

TECHNICAL ELECTIVES AND DESIGN PROJECT SELECTION

2010-11

Technical Electives

- Enrichment courses that you choose based on your interests and career goals
- Linked to research areas of department
- Groups of courses in polymers and process systems are good preparation for specific industries
- Some restrictions due to Canadian Engineering Accreditation Board (CEAB) requirements so that you don't have to take technical exams for PEng

Technical Electives

Program	Restricted Electives	Technical Elective List
ChE Level 4	12 units	9-10 units
ChE & Mgt Level 4 Level 5	3 units 9 units	3-4 units 3-4 units
ChE & Society Level 4 Level 5	6 units 9 units	3-4 units 3-4 units
ChE & Bioengineering Level 4 Level 5	12 units	6-7 units 3-4 units + 6 units bio- sciences/engineering

ChE APPROVED TECHNICAL ELECTIVES 2010-2011

LEVEL 3 COURSES

Course	Term	Course Description
Chem Eng 3BK3	1	Bioreaction Engineering
Chem Eng 3BM3	2	Bioseparations Engineering
Civ Eng 3U03	2	Physical, Chemical and Biological Processes
Eng Phys 3W04	3	Acquisition Analysis of Experimental Information
Matls 3M03	1	Mechanical Behaviour of Materials
Mech Eng 3C03	2	Manufacturing Engineering

ChE APPROVED TECHNICAL ELECTIVES 2010-2011

LEVEL 4 COURSES

Course	Term	Course Description
Chem Eng 4B03	1	Polymer Reaction Engineering
Chem Eng 4C03	2	Statistics for Engineers
Chem Eng 4E03	1	Digital Computer Process Control
Chem Eng 4G03	2	Optimization in Chemical Engineering
Chem Eng 4K03	1	Reactor Design for Heterogenous Systems
Chem Eng 4M03	1	Separations
Chem Eng 4T03	2	Applications of Chemical Engineering in Medicine
Chem Eng 4X03	1	Polymer Processing
Chem Eng 4Y04	3	Senior Independent Project
Chem Eng 4Z03	2	Interfacial Engineering

ChE APPROVED TECHNICAL ELECTIVES 2010-2011

Elec Eng 4CL4	2	Control System Design
Eng 4U03	2	Unit Operations & Processes in Environmental Engineering
Matls 4I03	2	Sustainable Materials Processing <i>Offered in alternate years.</i>
Matls 4P03	1	Properties of Polymeric Materials <i>Offered in alternate years.</i>
Mech Eng 4H03	2	Mechatronics

Technical Streams Option

- Students may choose to follow a stream of recommended technical elective courses.
 - Process systems engineering (PSE) stream
 - Polymer materials and manufacturing (PMM) stream

Process Systems Engineering (PSE)

- Process Systems Engineering (PSE) provides knowledge and skills that enable engineers to analyze integrated processes using mathematical methods and computer tools. PSE analysis is based on engineering fundamentals and seeks to design and operate systems that achieve desired steady-state and dynamic behavior, including safety, consistent product quality and high profit.
- Required Courses: ChE 4E03, ChE 4G03, ChE 4C03, ChE 4L02 (PSE laboratories completed), ChE 4W04 (with an approved PSE project). Other courses may be substituted with permission of the Department Chair.
- Recommended technical electives outside ChE: Elect.Eng. 4CL4, Mech 4H03, Eng.Phys. 3W04
- Students who complete the required courses and the technical electives, within the overall annual credit requirements, will be eligible to have a transcript notation denoting the completion of the elective stream.

Polymer Materials and Manufacturing (PMM)

- Polymer Materials and Manufacturing (PMM) provides knowledge and skills to enable engineers to address manufacturing problems and processes. The recommended courses recognized that manufacturing engineering is an interdisciplinary team-based problem solving activity and so courses from Materials Science and Engineering and Mechanical Engineering supplement and enrich the existing Chemical Engineering curriculum.
- Required courses: ChE 3Q03, ChE 4B03, ChE 4C03, ChE 4L02 (PMM laboratories completed), ChE 4X03, ChE 4W04 (with approved PMM project). Other courses may be substituted with permission of the Department Chair.
- Recommended technical electives courses: Mech.Eng. 3C03, Matls. 3M03, Matls 4P03
- Students who complete the required courses and the technical electives, within the overall annual credit requirements, will be eligible to have a transcript notation denoting the completion of the elective stream.

ChE & BIO APPROVED BIOSCIENCES/BIOENGINEERING ELECTIVES 2010-2011

Course	Term	Course Description
*Biochem 3H03	2	Clinical Biochemistry
Biochem 3N03	2	Nutrition and Metabolism
Biochem 4E03	1	Recombinant DNA Technology and Gene Expression
*Biochem 4H03	1	Biotechnology and Drug Discovery
*Biochem 4N03	2	Molecular Membrane Biology
Biochem 4Q03	1	Biochemical Pharmacology
Biochem 4Y03	2	Genomes and Evolution
Elec Eng 4BC3	1	Modelling of Biological Systems
Elec Eng 4BD4	2	Biomedical Instrumentation
Elec Eng 4BE4	2	Medical Robotics
Med Phys 4T03	1	Clinical Applications of Physics in Medicine

*Especially Recommended

Design and Research

- **Chem Eng 4W04**

- Prerequisite: Registration in Chem Eng 4N04, Registration in the final level of any Chemical Engineering program.
- Information Sessions will be scheduled in September. There will be 3 projects available:
 - Environmental Design Project: (Eng 4U03 recommended) – required for ChE & Bio
 - Polymer Design Project
 - Process Systems Project

