3. Discuss how the concept of local isotropic turbulance can be applied to explain the effect of high agitation intensities on the mass transfer rate at solid particle surfaces in dispersed phase reactor system?

4. How the rheological properties of microbial broth containing yeast, bacteria and filamentous fungi can be determined? How the metabolic products and age of the culture affect the rheological behaviour.

5. Write short notes on (any **two**)

   a) Dynamic method of $K_L a$ determination

   b) Bubble coalescence and break up in a bubble column bioreactor.

   c) Power input in bubble column

   d) Minimum impeller speed in an agitated tank reactor

MASTER OF TECHNOLOGY IN FOOD TECH. & BIOCHEMICAL ENGINEERING EXAMINATION, 2012

(1st Semester)

ADVANCED BIOCHEMICAL ENGINEERING

Time : Three Hours Full Marks - 100

(50 marks for each Part)

Use a separate Answer Script for each Part

Part - I

Answer any **Two** questions from **Group A** and

One question from **Group B**

Group A

1. Deduce the heat transfer relationship with respect to heating and colling of medium undergoing fermentation in a bioreactor, considering Newton's law of heat transfer. 16

2. Discuss the different physical mechanisms of collection of aerosol by fibrous media. Discuss one of the mechanisms by which air becomes sterile.

3. Write short notes on (any **two**)

   i) Discuss the importance of Monod equation in case of batch fermentation.

ii) Discuss in brief the function of the occessories associated with a fermenter with the help of a neat sketch.

iii) Design of a culture medium.

iv) Importance of screenins to find out suitable microbial cultures of industrial importance.

4. a) Discuss the kinetics of cell death with respect to sterilization in Batch and continuous fumenter. 8

b) With the help of the typical bacterial growth cycle state the importance of exponential growth phase with mathematical expression. 8

Group B

5. a) State the basic sterilization equation and draw the time temperature profiles for constant degree of sterilization and deactivation of microbes. 6

b) The initial cell count presterilization is 2×10^4 cells / ml and the media volume is 9000 litres. The heating from 100^oC to 121^oC (the holding temperature) takes 15 min and cooling down to 100^oC takes 20 min. Calculate holding time. (Table supplied) 10

air was introduced through the sparger at the rate of 0.04 wm. The fermenter, equipped with two sets of flat blade turbines and four baffle plates was having the following dimensions.

Dimeter of fermenter = 4 m
Dia of the impeller = 2 m
Baffle plate width = 0.4 m
Liquid depth infermenter = 6.5 m

For designing the overall fermentation process it is required to determine

a) Power requirement for ungassed system

b) Power consumption for gassed system.

c) Volumetric oxygen transfer coefficient K_2a using the relationship

$$K_La = 0.0635\left(P_{8/V}\right)^{0.95}\left(V_S\right)^{0.67}$$

b) What do you understand by orifice transition gas flow rate in a bubble column bioreactor? How it can be determined?

2. What are the resistances involved in transferring oxygen from the gas phase to a respiring cell? Discuss the effect of molecular diffusivity on mass transfer coeffifient under different hydrodyanamic conditions.

6. Glucose was added to a batch culture of micro-organisms and removal was measured over time. With the help of the following data determine the reaction order of the removal process and calculate the value of constant. Establish the reaction rate equations for 0, 1 and 2 orders reaction and then predict the order of reaction by graphical methods (3 different graphs are to be drawn). 16

T (°C)	k (min^{-1})	∇ Heating / Cooling
100	0.019	–
101	0.025	0.044
102	0.032	0.076
103	0.040	0.116
104	0.051	0.168
105	0.065	0.233
106	0.083	0.316
107	0.105	0.420
108	0.133	0.553
109	0.168	0.720
110	0.212	0.932
111	0.267	1.199
112	0.336	1.535
113	0.423	1.957
114	0.531	2.488
115	0.666	3.154

[Turn over

T (°C)	k (min^{-1})	∇ Heating / Cooling
116	0.835	3.989
117	1.045	5.034
118	1.307	6.341
119	1.633	7.973
120	2.037	10.010
121	2.538	12.549
122	3.160	15.708
123	3.929	19.638
124	4.881	24.518
125	6.056	30.574
126	7.506	38.080
127	9.293	47.373
128	11.494	58.867
129	14.200	73.067
130	17.524	90.591

Part - II

Answer any **Three** questions.

All questions cary equal marks**.**

7. a) A bacterial fermentation was carried out in a reactor containing a medium having a density of 1.2×10^3 kg/m^3 and a viscosity of 0.02 NS/m. The broth was agitated with the help of an impeller having a speed of 90 rpm and