**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI**
**(MID SEMESTER EXAMINATION)**

**CLASS: BE** **SEMESTER: VII**
**BRANCH: BIOTECHNOLOGY** **SESSION : MO/2018**

**SUBJECT : BT7023 BIOREACTOR AND BIOPROCESS DESIGN**

**TIME: 1.5 HOURS** **FULL MARKS: 25**

**INSTRUCTIONS:**
1. The total marks of the questions are 30.
2. Candidates may attempt for all 30 marks.
3. In those cases where the marks obtained exceed 25 marks, the excess will be ignored.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. The missing data, if any, may be assumed suitably.

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Q1 (a) Write about the design considerations for designing of bioreactors? [2]
(b) A fermentation broth with viscosity $10^{-2}$ Pa s and density 1000 kg $m^{-3}$ is agitated in a 50 $m^3$ baffled tank using a marine propeller 1.3 m in diameter. Calculate the power required for a stirred speed of 4 $s^{-1}$. [3]

Q2 (a) Write in detail about the factors affecting fermentation viscosity? [2]
(b) A fermentation broth with viscosity $10^{-2}$ Pa s and density 1000 kg $m^{-3}$ is agitated in a 2.7 $m^3$ baffled tank using a Rushton turbine with diameter 0.5 m and stirred speed 1 $s^{-1}$. Estimate the mixing time. [3]

Q3 Write in detail about the aerobic processes of producing ethanol. [5]

Q4 Write in detail about the process for Acetone-Butane production. [5]

Q5 Consider the first-order reaction $A \rightarrow B$ carried out in a tubular reactor of 10 cm in diameter and 6.36 m in length in liquid phase. The kinetic constant is 0.25 min-1. A pulse tracer test is performed in the reactor with the following results: [5]

| t (min) | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C (g/m3) | 0 | 1 | 5 | 8 | 10 | 8 | 6 | 4 | 3 | 2.2 | 1.5 | 0.6 | 0 |

Calculate the conversion in the system obtained using: a) the dispersion model for a closed closed vessel, b) tanks-in-series model, c) ideal PFR model d) complete segregation model, e) ideal CSTR model.

Q6 (a) According to several experiments carried out in a continuous stirred tank reactor we suspect that the behaviour of the reactor is not ideal. The response to a pulse tracer test is given by equation $C(t) = 5t \exp(-2.5t)$ (with t in min). It seems that the reactor can be modelled considering that the fluid elements of different ages do not mix with each other, appearing like if small batch reactors were operating inside the continuous reactor. (a) Which fraction of the effluent remains in the reactor after the first minute after injection of the tracer? [2]
(b) Which conversion could be achieved in this reactor if a second-order reaction were carried out in liquid phase with $kC_{A0} = 23.75$ $min^{-1}$? (k referred to-rA). [3]

**::::::11/09/2018 ::::::M**