- **Chem Eng 4Y04 Undergraduate Research Project**

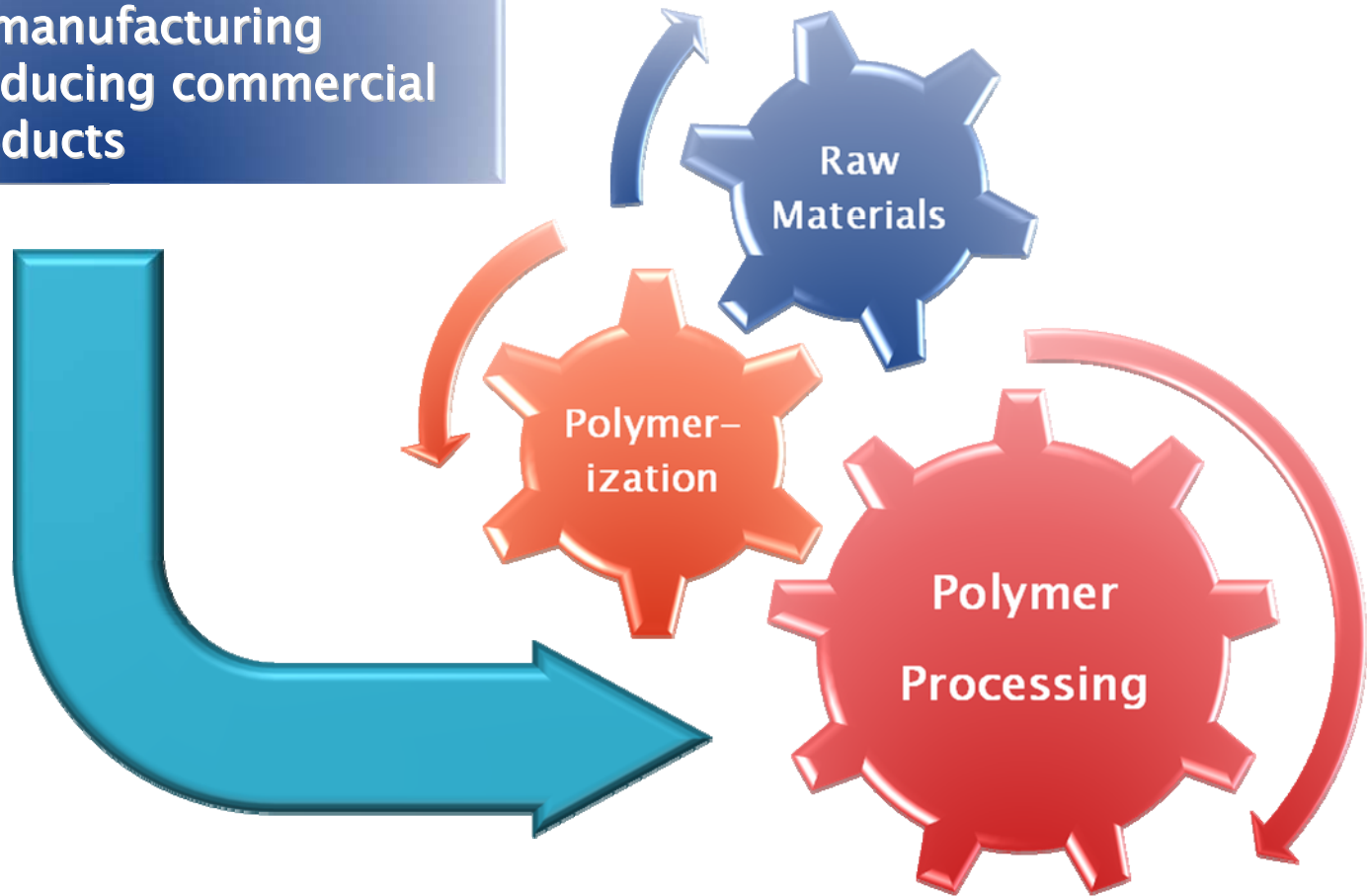
- Requires a CA of 9.5 or permission of the Chair

See detailed course
information at

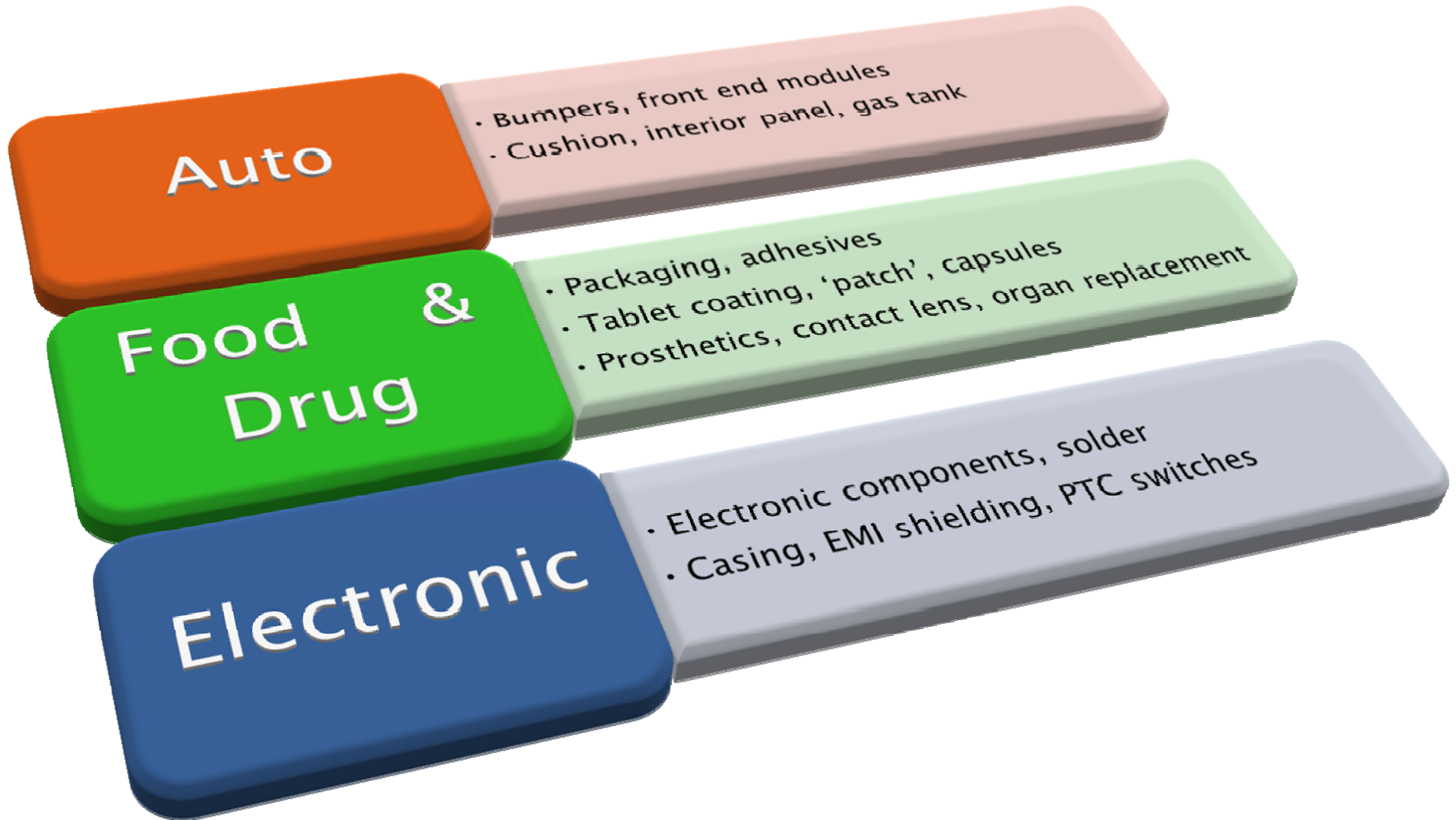
<http://www.chemeng.mcmaster.ca/undergraduate>

