

May 2011

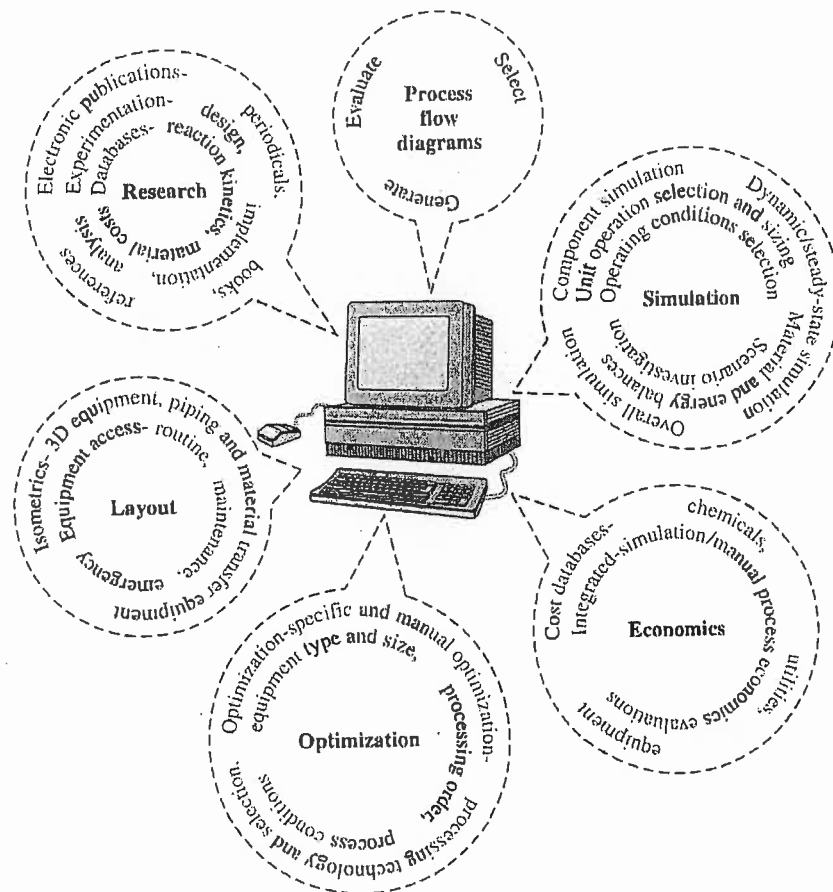
04-Chem-A5 Chemical Plant Design and Economics

3 Hours Duration

Notes:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper a clear statement of the assumptions made.
2. Any non-communicating calculator is allowed. This is an OPEN BOOK exam.
3. The questions are of equal value. The candidate will answer any five of the seven questions. Only five questions that you answer will be marked.
4. Most questions require an answer in essay format. Clarity and organization of the answer are important

1) The use of software in process design (20 marks)



The above diagram illustrates the various aspects of process design where software has become indispensable. Give a brief description of where these various types of software would be used and what are the expectations to be derived from their uses. Where in the design process would they usually be used?

Although very sophisticated software has become readily available and is generally quite easy to use there are several potential risks in using this software. Discuss some of these.

2. PROCESS DESIGN Why would we do one? (20 marks)

Why would a major corporation be interested in carrying out a process design? Although the potential cost of a design varies from the back of the envelope “quick and dirty” to a detailed process design ready to be handed on to a contractor or internal construction capability it still represents an investment in manpower. There are different levels of risk and reward in several options. Discuss these.

3. Green Chemistry/Green Engineering (20 marks)

According to the uninformed media Green Chemistry and Green Engineering are something new. This not the case, competent process designers have been aware of Health Safety and Environmental issues for quite a long time. As a process design specialist with the responsibility for a process design what issues must you be cognizant of. Take for example the design of a large unit that consists of feed preparation a high-pressure reactor where hydrogen is a major feed stream and subsequent separation and purification. What issues in such a design could be considered “green” ?

As an option consider the case where you are designing a CO₂ sequestration unit that removes CO₂ from flue gas of a coal burning electricity unit, compresses it and then pipelines the High pressure CO₂ many miles to an injection site where it is to be pumped underground into an oil bearing deposit (Enhanced Recovery/sequestration).

4. Capital Cost Estimation (20 marks)

The attached process flow sheet is for a MTBE(Methyl Tertiary Butyl Ether) Process Prepare a table illustrating how an equipment factored estimate would be prepared for this unit. What is the expected accuracy of this type of estimate and at what points during a project would it normally be prepared? There can obviously be several points in the development of a process design where a capital cost estimate may be required but there are usually only three types, the equipment factored estimate and two others. What are the other two?

5. Project Profitability (20 Marks)

In today’s economy with forces of globalization and technological change, it is expected that the overall economy will continue to be quite volatile. The generation of the timing and size of cash flows is a relatively straightforward process of simple accounting. In an orderly market and economy it has generally been assumed that cash flows are deterministic. In fact the data concerning cash flows have always been an estimate and subject to uncertainty. In view of the anticipated continuing volatility in the market, there are several advanced techniques that are better able to reflect these uncertainties than the deterministic approach. Describe at least two of these procedures.

One example that you might comment on is the fact that governments around the world have bought into “Climate Change” and have set up systems where the FIT (Feed in Tariff) for green energy, wind farms and solar farms is often many times greater than the current cost of electricity. What is your opinion of your company investing large sums of money on the assumption that these exorbitant perks will continue.

6. Materials of construction (20 Marks)

The process engineer has an important role in the selection of materials of construction. There are several reasons why materials of construction are important. Discuss several of these. Economics play a large part in the selection of the appropriate material, can you elaborate on this?

In a situation where there is a relatively high temperature reactor containing 50% sulphuric acid how would safety considerations affect the selection of the appropriate metallurgy. Is there a case for using mild steel, and keeping close watch on the thinning of the reactor walls (assuming of course that the resulting contamination is not important) and replacing them well before the point of collapse due to corrosion?

7. Risk Analysis (20 Marks)

Any process design must undergo a thorough risk analysis before it can be released to a contractor. There are several accepted techniques available. Discuss one such procedure.

