Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

VII SEMESTER B.TECH (BIOTECHNOLOGY)

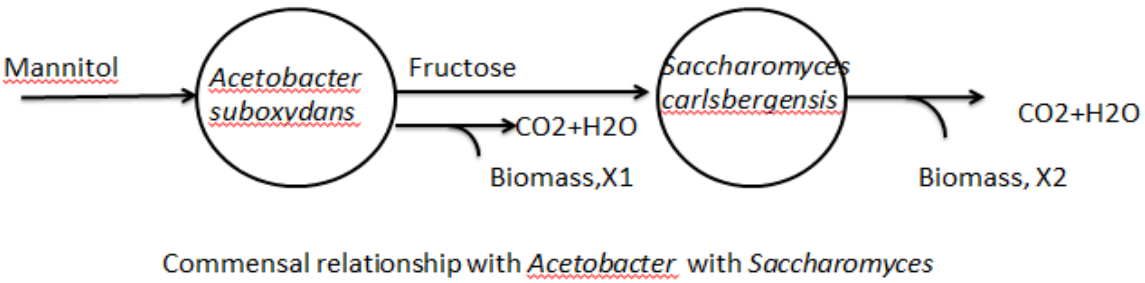
END SEMESTER EXAMINATIONS, NOVEMBER 2018 (REGULAR)

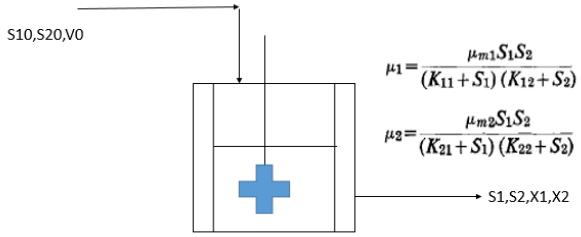
SUBJECT: ADVANCED BIOPROCESS ENGINEERING (BIO 4013)

REVISED CREDIT SYSTEM

Time: 3 Hours (27.11.2018) MAX. MARKS: 50

Answer ALL questions

1A.	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.	Explain the possible mechanisms by which the productivity of recombinant protein can be increased by cell arrest via Temperature shift to conditions of mild hypothermia	**04**
1C.	Explain the following during the synthesis of tissue plasminogen activator (t-PA) using Chinese hamster ovary (CHO) cell lines i. Why the consumption rate for Glucose is much higher than Galactose? ii. Higher concentration of Ammonium ion generation in the medium occurs with the Fructose and Galactose as carbon source than Glucose and Mannose	**03**
2A.	With suitable diagrams explain the operation of TFF and ATF perfusion systems used for cultivation of shear sensitive cells.	**04**
2B.	Explain the principle involved in roller bottles that are used in animal cultivation. Write any two advantages of this system.	**03**
2C	Explain with suitable examples: i. Mutualism ii. Commensalism.	**03**
3A.	The growth of *Acetobacter suboxydans* on the monosaccharide Mannitol results in the production of fructose. When a yeast such as *Saccharomyces carlsbergensis* is grown in continuous fermentation with the *Acetobacter*, it is able to consume the fructose for growth as shown in the following figure. It is unable to consume Mannitol and thus has a commensal relationship with the *Acetobacter*. Find the community matrix at the coexistence steady state.  Commensal relationship with *Acetobacter* with *Saccharomyces*	**05**
3B.	A particular bio-product is synthesized using two organisms and two substrates in a chemostat shown in the following figure. There is competition between these two organisms (X1, X2) for the limiting nutrients S1 and S2. where μ_{m1} and μ_{m2} are the maximum specific growth rates of organisms 1 and 2, respectively, K_{ij} is saturation constant representing saturation effect of j^{th} substrate by i^{th} organism	**05**

	(i, j= 1,2).  With the help of contour plots for specific growth rate of organism1 on S_1 versus S_2 plane and discuss the following case for coexistence of both the organism in the continuous cultures. $\mu_{m1} \neq \mu_{m2}$ $\frac{\mu m2}{\mu m1} K11 < K21 < K12 \ldots . and . . \frac{\mu m2}{\mu m1} K12 < K22 < K12$	
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 $\frac{dF}{dt} = aF - \gamma.F.S$ $\frac{dS}{dt} = -bS + \varepsilon.\gamma.F.S$ 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) γ=0.007 death rate per encounter of fish with shark ε=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.	**04**
4B.	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, μ_m=0.53 h^{-1}, K_s=0.12 g/l, Ki=0.8 g/l and Y=0.4 $\mu = \frac{\mu m.S}{(Ks + S + \frac{S^2}{KI})}$ i. Find the elements of A matrix ii. Find the Eigen values and comment on the stability of the system	**06**
5A.	Write on the production of Lysine via fermentation route and its commercial applications	**03**
5B.	For the activated- sludge unit the specific growth rate of cells is given by $\mu net = \frac{\mu_m S}{K_s + S} - K_d$ The following parameter values are known: v_0 = 500 l/h, α = 0.4, γ = 0.1, X_e = 0, V = 1500 liters, K_s = 10 mg/l, μ_m = l h^{-1} , K_d = 0.05 h^{-1} , S_0 = 1000 mg/l, $Y_{X/S}$ = 0.5 g dw/g substrate. a. Calculate the substrate concentration (S) in the reactor at the steady	**4**

	state. b. Calculate the cell concentration in the reactor. c. Calculate X_r and S_r in recycle stream.	
5C.	i. Name the various stages need to be considered in designing of the new bioprocessing plant ii. What are the Economic factors that must be considered during the production of various Recombinant DNA products	**03**