ChE 4X03 Polymer Processing

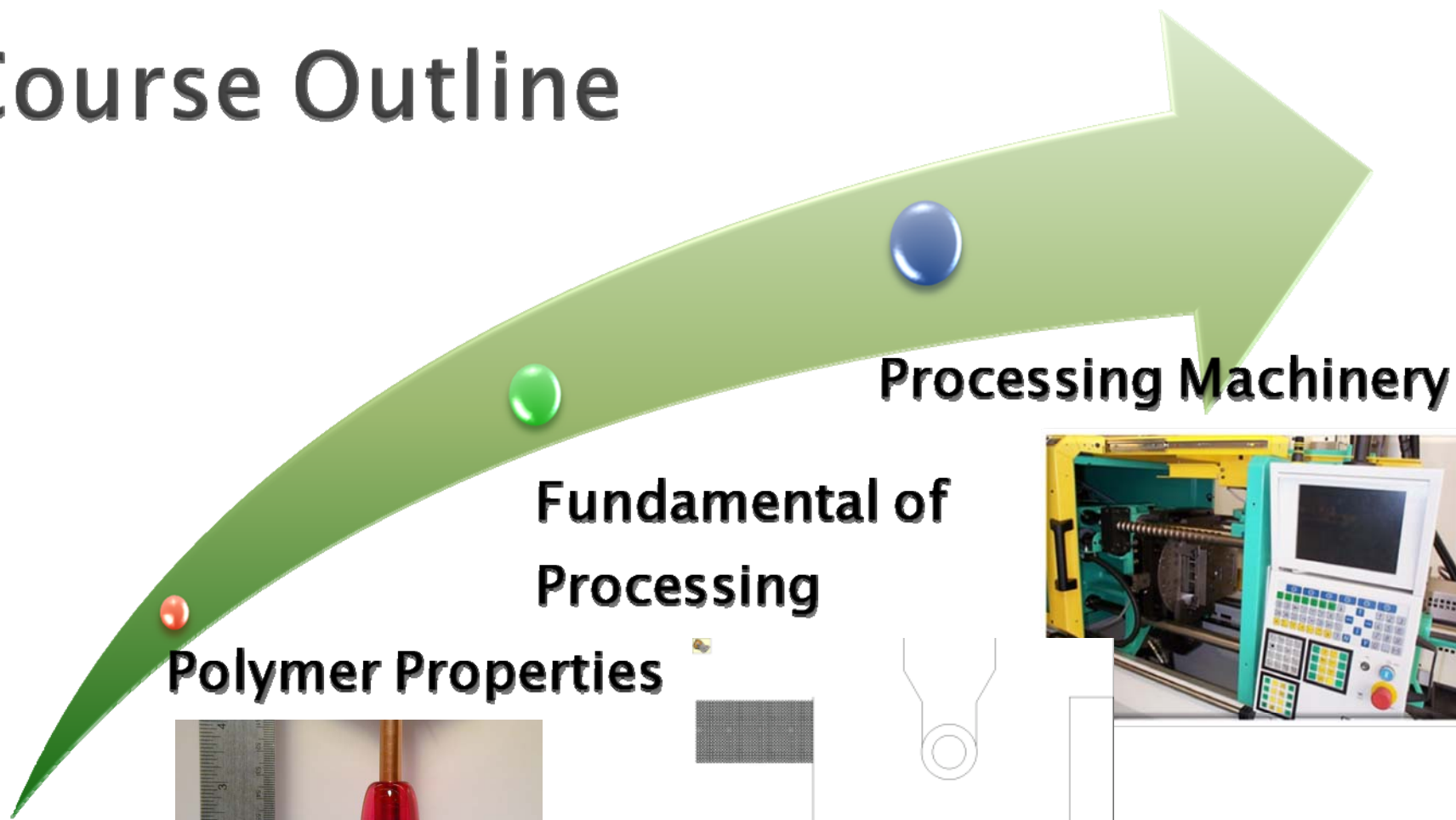
This course introduces students to the final manufacturing stage to producing commercial polymer products



