Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

V SEMESTER B.TECH (BIOTECHNOLOGY)

END SEMESTER EXAMINATIONS, DEC 2015/JAN 2016

SUBJECT: **FERMENTATION ENGINEERING** [BIO 303]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

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

1A.	Discuss the various stages in the bioprocess development of an antibody production in large scale.	**5**
1B.	The thermal death kinetics of thermos-tolerant spore forming bacterium *Clostridium thermocellum* are shown below. Find the kinetic parameters that describe the data. If a sample of *C.thermocellum* were to be placed in boiling water, how long does it take to reduce the spore population by 50%? **Temp. (°C)** 120 130 140 150 **k_d (min^{-1})** 0.109 1.45 17 177.8	**5**
2A.	Explain the theory and design of filter sterilization method.	**5**
2B.	Medium at a flow rate of $2m^3$ / h is to be sterilized by heat exchange with steam in a continuous sterilizer. The liquid contains bacterial spores at a concentration of $5x10^{12}$ m^{-3} and Ed = 283 kJ/mol and A= $5.7x10^{39}$ /h. A contamination risk of one organism surviving every 60 days operation is acceptable. The sterilizer pipe has an inner diameter of 0.1 m; the length of holding section is 24m. Density= $1000kg/m^3$; Viscosity=3.6kg/m.h. What sterilization temperature is required?	**5**
3A.	Assume that an enzyme is immobilized (K_M = 1M) uniformly on a ceramic slab on one side and is kept in contact with the substrate solution (0.1M). Derive an expression for concentration profile of substrate and internal effectiveness factor when it is catalysed by the immobilized enzyme which follows Michalis-Menten kinetics:	**5 + 5**
4A.	Consider a single air bubble and single microbial cell in a fermentation medium. Explain the step by step physical transfer of oxygen molecule from air bubble to the cytoplasm of the cell and identify the various mass transfer resistances in series. Which mass transfer resistance is usually the rate limiting step in the oxygen mass transfer?	**10**
5A.	Give reasons for the following: i. Pearl and Read model is better than exponential growth model ii. Monod model is an empirical model	**5x2**

	iii. $\mu = \mu_m$ in the exponential phase of growth curve iv. C_{AL} should be at C_{crit} or above C_{crit} for aerobic fermentation v. C_A can be less than or equal to zero inside a spherical biocatalyst for a zero order reaction	
6A.	From the following data determine which cells grow fastest?	**10**

Time (days)	[Cells] (No. of cells/ml)	
	Medium I	Medium II
0	7.30×10^{-3}	3.00×10^{-3}
1	1.01×10^{-2}	4.92×10^{-3}
2	1.38×10^{-2}	7.89×10^{-3}
4	2.63×10^{-2}	2.50×10^{-2}
6	4.97×10^{-2}	6.40×10^{-2}
7	6.85×10^{-2}	1.00×10^{-1}
8	9.44×10^{-2}	9.50×10^{-2}
10	8.40×10^{-2}	8.40×10^{-2}