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

CLASS: BE **SEMESTER : VII**
BRANCH: BIOTECHNOLOGY **SESSION : MO/18**

SUBJECT: BT7023 BIOREACTOR AND BIOPROCESS DESIGN

TIME: 3.00 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) Describe the process of oxygen transfer methodology from air bubble to the cluster of cells in the fermentation broths. [2]

Q.1(b) Write in detail about i) Airlift fermentor ii) Three- phase fluidized bed reactor. [4]

Q.1(c) Calculate the Reynolds number and power required to agitate a 10,000 litre tank filled with water. The diameter of the tank is 2.0 m and is agitated at 100 rpm by a 6-blade turbine type agitator. The agitator is half the tank diameter. (Np=4) [6]

Q.2(a) Write about the aerobic processes of producing ethanol. [2]

Q.2(b) Write in detail about the commercial importance of penicillin. [4]

Q.2(c) Explain the production process of citric acid by submerged fermentation. [6]

Q.3(a) Distinguish between ideal and non-ideal reactors. [2]

Q.3(b) Describe F curve and C-curve in RTD studies of non –ideal flow bioreactor. [4]

Q.3(c) The concentration at the exit end against a pulse input in a reactor is presented in the following table for RTD analysis [6]

t (S)	0	150	175	200	225	240	250	260	275	300	325	350	375	400	450
C (g/ L)	0	0	1	3	7.4	9.4	9.7	9.4	8.2	5.0	2.5	1.2	0.5	0.2	0

Plot $E(t)(t\text{-}tm)^2$ as a function of time. What fraction of material spends between 230 and 270 s in the reactor?

Q.4(a) Write about scale down approach methods. [2]

Q.4(b) List out the criteria to be followed for scaling up of a bioreactor using i) Constant power input per unit volume (P/V = constant). ii) Constant KLa. [4]

Q.4(c) Scraper blades set to rotate at 35 rpm are used for a pilot plant addition of liquid ingredients into a body-wash product. What should the speed of the blades be in a full-scale plant, if the pilot and the full-scale plants are geometrically similar in design? Assume scaleup is based on constant tip speed, diameter of the pilot plant scraper blades is 0.6 m, and diameter of the full-scale plant scraper blades is 8 ft. [6]

Q.5(a) Write about the different welding methods used in the fermenter vessel construction. [2]

Q.5(b) Write in detail about the piping for biotechnology production plants. [4]

Q.5(c) Write down the different types of valves used in bioreactor with suitable explanation. [6]

Q.6(a) What is a biosensors? [2]

Q.6(b) Explain the different methods of on-line and off-line biomass estimation. [4]

Q.6(c) Write in detail about the Physical and chemical sensors for the analysis of medium and gases in the fermentor. [6]

Q.7(a) Write about Prandtl number and Nusselt number. [2]

Q.7(b) A stirred tank bioreactor is approximately cylindrical in shape. It has a total volume (V_t) of 100,000 litres. Calculate the dimensions of the reactor. [4]

Q.7(c) Write the various steps involved in designing a suitable bioreactor for the production of recombinant human therapeutic protein expressed in *Pichia pastoris*. [6]

:::::30/11/2018:::::M