Examples by Industry



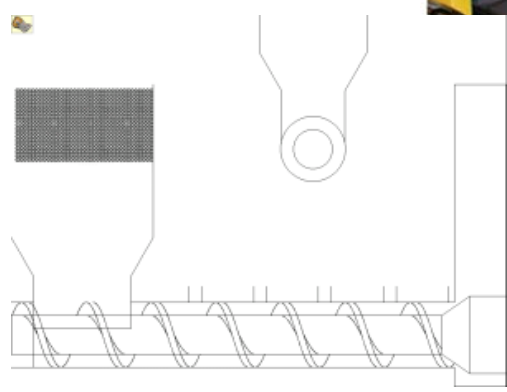
Course Outline



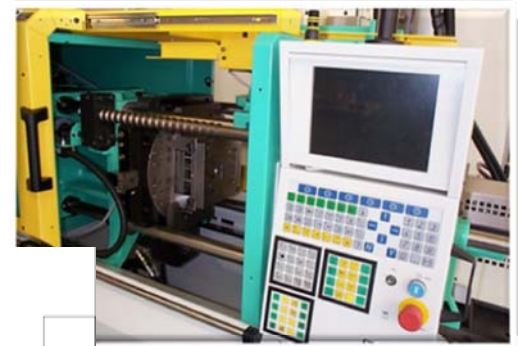
Polymer Properties



Fundamental of Processing



Processing Machinery



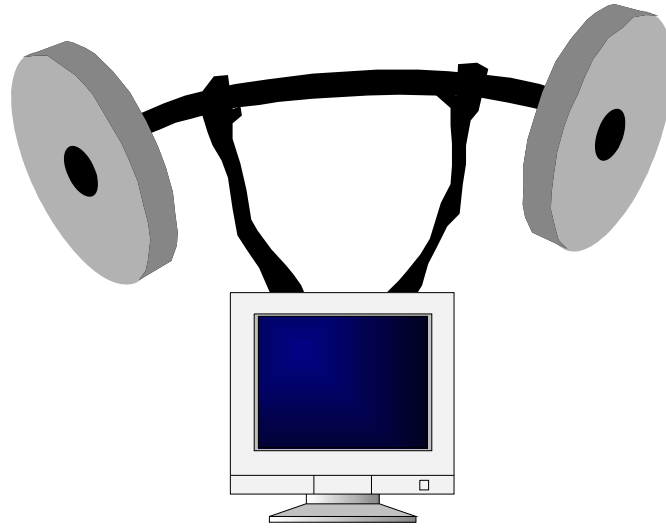
ChE 4Y04 Project Proposal

- Bulk Modification of Starch
 - Creation of RS4 Resistant Starch for Food Processing
 - Special Task – keep it in granule form.



PROCESS SYSTEMS ENGINEERING

Applying The Power Of Computing To Chemical Engineering



Process Systems Engineering (PSE) involves the application of **mathematical methods and computer tools** to the **analysis and design** of integrated processes systems. PSE analysis is based on engineering fundamentals and seeks to design and operate systems that achieve desired steady-state and dynamic behaviors, including safety, consistent product quality and high profit.

PROCESS SYSTEMS ENGINEERING

Applying The Power Of Computing To Chemical Engineering

Suite of courses that integrate PSE Skills with Chemical Engineering (Bio + Commerce + Society) technology and opportunities

Required Courses for PSE designation on your transcript

- 4E03 – Digital Process Control
- 4L02 – Select labs that are related to process control
- 4G03 – Optimization
- 4C03 – Applied statistics
- 4W04 – Select project that is related to process systems engineering

You can also take any elective without completing the entire stream

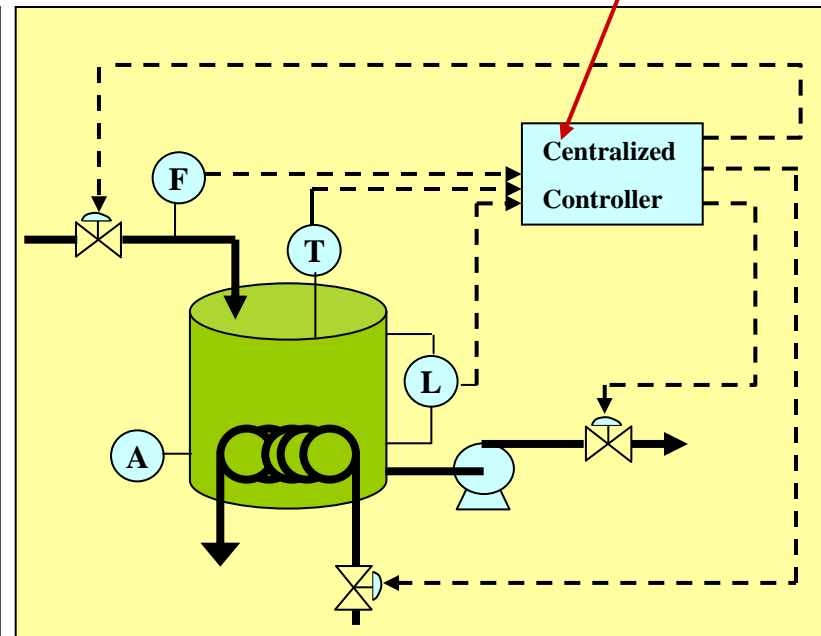
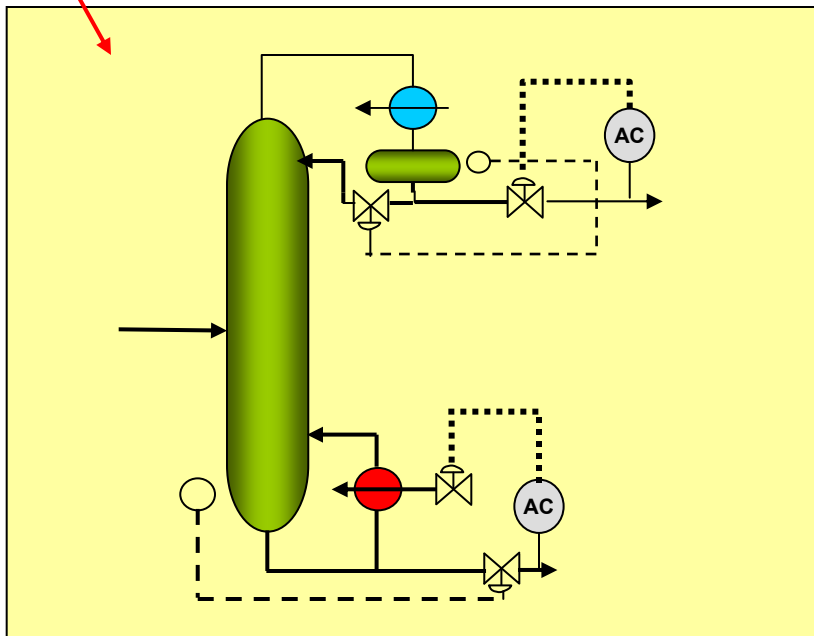


