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B.Tech.

(SEM. VII) ODD SEMESTER THEORY EXAMINATION 2013-14

BIOPROCESS ENGINEERING – II

Time : 3 Hours   *Total Marks : 100*

Note :–Attempt **all** questions.

1. Attempt any **two** parts of the following :   (10×2=20)

    (a) Make the following conversions of :

        (i)   400 inch³/min to cm³/min

        (ii) 1100 ft/sec to miles/min

        (iii) 50 lb/inch² to N/m²

        (iv) 200 calories to erg.

    (b) Write down the SI units and dimensions of the following :

        (i)   Specific heat

        (ii) Viscosity

        (iii) Thermal conductivity

        (iv) Power number.

    (c) What are the different types of Error ? Explain the various methods for plotting the experimental data.

2. Attempt any **two** parts of the following : (10×2=20)

(a) Antimony is obtained by heating pulverized stibnite (Sb_2S_3) with scrap iron and drawing off the molten antimony from the bottom of the reaction vessel.

$$Sb_2S_3 + Fe \rightarrow Sb + FeS$$
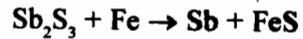
Suppose that 0.6 kg of stibinite and 0.250 kg of iron turning are heated together to give 0.20 kg of antimony metal. Determine the :

(i) Limiting reactant

(ii) % of excess reactant

(iii) Degree of completion

(iv) % conversion.

(b) Assume that experimental measurements for a certain organism has shown that cells can convert one-thirds (w/w) of the substrate carbon (alkane) to biomass.

(i) Calculate the stoichiometric coefficients for the following biological reaction :

$$C_{16}H_{34} + aO_2 + bNH_3 \rightarrow c(C_{4.4}H_{7.3}O_{1.2}N_{0.86}) + dCO_2 + eH_2O.$$
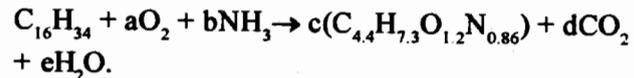
(ii) Calculate the yield coefficient Yx/s(g dw cell/g substrate), Yx/o_2(g dw cell/g o_2).

(c) What are the factors affecting cellular oxygen demand? Analyze the oxygen transfer in bioreactor.

3. Attempt any **two** parts of the following : (10×2=20)

(a) Explain washout phenomena in a single stage continuous culture. Develop the condition for washout and show that the maximum productivity is realized near washout conditions.

(b) After a batch fermentation, the system is dismantled and approximately 75% of the cell mass is suspended in the liquid phase (2 L) while 25% is attached to the reactor walls and internals in thick film. Work with radioactive tracers shows that 50% of the target product (intracellular) is associated with each cell fraction. The productivity of this reactor is 2g product/L at 2 L scale. What would be the productivity at 20,000 L scale if both reactors had height to diameter ratio 2:1 and geometrically similar ?

(c) What are the various configurations of bioreactors ? Explain the design, operation and applications of air lift bioreactor.

4. Attempt any **two** parts of the following : (10×2=20)

(a) What are the various approaches used in the industry for scale up of bioprocesses ? Explain with suitable example.

(b) Why degree of agitation has profound effect on oxygen transfer efficiency of an agitated fermenter. Discuss the practical considerations in construction and design of a bioreactor.

(c) What difficulties arise during scale up of animal cell cultivation ? Explain how they are removed ?

5. Attempt any **two** parts of the following : (10×2=20)

(a) (i) Mention the different instruments used in measurement of Bioprocess Parameters, temperature, viscosity, pressure, fluid flow and chemical compositions.

(ii) Explain the theoretical aspects of PID controller.

(b) Write short notes on :

    (i) Feed back control system

    (ii) Role of sensors in process control.

(c) What is adaptive control loop ? Discuss the artificial neural network based control of a bioreactor.