BEL702: Bioprocess Plant Design

Major Examination
Answer all questions. Maximum marks 100

29th April, 2008
1.00 – 3.00 P.M
II – LT2

1. What are the differenees between a flow sheet and a piping and instrumentation diagram with respect to the information they earry about the streams earrying utilities such as steam, eooling water etc.?

(8 marks)

2. Why is it necessary to provide eompensation for openings made on the shell/closure of an unfired pressure vessel? What is the eoncept behind the "area for area" method of providing eompensation?

(8 marks)

3. (i) During the design of a shell and tube heat exchanger, the theoretical valuc of shell side film coeffieient needs to be corrected. What are the major factors which need to be considered while applying such a eorrection?

   (ii) What is the relevance of ehecking the pressure drop across a heat exchanger unit during the design stage? What will you do if it was seen that the ealculated value of pressure drop is too high (a) for the shell-side fluid (b) for the tube-side fluid ?

(12 marks)

4. (i) How will you estimate the total equipment cost (delivered and installed at site) (a) while carrying out an economic feasibility study for a proposed project (b) during detailed engineering/project implementation stage?

   (ii) What is depreciation? Why is it shown as an expenditure?

   (iii) A fermenter was purchased at a total cost of Rs 800,000. It has an estimated life of 10 years, at the end of which it could fetch a maximum of Rs 50,000 through sale as scrap. What will be the depreciation cost for the first three years for this piece of equipment if depreciation calculations follow (i) straight line method (ii) declining balance method (iii) sinking fund method? Which method would

you prefer if you were the owner of the equipment? Why? Interest rate may be taken as 8%.

(20 marks)

5. What are the major safety concerns in a typical biochemical/biological manufacturing facility? How will you address them as the design engineer in charge of developing the detailed engineering for the plant?

(12 marks)

6. What is the concept of "Bioprocess Validation" as stipulated by the Centre for Biologics Evaluation and Review of the U.S. Food and Drug Administration? Explain.

(8 marks)

7. What are the major advantages and disadvantages of plate-type heat exchangers?

(8 marks)

8. The downstream process for the manufacture of product P involves extracting the product P from the fermentation broth using an organic solvent B. The relative volatility of the mixture of P and B are such that they can be effectively separated using distillation. Explain in detail how you will proceed to develop the detailed engineering for a distillation column to separate P and B, with inputs from the process flow sheet. How will you check the plate hydraulics for stable operation?

(24 marks)