Related Electives (if you want to “bulk up”)

- Mechanical engineering 4H03 – Mechatronics (good recent feedback from students)
- Electrical Engineering 4CL4 – Control system design

4E03 Digital Process Control

- Process control implemented via **digital computation**
- Industrial processes are complex - **Multiple PID controllers**
- Controllers use models explicitly - **Model Predictive Control**

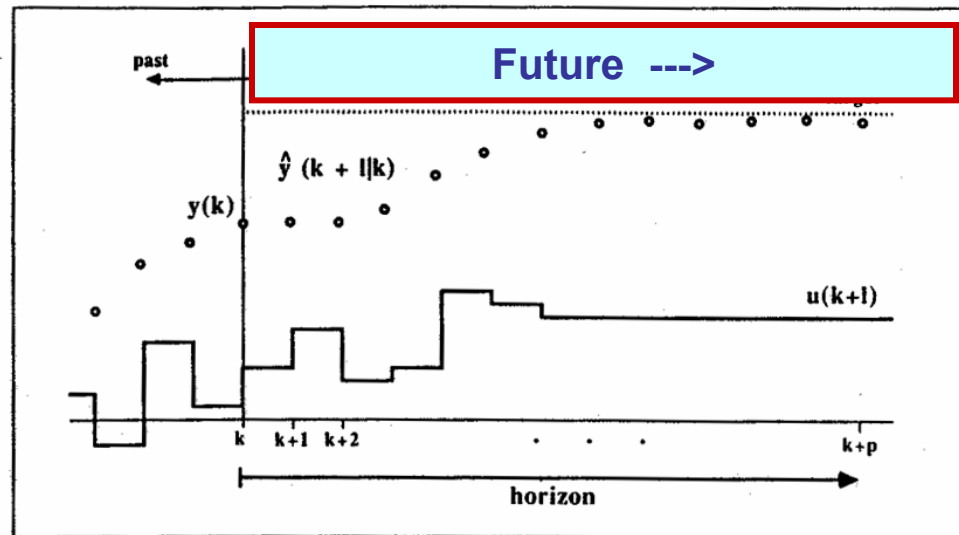


4E03 Digital Process Control



Meet with industrial engineer who implements advanced controls

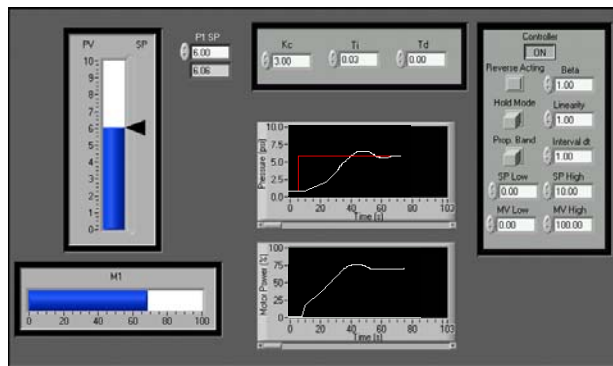
Model predictive control finds the best trajectory back to the set point(s)



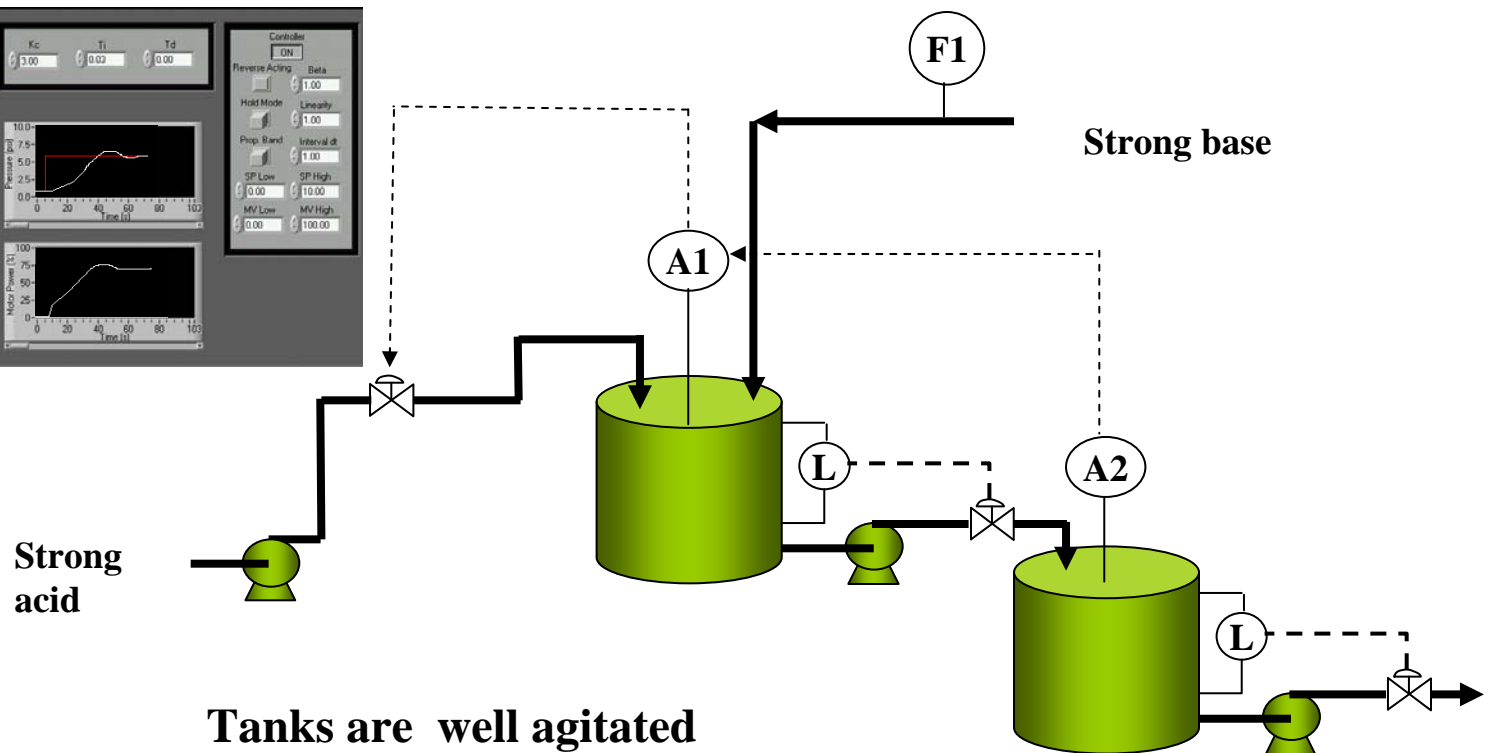
MATLAB, mostly menu-driven

4L02 Control Laboratories

This design is giving poor performance. The pH of the effluent stream has large variability. What should we do?

