JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -2 EXAMINATION- 2024

B.Tech-V Semester (BT & BI)

COURSE CODE (CREDITS): 18B11BT511 (04) MAX. MARKS: 25

COURSE NAME: Bioprocess Engineering

COURSE INSTRUCTORS: Dr. Saurabh Bansal MAX. TIME: 1 Hour 30 Minutes

Note: *(a) All questions are compulsory.*

(b) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems

(c)The candidate is allowed to bring a formula sheet signed by me during the exams.

Q. No.	Question	CO	Marks
Q1	Differentiate Between the following: a) Axial Flow Impeller & Radial Flow Impeller b) Quasi Steady State & Steady State	CO-1	4
Q2	The equation for aerobic production of acetic acid from ethanol is: $C_2H_5OH + O_2 \rightarrow CH_3COOH + H_2O$. (Ethanol) (Acetic acid) *Acetobacter aceti* bacteria are added to a vigorously aerated medium containing 10 g l^{-1} ethanol. After some time, the ethanol concentration is 2 g l^{-1} and 7.5 g l^{-1} acetic acid is produced. How does the overall yield of acetic acid from ethanol compare with the theoretical yield?	CO-1	2
Q3	In an animal cell culture, which type of impeller (Rushton or Marine propeller) should be used and why?	CO-2	2
Q4	How do you explain the difference between the amount of electrical power consumed by the motor and the power dissipated by the stirrer?	CO-2	2
Q5	Which mode of fermentation will you prefer for the following cases? Also, give the justification for your answer. a) During a fermentation process, an unwanted toxic metabolite is produced along with desired products. b) A high concentration of growth-limiting substrates inhibits product production.	CO-2	2

Q6	*Lactobacilus casei* is propagated under essentially anaerobic conditions to provide a starter culture for manufacture of Swiss cheese. The culture produces lactic acid as a by-product of energy metabolism. The system has the following characteristics: $Y_{x/s} = 0.23$ kg kg^{-1}, $K_s = 0.15$ kg m^{-3}, $\mu_{max} = 0.35$ h^{-1} A stirred fermenter is operated in fed-batch mode at quasi steady state with a feed flow rate of 4 m^3 h^{-1} and feed substrate concentration of 80 kg m^{-3}. After 6 h, the liquid volume is 40 m^3. What was the initial culture volume?	CO-3	2
Q7 (a)	A strain of *Escherichia coli* has been genetically engineered to produce human protein. A batch culture is started by inoculating 12 g cells into a 100-1itre bubble-column fermenter containing 10 g l^{-1} glucose. The maximum specific growth rate of the culture is 0.9 h^{-1}; the biomass yield from glucose is 0.575 g g^{-1}. Estimate the time required to reach the stationary phase.	CO-3	2
Q7 (b)	What will be the final cell density if the fermentation is stopped after only 70% of the substrate is consumed?	CO-3	2
Q8	An industrial fermenter containing 1000 L of medium needs to be sterilized. The initial spore concentration in the medium is 10^5 spores mL^{-1}. The desired probability of contamination after sterilization is 10^{-3}. The death rate of spores at 121 °C is 5 min^{-1}. Assume that there is no cell death during the heating and cooling phases. Estimate the holding time of the sterilization process in min.	CO-4	2
Q9	Laboratory-scale fermenters are usually mixed using small stirrers with electric motors rated between 100 and 500 W. One such motor is used to drive a 7-cm turbine impeller ($N_p = 5$) in a small reactor containing fluid having a viscosity and density of 1 g/cm^3. The stirrer speed is 900 rpm. Estimate the power requirements for this process.	CO-4	3
Q10	A fermentation broth with a viscosity of 10^{-2} Pa.s and density of 1000 kg m^{-3} is agitated in a 3 m^3 baffled tank using a Rushton turbine with a diameter of 0.5 m and stirrer speed of 1 s^{-1}. Estimate the mixing time.	CO-4	2