BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BE **SEMESTER : V**
BRANCH: BIOTECHNOLOGY **SESSION : MO/19**

SUBJECT: BT5021 BIOPROCESS ENGINEERING

TIME: 3 HOURS **FULL MARKS: 60**

INSTRUCTIONS:
1. The question paper contains 7 questions each of 12 marks and total 84 marks.
2. Candidates may attempt any 5 questions maximum of 60 marks.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

Q.1(a) What is balanced growth? [2]
Q.1(b) Discuss the effect of substrate concentration on specific growth rate of a bacterial culture Growing in a chemostat. [4]
Q.1(c) Discuss the model used to describe heat generation by bacteria in a batch culture. [6]

Q.2(a) Differentiate between yield and productivity. [2]
Q.2(b) Show that mixed growth associated product formation follows Leudeking-piret equation. [4]
Q.2(c) Production of single cell protein from hexadecane in presence of ammonia was done as follow. If, RQ=0.43, determine stoichiometric coefficients. [6]

$$C_{16}H_{34}+aO_2+bNH_3 \Longrightarrow cCH_{1.66}O_{0.27}N_{0.20}+dCO_2+eH_2O$$

Q.3(a) What do you mean by enzymes? Write the role of enzymes in food sector. [2]
Q.3(b) Discuss the immobilization of enzyme by membrane entrapment methods. [4]
Q.3(c) Derive an expression for rate of reaction (V_o) for single substrate enzyme catalysed reaction. [6]

Q.4(a) What is decimal reduction time with respect to medium sterilization? [2]
Q.4(b) Design a continuous sterilization system for medium using heat exchangers. [4]
Q.4(c) What do you mean by 'Del' factor? Calculate the holding time at 121 ^oC in an batch autoclave (Initial and final concentration of bacteria were $1x10^{14}$ L^{-1} and $1x10^{-3}$ L^{-1}, respectively). The value of sp. death rate, $Del_{heating}$ and $Del_{cooling}$ were recorded as 2.54 min^{-1}, 9.8 and 10.1, respectively. [6]

Q.5(a) Describe the features of Rushton turbine. [2]
Q.5(b) Discuss the power requirements for a CSTR in ungassed condition. [4]
Q.5(c) Calculate the K_La value from the given data of bacterial culture (2.5 g/l) in a CSTR. (Given that C*=7.1 mg/l) [6]

DO (mg/l)	4.3	4.3	4.3	2.8	2.5	1.8	2.4	3.2	4.0	4.1	4.2
Time (min)	0	1	2	3	4	5	6	7	8	9	10
Air (on/off)	on	on	off	off	off	on	on	on	on	on	on

Q.6(a) Differentiate between batch and continuous mode of CSTR operations. [2]
Q.6(b) How will you change a batch CSTR into continuous CSTR ? Write your strategy. [4]
Q.6(c) 'Most of the commercial fermenters are batch fermenter', justify the statement. [6]

Q.7(a) Give a labelled diagram of bubble column reactor. How it works? [2]
Q.7(b) Design a system for operation of a CSTR as chemostast. [4]
Q.7(c) Describe the various methods for setup of fed batch bioreactor. Mention method of monitoring of bioreactor during its use. [6]

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