| Reg. No. | | | | | | | | | | |
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# Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

## VII SEMESTER B.TECH (BIOTECHNOLOGY)

## END SEMESTER EXAMINATIONS, NOV/DEC 2017 (REGULAR)

## SUBJECT: ADVANCED BIOPROCESS ENGINEERING (BIO 4013)

**REVISED CREDIT SYSTEM**

Time: 3 Hours (23.11.2017) MAX. MARKS: 50

**Instructions to Candidates:**

- Answer **ANY FIVE FULL** the questions.
- Missing data may be suitable assumed.

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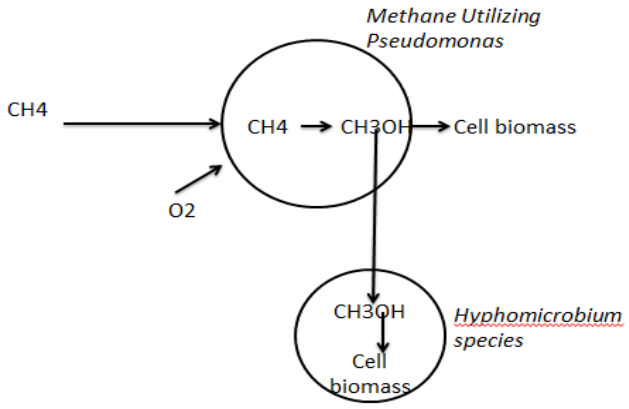
|---|---|---|
| **1A.** | Explain how cellular productivity can be increased (i) adding inducers (ii) decreasing amount of repressor | **03** |
| **1B.** | Explain the cell culture technique which uses filtered cow lymph to provide medium components during animal cell cultivation | **03** |
| **1C.** | Write on the scheme of the most relevant metabolic pathways for the metabolism of sugar compounds and glutamine in Chinese hamster ovary (CHO) cell lines during the synthesis of tissue plasminogen activator (t-PA). Also explain on influence of carbon sources on the formation of Lactate and ammonium. | **04** |
| **2A.** | Explain how cellular productivity can be increased via cell arrest using chemicals NaBu, Pentanoic acid and Quinidine. | **03** |
| **2B.** | Explain the operation of the following bioreactors used in animal cell cultivation: (i) Packed bed bioreactor with internal silicone tubing (ii) TFF perfusion system | **05** |
| **2C** | Explain the development of process for the production of Mono clonal Antibodies from the seed train to production scale. | **02** |
| **3A.** | With suitable example explain: Commensalism and Mutualism | **03** |
| **3B.** | Develop the model equations for biomass, product and oxygen in the following Bioprocessing system (Fig. 1) of methane utilizing pseudomonas species and methanol utilizing Hyphomicrobium species in a Chemostat.   Fig1 | **04** |

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<tr><td>3C</td><td>Write material balances on Biomass and substrate in a Chemostat with two competing species. Using the operating diagram explain the coexistence of two species in a Chemostat.</td><td>03</td></tr>
<tr><td>4A.</td><td>Lotka-Volterra model equations for Predator-Prey are given as follows. In this Predator (Shark) and Prey (Fish) are considered in a closed system. The first order system ODE governing fish population F and the Shark population S is given by<br>$\frac{dF}{dt} = aF - \gamma.F.S$<br>$\frac{dS}{dt} = -bS + \varepsilon.\gamma.F.S$<br>With initial conditions F(0)=100 & S(0)=80<br>a=0.7 growth rate of fish in the absence of shark (1/year)<br>b=0.5 death rate of shark in the absence of their prey, fish (1/year)<br>$\gamma$=0.007 death rate per encounter of fish with shark<br>$\varepsilon$=0.3 Efficiency of turning predated fish into shark<br>Find the A matrix and Eigen values at<br>i. Non-trivial steady state<br>ii. Trivial steady state<br>and comment on the stability of predator-prey system.</td><td>05</td></tr>
<tr><td>4B.</td><td>Lactic acid is produced using Lactobacillus in a Chemostat under sterile environment with glucose as the substrate, $S_0$=4 g/l at dilution rate of D=0.18 $h^{-1}$. Steady state substrate and biomass concentrations are 1.5 and 1.0 g/l respectively. Assume that growth follows the Substrate inhibition kinetics given by the following equation with, $\mu_m$=0.53 $h^{-1}$, $K_s$=0.12 g/l, Ki=0.8 g/l and Y=0.4<br>$\mu = \frac{\mu m.S}{(Ks + S + \frac{S^2}{KI})}$<br>i. Find the elements of A matrix<br>ii. Find the Eigen values and comment on the stability of the system</td><td>05</td></tr>
<tr><td>5A.</td><td>A food processing industry has purchased two heat exchangers, one in 1990 and other in 1995 for the same purpose. Find the cost of 80 $m^2$ heat exchanger in the year 2016 base on the following data, CEPCI (2016)=575
<table>
<tr><td>Heat exchanger</td><td>A</td><td>B</td></tr>
<tr><td>Area</td><td>70</td><td>130</td></tr>
<tr><td>Time</td><td>1990</td><td>1995</td></tr>
<tr><td>cost</td><td>17 lakhs</td><td>24 lakhs</td></tr>
<tr><td>Chemical Engineering Plant Cost Index (CEPCI)</td><td>358</td><td>397</td></tr>
</table></td><td>03</td></tr>
<tr><td>5B.</td><td>An activated-sludge waste treatment system is required to reduce the amount of BOD5 from 1000 mg/l to 20 mg/l at the exit. The sedimentation unit concentrates biomass by a factor of 3. Kinetic parameters are $\mu_m$ = 0.2 $h^{-1}$, Ks = 80 mg/l, $K_d$ = 0.01 $h^{-1}$ , and $Y_{X/S}$ = 0.5 g MLVSS/g BOD5. The flow rate of waste water is 10000 L/h and the size of the treatment basin is 50,000 liters<br>a. What is the value of the solids residence time (θc) ?<br>b. What value of the recycle ratio must be used?</td><td>4</td></tr>
<tr><td>5C.</td><td>Explain how insulin is obtained in purified crystallized form from pancreas of pigs.</td><td>03</td></tr>
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