Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.Tech(PBIR)/SEM-3/MBT-302/2012-13

2012
BIOPROCESS PLANT DESIGN

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP – A
(Objective Type Questions)

1. Choose the correct alternatives for the following : $10 \times 1 = 10$

   i) For bioreactor operating at 1·033 kg/cm^2 pressure, the most suitable head is

   a) flat plate b) elliptical head

   c) hemispherical head d) conical head.

   ii) A downstream unit made of S. S,. 316 is operating at 2 kg/cm^2 pressure. The design pressure to be considered is

   a) 2·2 kg/cm^2 b) 2·4 kg/cm^2

   c) 2·6 kg/cm^2 d) 2·1 kg/cm^2

   iii) FAR is the expected death rate per

   a) 10^8 exposed hours b) 10^4 exposed hours

   c) 10^{12} exposed hours d) 10^2 exposed hours.

iv) Geometric similarity is said to exist between the model and the prototype if
   a) both of them are identical in shape but differ in size
   b) both of them have identical motions or velocities
   c) both of them have identical forces
   d) none of these.

v) Depreciation comes under
   a) fixed charges b) manufacturing costs
   c) plant overhead cost d) both (a) and (b).

vi) The cost involved for expenditure on raw materials comes under
   a) direct production cost b) fixed charges
   c) plant overhead cost d) none of these.

vii) Define Turnover Ratio.

viii) What is breakeven point ?

ix) State the components of Capital Investment.

x) Define Fire Triangle.

GROUP – B

(Short Answer Type Questions)

Answer any *four* of the following. $4 \times 2\frac{1}{2} = 10$

2. A mixture of gases having the following composition by volume is at 30°C and 755 mm Hg. Find the specific gravity of the gas mixture.

Component	O_2	N_2	CO_2	CO
% by volume	10	60	25	5

$2\frac{1}{2}$

3. Name the different mathematical methods used for profitablility evaluation. Explain payout period. $1\frac{1}{2} + 1$

4. A solution of potassium dichromate in water contains 13% $K_2 Cr_2 O_7$ by weight. From 1000 kg of this solution are evaporated 640 kg of water. The remaining solution is cooled to 20°C. Calculate the percentage yield of $K_2 Cr_2 O_7$ crystal produced.
   Data : Solubility of $K_2 Cr_2 O_7$ at 20°C = 0·39 kmol/1000 kg water. $2\frac{1}{2}$

5. Name the different steps needed for process design and breifly explain any one of them. $2\frac{1}{2}$

6. Prepare a list of items that should be considered in making a feasibility survey. $2\frac{1}{2}$

7. Name the different methods used for estimation of capital investment. $2\frac{1}{2}$

GROUP – C

(Long Answer Type Questions)

Answer any *five* of the following. $5 \times 10 = 50$

8. Explain in detail the different component of expenses necessary to be considered during operating cost estimation. 10

9. An estimate of Rs. 100 millions is available towards all delivered equipment cost. What will be the fixed capital investment for this project ? Use percentage of delivered equipment cost technique for solving this problem. 10

10. a) Write a brief note on steel, aluminium and copper as materials of construction for pressure vessel.
    b) Explain briefly different types of heads used in pressure vessel. 5 + 5

11. A bioreactor is made of stainless steel 316 and has inner diameter 1000 mm. Submit the mechanical design of shell body, head, bolt and flange. Asbestos gasket (3 mm thick) has been used to prevent leakage.

    Data : Reactor operating pressure = 1·5 kg/cm^2, Gasket factor (m) = 2

    Permissible stress for stainless steel 316 = 13·00 kg/mm^2

    Minimum seating stress of gasket = 112kg / cm^2

    Permissible stress for bolting material = 5·87 kg/mm^2

    Permissible stress for flange material = 952 kg/cm^2

12. Define : $4 \times 2\frac{1}{2}$

    i) Fire and explosion

    ii) Lower and Upper flammability limits

    iii) BLEVE

    iv) Fire Triangle

13. A car driver while driving his car noticed that the fuel tank is almost empty. He drove to a nearby gas station to fill the fuel tank. However, the undersired event was "no fuel to the car driver". Express this event in an unquantified fault tree diagram. 10

14. After a batch fermentation, the system in dismantled and 75% of the cell mass is suspended in the liquid phase (2 liters), while 25% is attached to the reactor walls and internals *n* a thick film of 3 mm. Work with radioactive tracer shows that 50 % of the target product is associated with cell fraction. The productivity of this reactor is 2 gm product / liter at the 2 liter scale. What would be the productivity at 20,000 liter scale if both reactors have height to diameter ratio of 2 to 1 ? 10