Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

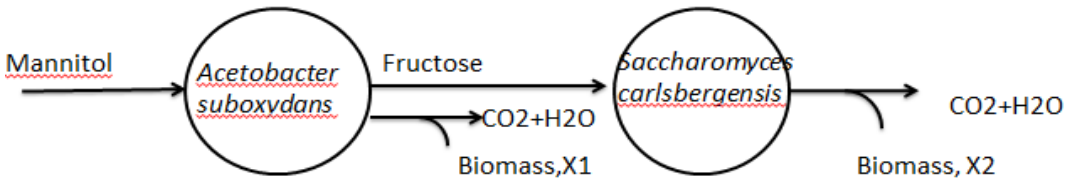
VII SEMESTER B.TECH (BIOTECHNOLOGY)

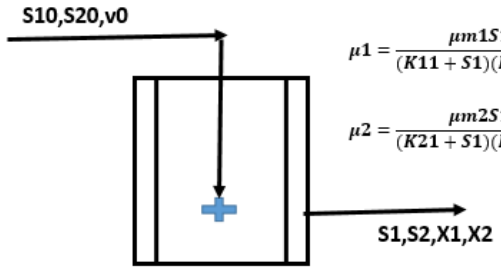
END SEMESTER EXAMINATIONS, NOVEMBER 2019 (REGULAR)

SUBJECT: ADVANCED BIOPROCESS ENGINEERING (BIO 4013)

Time: 3 Hours (23.11.2019) MAX. MARKS: 50

Answer ALL questions

1A.	Write the advantages and disadvantages of serum in culture media.	**03**
1B.	Write briefly on i. Designing of oxygen supply system for large scale animal cultivation ii. Desirable characteristics of micro carrier beads used in 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.	Write on the following aspects to increase recombinant protein productivity with use of cell cycle arrest by temperature shift. i. Biphasic culture process ii. Mammalian cell response to reduced culture temperature	**03**
2B.	Write on the following reactors used in animal cell cultivation i. Hollow fiber bioreactor ii. Roller bottle cultures	**03**
2C	Why packed bed bioreactors preferred in viral vaccines production? Explain the operation of conventional packed bioreactor with suitable diagram.	**04**
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*.  Commensal relationship with *Acetobacter* with *Saccharomyces* i. Develop the set of unsteady state mass balances for bacteria, yeast and both substrates which describes commensal interactions in a chemostat. Use Monod kinetic model for growth. ii. Show that there are three possible steady states, with one of these corresponding populations. What are the concentrations of substrates and cells at this steady state?. What is the range of dilution rate over which this steady state is possible?	**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 (i, j= 1,2).  $\mu 1 = \frac{\mu m1 S1 S2}{(K11+S1)(K12+S2)}$ $\quad a = \frac{K11\mu m2 - K21\mu m1}{\mu m1 - \mu m2}$ $\mu 2 = \frac{\mu m2 S1 S2}{(K21+S1)(K22+S2)}$ $\quad b = \frac{K12\mu m2 - K22\mu m1}{\mu m1 - \mu m2}$ $c = \frac{\mu m1 \mu m2 (K11-K21)(K12-K22)}{(\mu m1 - \mu m2)^2}$ 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. $\mu_{m1} \neq \mu_{m2}$ $K22 \leq \frac{\mu m2}{\mu m1} K12 \quad and..K21 \leq \frac{\mu m2}{\mu m1} K11$	**05**
4A.	For following Lotka-volterra model equations: $\frac{dn1}{dt} = an1 - \gamma n1n2$ $\frac{dn2}{dt} = -bn2 + \epsilon\gamma n1n2$ Find i. Trivial and Non-trivial steady state points ii. A –matrix iii. Eigen values at trivial and non-trivial steady states	**04**
4B.	Write on application of mixed culture organisms in following processes i. Symba process for treatment of starchy waste ii. Cheese making process iii. Separation of methane gas in oil industries. iv. SCP production using hydrocarbons	**04**
4C.	Describe the various clinical development steps and process development steps that are generally used before launching new products from animal cell culture technology	**02**
5A.	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 μ_m = 0.2 h^{-1}, K_s = 80 mg/l, K_d = 0.01 h^{-1} , and $Y_{X/S}$ = 0.5 g biomass/g BOD5. The flow of waste water is 10000 L/h and the size of the treatment basin is 50,000 L. a. What is the value of the solids residence time (i.e., θc)? b. What value of the recycle ratio must be used? c. Biomass concentration the aeration tank	**4**
5B.	Estimate the total capital investment for a new pharmaceutical plant using the following bare module cost of major equipment, ancillary equipment and working capital. Cost of major equipment (bare module):800 crores; Cost of ancillary equipment (bare module): 175 crores; Working capital : 210 crores :	**03**
5C	Write on Production of Lysine via Fermentation route and its commercial applications.	**03**