

December 2012 National Exams

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) Process Synthesis (20 marks)

Any process design is considered to consist of a Synthesis stage (Process Flowsheet Synthesis and Development), an Analysis stage and an Optimization stage. The Analysis stage is where the process is defined, for example in distillation, column diameters and number of trays are specified, type and surface area of heat exchangers are specified and so on. Describe the Synthesis stage

2) Capital Cost Estimation (20 marks)

In most instances the economic viability of any process design is critical. Describe the various types of capital cost estimation procedures that will be used through the development of the process design, from initial concept to the point where the design is ready to be turned over to construction.

3) Business Economics (20 marks)

In addition to capital cost there are other factors that can be important beginning in the preliminary stages of gathering information before embarking on the design, and in particular when the process design is complete. Select at least three factors that are important and discuss these. You might comment on how the current economic turmoil might have a bearing on this process.

4) Optimum Designs (20 Marks)

There are very few breakthrough chemical and hydrocarbon processes where the potential return is sufficient that the corporation can ignore the need to optimize a design. Discuss the various methods that may be used in order to optimize a design.

5) Economic risk assessment (20 Marks)

Corporations invest money in a project to return a profit in almost all cases. Before committing to a large capital investment it is usually necessary to assess potential risk to the profitability of the project. In particular today's economy can be a real challenge. How can one assess risk for project profitability? Are you aware of Scenario analysis or stochastic methods, if so discuss these briefly.

6) Software in Process Development and Design (20 Marks)

Software is an essential factor in Process Development and Process Design. A typical flowsheet simulator such as PRO/II or HYSIS provides several important aspects to a process design. Give a brief outline of these components of a simulation. The term GIGO (Garbage in Garbage out) is always a potential problem with computer simulation. What aspects of simulation could result in such a situation?

7) Tradeoffs in Process Design (20 Marks)

There are three major process routes to isopropyl alcohol from propylene, the first process is reaction of propylene with sulphuric acid to form propyl hydrogen sulphate. This is then hydrolysed to produce a crude alcohol and a spent acid stream. The second process is a direct hydrolysis of propylene over an acid catalyst in the vapour state. This is a low conversion per pass system as compared to the acid/olefin route. The third process is based on an acidic ion exchange resin. This example illustrates many of the issues involved in selection of a process route. Can you discuss some obvious tradeoffs between the processes?