maximum fault diagnosis performance will be developed.
- Dynamic Data Reconciliation  
Data reconciliation is a technique used to filter process data and determine the best estimate of the process variable as well as detecting/eliminating any bias that comes from instruments. The project requires good programming skills in Fortran, C, or equivalent.
- Desalination  
One of the most important challenges these days is the desalination of sea-water. In this project, you will compare economically all existing technologies.
- Durable and Regenerable Antimicrobial Textiles  
An intermolecular chlorine transfer reaction has been considered as a cause for improved durability and power of biocidal functions on cotton fabrics containing a mixture of amine, amide and imide halamine structures. This has been recently investigated. Your job is to design a treatment plant and provide a business plan for the use of this technology.
- Cheaper way to make sodium and store/deliver hydrogen  
A company in Salt Lake City is making sodium by reforming NaOH with methane, which produces Syngas and Na. In addition, they claim they can store the hydrogen as sodium hydrate for transportation. Your job is to determine this technology's potential.
- Optimal Groundwater remediation  
This project deals with groundwater remediation networks. The aim of this work is to obtain a minimum cost groundwater remediation network that allows treatment of

groundwater to required levels and, also, a contaminant rich solution that can be used for further processing.

- Safety/Maintenance Module for Process Plants  
In this project, you will build a scheduler for performing maintenance in process plants. You will use a predictor of safety failures to assess potential losses and you will use information of the frequency of failure of parts to determine the optimal economical maintenance policy.
- Acetic Acid Production using zeolites  
A new catalyst has been proposed to produce acetic acid at lower temperatures and with 100% selectivity. You need to compare this process' economics to existing ones. .
- Organically-coated super-paramagnetic magnetite (Fe<sub>3</sub>O<sub>4</sub>) nanoparticles  
In this project, you will determine costs and market for producing organically-coated super-paramagnetic magnetite (Fe<sub>3</sub>O<sub>4</sub>) nanoparticles for biological research purposes. First, you will need to consider who currently is selling these types of particles. Then you will consider two types of coatings: oleic acid coatings and carbohydrate sugar coatings (e.g. dextran). You will consider two possibilities, either producing the magnetite in house, or purchasing the magnetite and then modifying the magnetite. You should consider quality control in your process, i.e. how do you know whether your coating was successful (if it is not, then biological cells will die since uncoated magnetite is toxic).
- Anti-fouling ship paints  
Many anti-fouling ship paints are targeted or being considered for banning. Your job is to find new harmless (or as harmless as possible) products as substitutes. You need to decide on price and the capacity of the production plant and commercialization efforts associated to it. Uncertainty needs to be taken into account.
- Olefins from Soybeans  
A new catalytic method converts biodiesel made out of vegetable oil into leafy olefinic esters. Your job is to determine profitability and choices of end products.
- Micelle-Based Water Softeners  
A thermoreversible Ca and Ba ion binding system for softening water has been recently developed. Your job is to study this system's commercialization.
- Cat Litter  
Cat litter is made out of a combination of highly absorbent clays and other absorbents. Your job is to investigate new options for this product. Decide price and the capacity of the production plant as well commercialization efforts.
- Hydroquinone  
Chemists in Michigan discovered a new route to produce this chemical. Your job is to evaluate this technology and propose an investment plan.
- Carbon Dioxide Absorption with immobilized amines  
This is project is to evaluate a new CO<sub>2</sub> separation technology ideal to capture CO<sub>2</sub> from gaseous streams. Your job is to provide recommendations as to where and how this technology can be used.
- Enzymatic route to polyurethanes  
Chemists in England have proposed a new enzymatic route to produce polyurethane. Your job is to propose a business plan to commercialize the new technology.
- Ionic liquids to scrub CO<sub>2</sub> from gases.  
At the University of South Alabama, it was discovered that certain ionic liquids can capture CO<sub>2</sub> at room temperature and release it by simple heating. The only problem seems to be that the liquid is highly viscous. Your job is to find out the cost of producing the ionic liquid and operating a CO<sub>2</sub> removal facility. Your company wants to commercialize the

technology and does not know if it is worthwhile to build a prototype. Make recommendations.