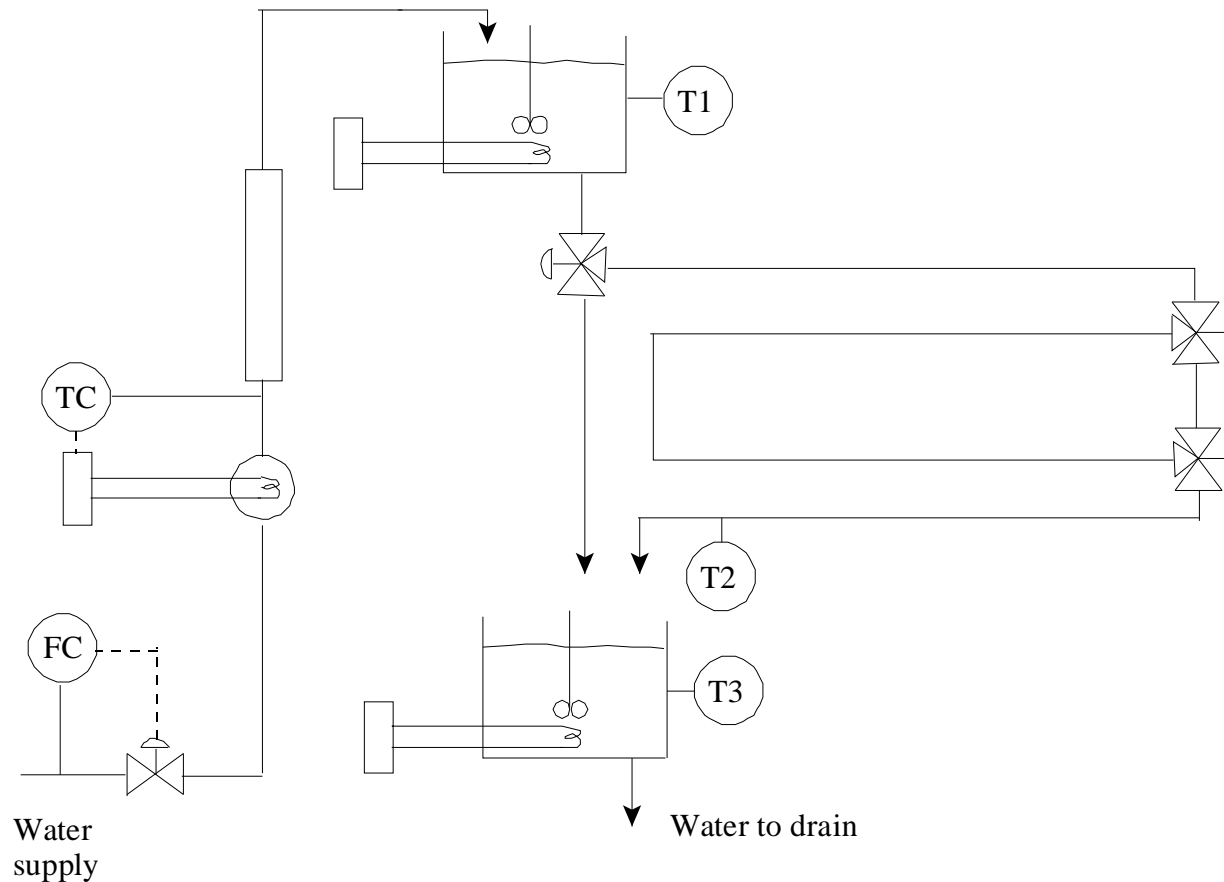


LabView
Software

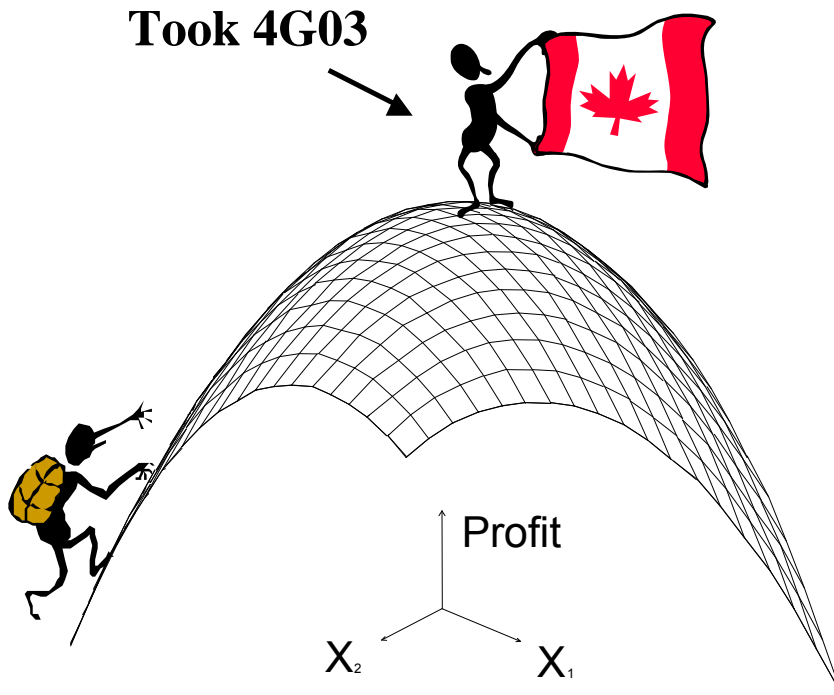


4L02 Control Laboratories

Opportunity to experience long dead time,
try cascade or feedforward



4G03 OPTIMIZATION



You know how to design and operate lots of stuff.

