

December 2008 National Exams

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) **Cost Estimation (20 marks)**

A process engineer is of necessity involved in the economics of any project. At each stage in the development of a process design and subsequent construction there are three general types of capital cost assessments required. Describe these, when they occur during the process, and what is the expected accuracy of each?

2) **Process Selection and Design (20 marks)**

Although cost and yield have been a concern for design engineers for quite some time now the current hype about energy and “green” engineering has had an effect on the selection and design of new units. Discuss some ways that designers can improve energy efficiency, as well as minimize risk.

3) **Health Safety and Environmental Issues (20 marks)**

A recent fire and explosion at the propane facilities of Sunrise Propane in Toronto has raised the profile of accidents of this nature with the general public. In hydrocarbon processes there are several Health Safety and environmental issues to deal with. Briefly describe the following acronyms stand for?

MSDS

BLEVE

HAZOP

FTA

4) **Profitability Evaluation (20 marks)**

We live in quite chaotic times with respect to energy. Crude prices as well as natural gas are quite volatile. Not so long ago a variation in the price of gasoline was likely the most significant energy issue that the general public cared about. Alternate technologies are being promoted such as wind power, hydrogen and Solar voltaics. If you are charged with the responsibility of developing a profitability assessment for a major project, how would you deal with the current situation?

**5) The use of Software in Process Design (20 Marks)**

Software for use in Chemical Engineering be it Design Troubleshooting , Finance and Economics Data analysis and so on has become very pervasive in the profession. Although this has certainly made an enormous impact on how professional engineers carry out their business it has also introduced a certain amount of risk. In process design when one is dealing with separations there is a potential risk. Please explain. Secondly discuss briefly the issue of extrapolation rather than interpolation when one is attempting to predict.

**6) The role of Optimization in Design and Operation of Chemical Processes (20 Marks)**

The Design process is often defined as Synthesis Analysis and Optimization. What are key factors involved in optimization of a process design? Profitability is certainly not the only issue to be considered.

**7) The Design and Selection of Chemical Reactors (20 Marks)**

There are many types of chemical reactors, liquid phase, vapour phase and mixed phase.

In the liquid phase, there are often choices to be made between a batch reactor or a continuous system. What are the general considerations that will direct this choice? What is the difference between a CSTR and a PFR ?

Can you describe a trickle phase reactor?