- *Adipic Acid*  
Chemists in London discovered a new route to produce this chemical. Your job is to evaluate this technology and propose an investment plan.

## Pre-Med and Bioengineering

### LIST D

- *Protein Folding and Solubility Predictions*  
This project will explore several mathematically-based means for the prediction of the protein folding. A graduate student as well as some junior/sophomore students will help.
- *Drug Distribution Body Simulator*  
When drugs are consumed they are distributed throughout the body, processes in different organs and eventually reaching the desired place. They then bind, are metabolized and eventually removed from the body through the kidney. The job here is to describe mathematically how this happens.
- *Metabolic State Determination.*  
Metabolic Flux analysis (MFA) is a name coined for the determination of the rate of reactions in the various metabolic cycles in cells. In this project, you will work on a technique that will perform MFA based on redundant information (if any) and will apply this technique to the control of various fermentations.

### LIST E

- *Carbohydrate Vaccines.*  
Vaccines are usually made from weakened or killed pathogens or from immunogenic proteins, glycoproteins or polysaccharides obtained from microorganisms. But the glycoproteins and r polysaccharides can be difficult to isolate. Researchers have developed novel chemical and enzymatic techniques for constructing oligosaccharides easily. You will be provided with a few examples and your job will be to evaluate the production of these vaccines (you may also come up with your own choice) and determine commercialization efforts, including FDA approval.
- *Tiopeptide Antibiotic*  
Recently, a tiopeptide antibiotic has been synthesized in the laboratory. Your job is to evaluate the production cost of this antibiotic first and then model the FDA approval decision making process.
- *Therapeutic monoclonal antibodies*  
Therapeutic monoclonal antibodies have many uses. Their market is very diverse including targets like tumor-specific antigens, cytokines, membrane-bound and soluble receptors, as well as a large number of pathogens. Such diversity allows them to be used as treatment in a variety of diseases ranging from cardiovascular and autoimmune diseases to cancer. Therapeutic antibodies represent the second largest group of biotechnology drugs in clinical development, but if the preclinical trials are also included then it is the largest biotech group today. In 05, a group of students developed a cancer treatment based on monoclonal antibodies selectively delivering a chemotherapy drug directly to the tumor cells. Pick it from there or use some other ideas, like attaching carbon nanotubes, deliver them to the

cancer cells and later use near-infrared radiation (this has been recently attempted at Stanford and a similar research is being performed at OU).

- *Defeating Diarrhea with a new Chemical.*  
A new substance has been found. Can it be effectively commercialized?
- *Functional Polymers as Human Therapeutic Agents*  
Polymeric pharmaceuticals can be used to sequester lower molecular weight disease-causing species in the intestinal fluid like bile acids, phosphate, iron ions, toxins, viruses, bacteria, etc. Your job is to evaluate existing technology first and propose new polymers next. This will require you to understand the functional groups that can be used for a specific disease and reverse engineer this for other diseases by finding the right functional groups and proposing a new polymer.

## LIST F

- *Sugar Decked Polymers to detect Pathogens.*  
A Carbohydrate functionalized poly (*p*-phenylene ethynylene) is recognized by bacteria during infections. Inasmuch as a specific carbohydrate bound by particular bacteria is known, polymers can be constructed to detect them and unique fingerprints can be developed. Your job is to determine at least one and propose a commercialization effort. If FDA approval is needed you need to discuss this step in detail while considering commercialization.
- *Hepatitis C Protease Inhibitor.*  
Researchers in Canada have found an orally available small molecule that inhibits hepatitis C NS3 protease. Your job is to determine manufacturing and commercialization efforts (including the FDA approval process).
- *Tracking Diesel Exhaust Exposure*  
A method was developed to determine metabolites that result from exposure to Diesel exhaust. Your job is to determine the commercial viability of such a product.