Now, let's do it the best way - the **optimum way!**

Software used is **Excel and GAMS.**

Everyone is Optimizing. Don't be left out!

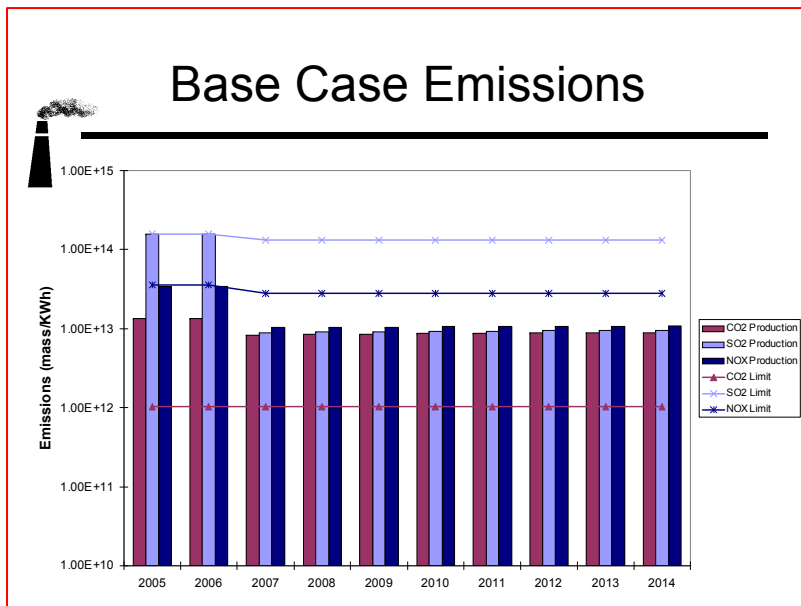
<u>Mother Nature</u>	<u>Engineering</u>	<u>Business</u>	<u>Environmental</u>
Min (Free Energy)	Max (Yield)	Max Profit	Min (Green House Gas)
Reaction Equilibrium (P,T)	Equipment design and operation	Reducing inventory	Produce electricity for Hamilton

