53 (FPT 712) FMTC

2019

FERMENTATION TECHNOLOGY

Paper : FPT 712

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions from **seven**.*

1. Answer ***any four*** from the following : 5×4=20

   (i) Fermentation

   (ii) Stoichiometry in microbial growth equation

   (iii) Upstream process

   (iv) Operational Strategies in bioreactor

   (v) Downstream process.

Contd.

2. Answer ***any five*** from the following : 4×5=20

(i) Cold sterilization of nutrient medium.

(ii) Indigenous metabolism in stationary phase of cell growth.

(iii) Maintenance coefficient.

(iv) Effectiveness factor.

(v) Air sterilization in fermentor and shake flask.

(vi) If 320 *g* oxygen is being consumed per 1*g mol* of glucose consumed by a microbial strain in a fermentation, calculate Theoretical oxygen demand.

3. *(i)* What is batch fermentation ? Discuss with biomass, product and substrate *vs* time plot.

(ii) Write Cell growth rate equation in batch.

(iii) Write advantages and disadvantages of batch culture. 10+4+6=20

4. *(i)* What is CSTR ? Write the advantages and disadvantages of CSTR.

(ii) Draw a schematic diagram of a fermentor with all probes and accessories. How is the fermentation regulated by the control unit in fermentor ? 10+10=20

5. *(i)* Briefly discuss about operational strategies of Fed-batch culture specifically mentioning its requirements.

(ii) How is O_2 transferred from air to microbial cells in suspension culture ?

(iii) Amylase enzyme was assayed at initial substrate concentration of 10^{-5} *moles*. $K_m = 2\times10^{-3}$ *moles*. After 1 minute, 2% substrate was converted to product. What % of substrate will be converted after 3 *min*. ? 10+5+5=20

6. *(i)* Discuss ***any two*** downstream processing techniques : 10

(a) Filtration

(b) Absorption

(c) Adsorption

(d) Liquid-liquid extraction.

(ii) Discuss fermentative production of the following : ***(any two)*** 10

(a) Citric Acid

(b) Alcoholic beverage

(c) Enzyme β-galactosidase

(d) Vitamin C (Antioxidant, Food additive).

7. (i) A microbial strain obey Monod model

$$\frac{dx}{dt} = \frac{\mu_{Max}[s][x]}{K_s + [s]}$$

$\mu_{Max} = 0.7h^{-1}$, $K_s = 5g/L$, $Y_{n/s} = 0.65$

The microorganism is cultured in CSTR. The feed flow rate = $5000L/h$.

Substrate concentration in feed = $85g/L$.

Substrate concentration in outlet stream = $5g/L$.

Calculate size of fermenter and cell concentration of outlet stream at steady state. 10

(ii) Yeast was cultured in CSTR under aerobic condition. Nutrient feed flow rate was varied and steady state concentration of cell and glucose was measured in fermentor (Table). Glucose inlet concentration $100g/L$. Volume of fermenter $500ml$.

Table :

Flow Rate ***mL/h***	**Cell Concentration** ***g/L***	**Substrate Concentration** ***g/L***
31	5.97	0.5
50	5.94	1.0
71	5.88	2.0
91	5.76	4.0
200	0	100

Find rate equation for cell growth. What should be the range of flow rate to prevent washout of the cell ? 10
