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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 2016 (REGULAR)

### SUBJECT: ADVANCED BIOPROCESS ENGINEERING (BIO 425)

### **REVISED CREDIT SYSTEM**

Time: 3 Hours

MAX. MARKS: 50

#### Instructions to Candidates:

✤ Answer ANY FIVE FULL the questions.

✤ Missing data may be suitable assumed.

1 <b>A</b> .	Why scale-up of animal cell cultures are difficult compared to bacterial cultures? Write on the scale-up procedure used for suspension animal cell cultures.	03
1B.	What is antimetabolite? Write the possible mechanisms with antimetabolite during the cancer treatment.	03
1C.	Write on the various chemicals with the appropriate mechanism that are used for cell arrest to increase the productivity of recombinant proteins.	04
2A.	Describe the various clinical development steps and process development steps that are generally used before launching new products from animal cell culture technology.	03
2B.	<ul> <li>Explain the following bio-reactors that are used for animal cell cultivation</li> <li>i. Bubble column bioreactor</li> <li>ii. Air-lift bioreactor</li> </ul>	05
2C	Write on the desirable characteristics of solid micro carriers that are used during animal cell cultivation	02
3A.	Explain with example: Mutualism, Ammensalism	03
3B.	Develop the mathematical model for two competing yeast organisms by considering interspecies competition and intra species competition in a batch cultures. Also find the equilibrium concentration of both the yeast organisms.	05
3C	Write the Vito Volterra model equations for two competing species $n_1$ and $n_2$ in a batch system. If effective yield coefficient for both the species on limiting nutrient are 0.58 and 0.48 and maximum specific growth rate of species $n_1$ is 1.56 $h^{-1}$ then find the specific growth rate for species $n_2$ at the coexistence.	02
4A.	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	05

	$\frac{dF}{dt} = aF - \gamma . F . S$ $\frac{dS}{dt} = -bS + \varepsilon . \gamma . F . S$ With initial conditions F(0)=100 & S(0)=80 a=0.7 growth rate of fish in the absence of shark (1/year) b=0.5 death rate of shark in the absence of their prey, fish (1/year) $\gamma$ =0.007 death rate per encounter of fish with shark $\varepsilon$ =0.3 Efficiency of turning predated fish into shark Find the Shark and Fish population after 4 years. Use the Runge-Kutta method with step size 4.	
4B.	<ul> <li>Write on the applications of mixed culture populations in the following industries</li> <li>i. Cheese making</li> <li>ii. Treatment of starchy waste from potato processing industries</li> <li>iii. Removal of methane gas from effluent air in oil industries</li> </ul>	05
	The following food web is taking place in a Chemostat under sterile environment with glucose as the substrate ,S0=4 g/l at dilution rate of D=0.3 h <sup>-1</sup> . Steady state substrate (Sss) and biomass concentrations (X1ss, X2ss) are 1.5, 1.0, 1.2 g/l respectively. Assume that growth follows the Monod's kinetics with, $\mu_{m1}$ =0.53, $\mu_{m2}$ = 0.65, K <sub>s1</sub> =0.12, K <sub>s2</sub> =0.35,Y <sub>s1</sub> =0.4 and Y <sub>s2</sub> =0.52. The mass balance equations for both the bacteria and substrate are expressed as follows:	
5A.	$\frac{\frac{dX1}{dt} = -DX1 + \mu 1(s)X1}{\frac{dX2}{dt} = -DX2 + \mu 2(s)X2}$ $\frac{\frac{dS}{dt} = D(S0 - S) - \frac{1}{Y_{S1}}\mu 1(s)X1 - \frac{1}{Y_{S2}}\mu 2(s)X2$	06
	<ul> <li>I. Determine all the elements of the Community matrix</li> <li>II. Write the signs of the elements of the matrix</li> <li>III. Discuss on stability of food web [3+2+1]</li> </ul>	

	Protozoa (predator) Bacteria1 (Prey1) Limiting Substrate Bacteria2 (prey2) Limiting Substrate	
5B.	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 <sup>-1</sup> , Ks = 80 mg/l, Kd = 0.01 h <sup>-1</sup> , and Y <sub>X/S</sub> = 0.5 g MLVSS/g BOD5. The flow of waste water is 10000L/h and the size of the treatment basin is 50,000 l a. What is the value of the solids residence time ( $\theta$ c) ?	4
6A.	Write on Production of Lysine via Fermentation route and its commercial applications	03
6B.	Write on Various stages of Synthesis of VitaminB-12 and its applications	03
6C.	Estimate the total capital investment for a new pharmaceutical plant using the following bare module cost of major equipment, ancillary equipment and working capital Data: i. Cost of major equipment (bare module) : 800 crores ii. Cost of ancillary equipment (bare module): 175 crores iii. Working capital : 210 crores	04