Widely applied in

- Eng. Sciences
- Plant operations
- **Business**
- **Public policy**

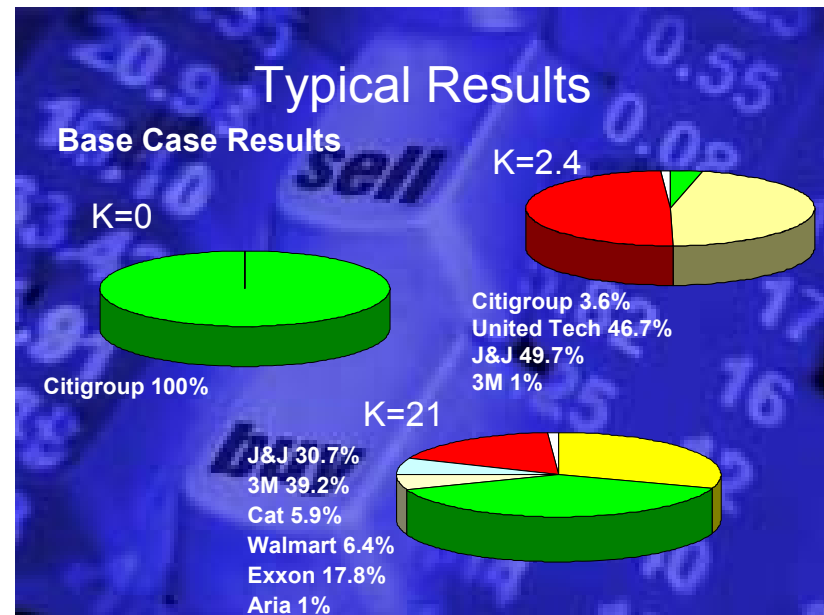
4G03 OPTIMIZAION

Some typical student-defined projects



Optimize the future power generation in Ontario

Tradeoff **Cost and pollution**

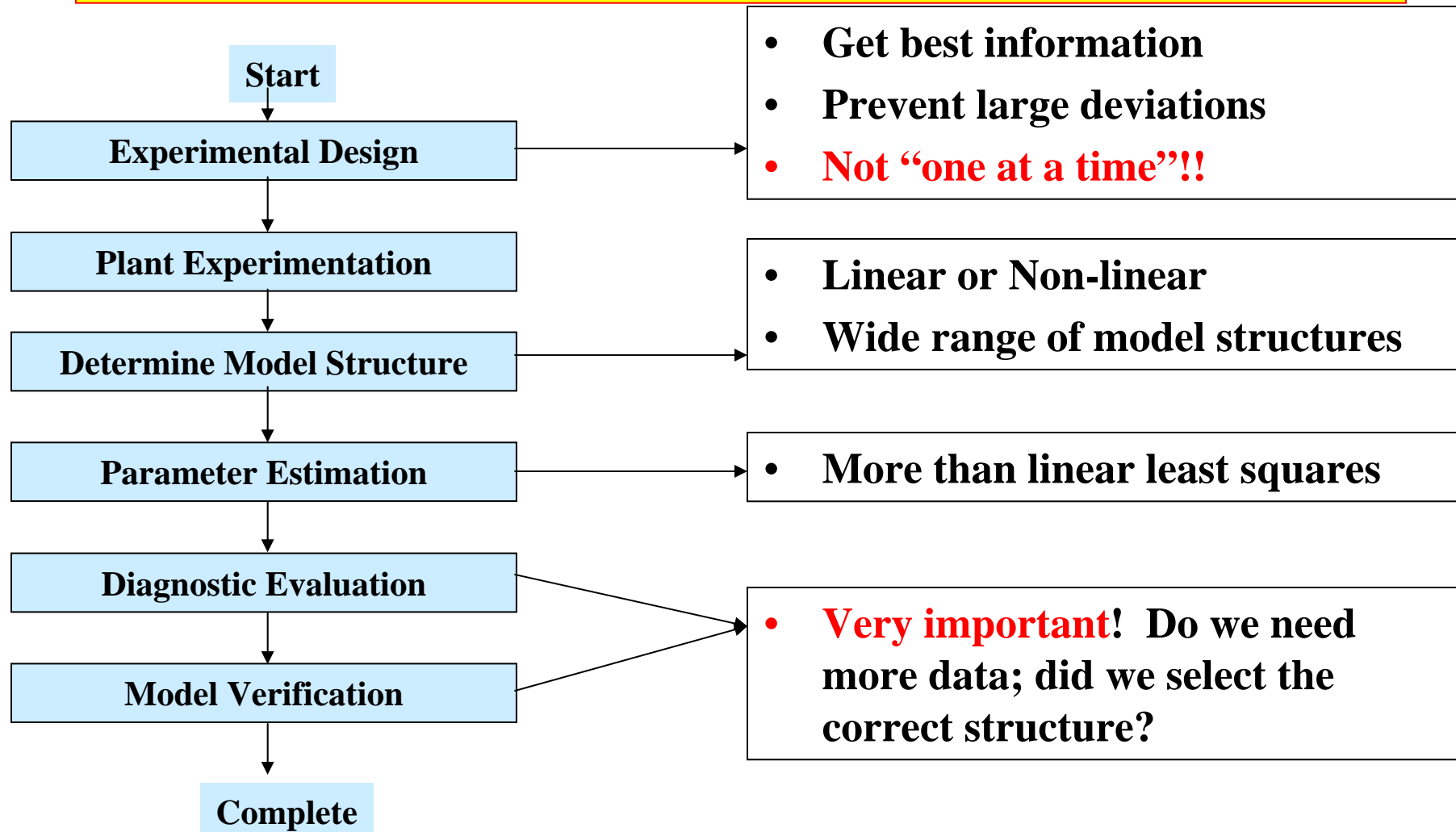


Optimize the portfolio investments

Tradeoff **Profit and risk**

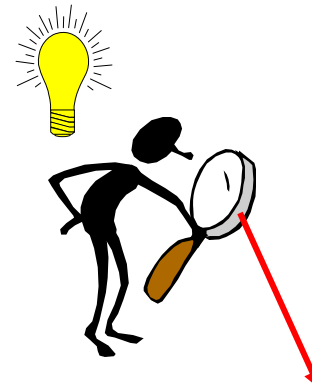
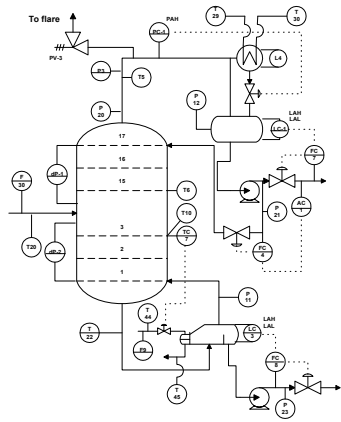
4C03 Applied Statistics

Model Building The Right Way!



4C03 Applied Statistics

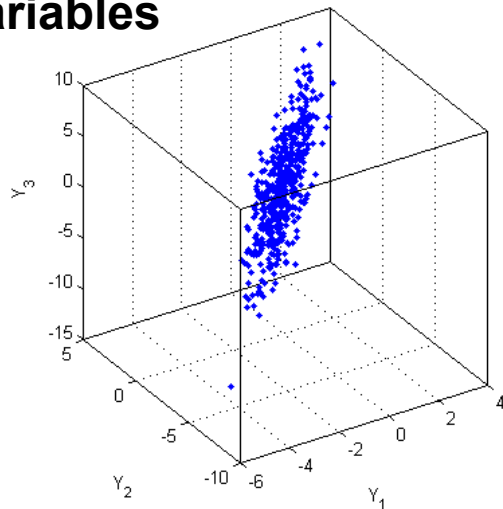
Some many measurements, how to diagnose!



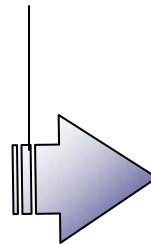
Diagnose here!

- Outside ellipse?
- Off plain?

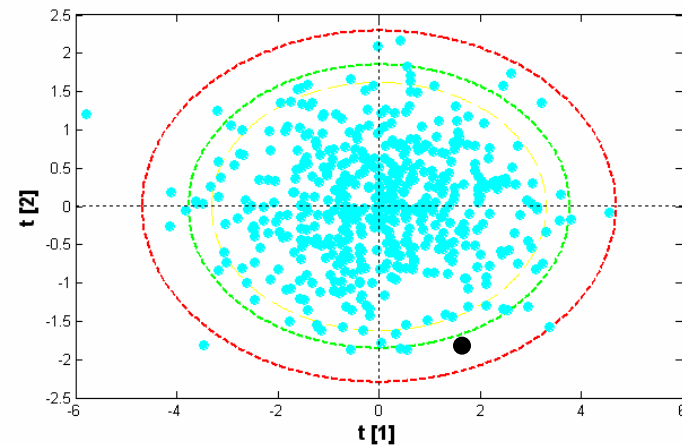
All measured Variables



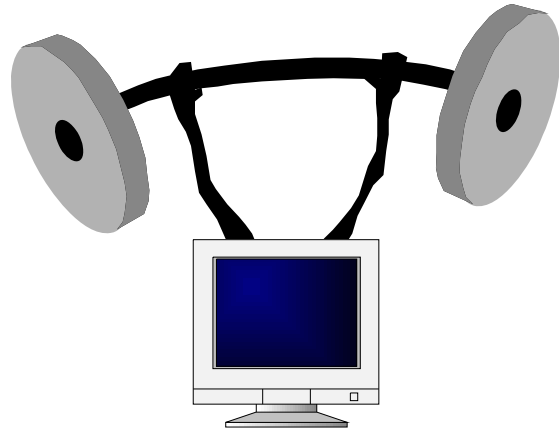
Multivariate Statistics



Latent variable space



PROCESS SYSTEMS ENGINEERING



- **Applicable to wide array of industries and careers**
- **Reinforces engineering skills & broadens applications**
- **Helps in the job market**
- **Opportunities for graduate studies (if you become excited)**