BT-12 **Roll No.** | | | | | | | | | | |

M.Tech.
(SEM I) ODD SEMESTER EXAMINATION 2015-16
PRINCIPLES OF BIOPROCESS ENGINEERING

[Time: 3 hrs.] **[Max. Marks: 100]**

Note- ***Attempt All Questions*. *All Questions carry equal marks*:-**

1. Answer any *FOUR* of the following questions. **(5x4 = 20)**

(a) Describe dimensional variables.

(b) Explain Newtonian & Non-Newtonian fluid.

(c) Discuss the viscosity for Newtonian fluids and apparent viscosity for Non-Newtonian fluids.

(d) Describe Pascal law.

(e) Explain two-film theory.

(f) Explain Michaelis-Menten kinetics.

(g) Describe regulation of enzyme activity.

2. Answer any *TWO* of the following questions. **(10x2 = 20)**

(a) Chemically defined media and complex media.

(b) Differentiate between selective media and differential media and also describe various method of sterilization.

(c) Explain the diffusion theory of mass transfer.

3. Answer any *TWO* of the following questions. **(10x2 = 20)**

(a) Define cell mass balance equation with the help of example.

(b) Explain various equipments and methods of heat transfer.

(c) Derive an expression for ideal chemostat.

4. Answer any *TWO* of the following questions. **(10x2 = 20)**

(a) Depending on culture conditions, $C_6H_{12}O_6$ can be catabolized by yeast to produce C_2H_5OH and CO_2 or can be delivered into other biosynthetic reactions. An inoculum of yeast is added to a solution containing 10 g/L of $C_6H_{12}O_6$. After sometime only 1 g/L of $C_6H_{12}O_6$ remains while the concentration of C_2H_5OH is 3.2 g/L. Determine:-

(i) Fractional conversion of $C_6H_{12}O_6$ to C_2H_5OH

(ii) Yield of C_2H_5OH from $C_6H_{12}O_6$

(b) Define LMTD in heat transfer operation. Also draw the neat sketch of 1-2 shell and tube heat exchanger.

(c) Corn steep liquor contains 2.5% invert sugars and 50% water; the rest can be considered solids. Beet molasses containing 50% sucrose, 1% invert sugars, 18% water and the remainder solids is mixed with corn-steep liquor in a mixing tank. Water is added to produce a diluted sugar mixture containing 2% (w/w) invert sugars, 125 kg corn steep liquor and 45 kg molasses are fed into the tank.

(i) How much water is required?

(ii) What is the concentration of sucrose in the final mixture?

5. Answer any *TWO* of the following questions. **(10x2 = 20)**

(a) A bioreactor (volume = 150 m^3) is operated at 35 $^{\circ}$C. The rate of O_2 intake is 1.5 $kgm^{-3}h^{-1}$, the agitator dissipates heat at a rate of 1 kWm^{-3}. Cooling water (16.7 kg/s) having temperature 10 $^{\circ}$C, is passed through an internal coil in the fermentation tank. If the system operates at steady state, what is the exit temperature of the cooling water?

(b) A furnace wall is constructed of firebrick 15 cm thick. The temperature inside the wall is 700 $^{\circ}$C; the temperature outside is 80 $^{\circ}$C. If the thermal conductivity of the brick under these conditions is 0.3 $Wm^{-1}K^{-1}$, what is the rate of heat loss through 1.5 m^2 of wall surface?

(c) A strain of *Azotobacter vinelandii* is cultured in a 15 m^3 stirred fermenter for alginate production. Under current operating conditions k_La is 0.17 s^{-1}. Oxygen solubility in the broth is approximately $8x10^{-3}$ kg m^{-3}.

(i) The specific rate of oxygen uptake is 12.5 mmol $g^{-1}h^{-1}$. What is the maximum possible cell concentration?

(ii) The bacteria suffer growth inhibition after copper sulphate is accidently added to the fermentation broth. This causes a reduction in oxygen uptake rate to 3 mmol $g^{-1}h^{-1}$. What maximum cell concentration can now be supported by the fermenter?