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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

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Program/course	: B. Tech/CE+RP	**Semester**	: III
Subject	: Introduction to Bioengineering	**Max. Marks**	: 100
Code	: CHEG 261	**Duration**	: 3 Hrs
No. of page/s	: 02		

Note: Assume suitable data wherever necessary. The notations used here have the usual meanings.

Answer all questions.

1. The following data were obtained from enzymatic oxidation of phenol by phenol oxidase at different phenol concentrations.   **(20 marks)**

S (mg/l)	10	20	30	50	60	80	90	110	130	140	150
V (mg/l-h)	5	7.5	10	12.5	13.7	15	15	12.5	9.5	7.5	5.7

   a. What type of inhibition is this?

   b. Determine the kinetic constants

   c. Determine the oxidation rate at [S] = 70 mg/l.

2. The growth of *S. cerevisiae* on glucose under anaerobic conditions is simply described by the following overall reaction: **(20 marks)**

$$C_6H_{12}O_6 + 0.113\ NH_3 \longrightarrow aCH_{1.74}N_{0.2}O_{0.45} + bCO_2 + cH_2O + dC_3H_8O_3 + eC_2H_5OH$$
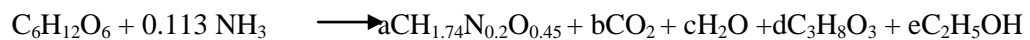
   i.   Determine the coefficients a, b, c, d and e

   ii. Determine the biomass yield coefficients ($Y_{X/S}$)

   iii. Determine the product yield coefficients ($YC_3H_8O_{3/S}$, $YC_2H_5OH_{/S}$ & $YCO_{2/S}$)

   iv. Determine degree of reduction for the substrate, bacteria, $C_3H_8O_3$ & C_2H_5OH

3. **(a)** Explain in detail about the types of impellers used for bioreactors **(10 marks)**

(b) Describe the air lift bioreactor in detail and mention its merits and demerits **(10 marks)**

4. **(a)** An enzyme is immobilized in 8 mm diameter agarose beads at a concentration of 0.018 Kg of protein per m^3 of gel. 10 beads are immersed in a well-mixed solution containing 3.2 X 10^{-3} Kg/m^3 of substrate. The effective diffusivity of substrate in agarose gel is 2.1 X 10^{-9} m^2/sec. kinetics of the enzyme can be approximated as first order with a specific rate constant of $3.11X10^5$ sec^{-1}/kg of protein mass transfer effects outside the particles are negligible plot the steady state substrate concentration profile as function of particle radius **(10 marks)**

(b) What is meant by sterilization? How it is helping to inhibit the growth of microbes in a batch system? **(10 marks)**

5. **(a)** Discuss the major steps involved in intracellular and extracellular bio product separation and purification from the fermented broth? **(10 marks)**

(b) Explain briefly about the mechanical methods of cell disruption? **(10 marks)**

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