

National Exams – May 2012

04-Chem-A5 – Chemical Plant Design and Economics

3 Hours Durations

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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 permitted. 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) Capital Cost Estimation (20 marks)**

There are many different approaches to estimation of capital investment. One method that gives a reasonable initial capital investment cost is by applying a factor to the estimated delivered equipment cost. Discuss how one arrives initially at the estimated delivery cost, and how one uses this information to arrive at an overall investment cost.

**2) Chemical Reactor Design (20 marks)**

There are many different types of chemical reactors, some for vapour reactions and some for liquids. Select three common types of reactors and discuss the various design considerations that one must deal with when designing a reactor for a specific service.

**3) Optimal Design (20 marks)**

In today's volatile financial environment, and increasing competition from emerging economies in Asia and elsewhere it is imperative that any process design be as close to the optimum as possible. Having said that, there are many difficulties involved in determining an optimum. Linear Programming is one method that is often used in order to determine an optimum. Give an outline of how one would construct a model for a particular process, the information required and the anticipated outcome.

**4) Process Diagrams (20 marks)**

There are usually two major diagrams prepared during the course of a process design, The Process Flow Diagram and the Piping and Instrumentation Diagram. What information is normally included on these diagrams? Which is primarily the responsibility of the chemical process engineer, and which is developed by associated skill sets such as mechanical?

**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.**

**For a case which is based on the time value of money, discuss some of the factors that make estimation of profitability in today's environment so difficult.**

**6) Separation processes (20 Marks)**

**Most if not all chemical processes require at some point a separation process. There are a great number of processes depending on the materials to be separated. Restricting our analysis to homogeneous mixtures. discuss at least three common processes. Indicate when they are appropriate, information required to design the equipment and the procedures used for design**

**7) Risk Analysis (20 Marks)**

**Process Safety Management and Loss prevention are two very important aspect of any process design. How are these issues dealt with in a process design?**