QPC: RJ20MTECH021 AR 19 Reg. No

GIET UNIVERSITY, GUNUPUR – 765022

M. Tech (First Semester – Regular) Examinations, June – 2021

MPCBT 1020 – Bioprocess Engineering and Technology

(Biotechnology)

Time: 2 hrs Maximum: 50 Marks

The figures in the right hand margin indicate marks.

PART – A **(2 x 10 = 20 Marks)**

Q1. Answer **ALL** questions

a. Define theoretical oxygen demand for an aerobic fermentation process.
b. Arrive a steady-state energy balance equation for cell culture in a continuous fermenter.
c. List out the different feed strategies can be adopted in the fed-batch culture systems.
d. Why mixing is considered as one of the most important operations in bioprocessing?
e. How do you classify agitators and illustrate any two types of the most widely used agitator system?
f. Highlight the significance of fault analysis in the monitoring and control of bioreactors.
g. What are filter aids?
h. Brief about Gaulin homogeniser with a neat sketch.
i. Write the different equilibrium relationships for an adsorption process.
j. How a disc bowl centrifuges can work?

PART – B **(6 x 5 = 30 Marks)**

Answer ***ANY FIVE*** questions **Marks**

2. Production of single-cell protein from hexadecane is described by the following reaction equation: **(6)**

$C_{16}H_{34} + aO_2 + b\ NH_3 \rightarrow c\ CH_{1.66}O_{0.27}N_{0.20} + dCO_2 + eH_2O$ where $CH_{1.66}O_{0.27}N_{0.20}$ represents the biomass. If RQ = 0.43, determine the stoichiometric coefficients

3. Citric acid is manufactured using submerged culture of *Aspergillus niger* in a batch reactor operated at 30°C. Over a period of 2 days, 2500 kg glucose and 860 kg oxygen are consumed to produce 1500 kg citric acid, 500 kg biomass, and other products. Ammonia is used as the nitrogen source. Power input to the system by mechanical agitation of the broth is about 15 kW; approximately 100 kg of water is evaporated over the culture period. Estimate the cooling requirements if the value of Δh_v water at 30°C is 2430.7 kJ/kg. **(6)**

4. Discuss in detail on the various factors affecting oxygen transfer in fermenters. **(6)**

5. A mouse-mouse hybridoma cell line is used to produce monoclonal antibody. Growth in batch culture is monitored with the following results. Determine the specific growth rate during the growth phase and compute the culture doubling time. **(6)**

Time (days)	**0**	**0.2**	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**
[Cell] (ml^{-1} x 10^{-6})	**0.45**	**0.52**	**0.65**	**0.81**	**1.22**	**1.77**	**2.13**	**3.55**	**4.02**	**3.77**	**2.20**

6. Elaborate the practical and design considerations for an industrial scale bioreactors. **(6)**

7. A fermenter used for antibiotic production must be kept at 35°C. After considering the oxygen demand of the organism and the heat dissipation from the stirrer, the **(6)**

maximum heat transfer rate required is estimated as 550 kW. Cooling water is available at 10°C; the exit temperature of the cooling water is calculated using an energy balance as 25°C. The heat transfer coefficient for the fermentation broth is 2150 W m^{-2} $°C^{-1}$. The heat transfer coefficient for the cooling water is calculated as 14 kW m^{-2} $°C^{-1}$. It is proposed to install a helical cooling coil inside the fermenter; the outer diameter of the pipe is 8 cm, the pipe wall thickness is 5 mm, and the thermal conductivity of the steel is 60 W m^{-2} $°C^{-1.}$ An average internal fouling factor of 8500 W m^{-2} $°C^{-1}$ is expected; the fermenter-side surface of the coil is kept relatively clean. What length of cooling coil is required?

8. Explain the theory and mechanism of any chromatographic technique of your interest. **(6)**

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