QP Code: R262B024 | Reg. No | | | | | | | | | | | AY 25

GANDHI INSTITUTE OF ENGINEERING AND TECHNOLOGY UNIVERSITY, ODISHA, GUNUPUR

(GIET UNIVERSITY)

M.Tech. (Second Semester) Regular Examinations, , May – 2026

24MCHPE12001 – Bioprocess Engineering

Chemical Engineering

Time: 3 hrs | Maximum: 60 Marks

Answer ALL questions

(The figures in the right hand margin indicate marks)

PART – A **(2 x 5 = 10 Marks)**

Q.1. Answer ***ALL*** questions	CO #	Blooms Level
a. Evaluate the importance of the effectiveness factor in chemical reaction engineering and explain its influence on reaction performance inside catalytic systems.	CO2	K1
b. Classify and explain the epigenetic and metabolic subsystems within a saturated biological model.	CO3	K1
c. Discuss the major industrial and biochemical applications of a plug flow reactor (PFR).	CO3	K2
d. Explain the function of elicitors in activating plant defense responses and secondary metabolite production.	CO4	K1
e. Distinguish between transduction and transformation as mechanisms of genetic material transfer in bacteria.	CO4	K3

PART – B **(10 x 5=50 Marks)**

Answer ***ALL*** the questions	Marks	CO #	Blooms Level
2. a. Determine the free-energy change of a biological reaction using the standard free energies of formation of the reactants and products involved.	5	CO1	K1
b. Discuss the thermodynamic aspects of biological reactions involving different electron donors and electron acceptors, and explain how these variations influence reaction free energy.	5	CO2	K2
(OR)			
c. Examine the important electron-donor half reactions associated with glucose oxidation in biological systems.	5	CO1	K1
d. In the aerobic oxidation of glucose with microbial growth, NH_4^+ serves as the nitrogen source and the final products formed are CO_2 and H_2O. Given the empirical formula of bacterial biomass as $C_5H_7NO_2$, calculate the stoichiometric coefficients for the overall microbial conversion assuming that 40% of the electrons are utilized for biosynthesis and 60% for energy production.	5	CO1	K2
3.a. Explain the kinetic modelling of microbial product formation using the Leudeking–Piret model with reference to substrate (carbon source) utilization.	5	CO2	K2
b. Differentiate between growth-associated, non-growth-associated, and mixed-growth-associated product formation kinetics based on the relationship between product synthesis and cellular energy metabolism.	5	CO2	K1
(OR)			
c. Compare the four phases of the microbial growth cycle by discussing the characteristics of each phase.	5	CO2	K2
d. Describe the various methods used for determining cell biomass and measuring cell numbers in unicellular microorganisms.	5	CO2	K3

4.a.	Compare the different types of impellers used in bioreactors with respect to their design features and the flow patterns they generate.	5	CO3	K2
b.	Discuss the important considerations that must be taken into account while designing an efficient fermenter for industrial bioprocess applications.	5	CO3	K3
	(OR)			
c.	Explain the major advantages offered by spiral heat exchangers in heat transfer operations.	5	CO3	K1
d.	Describe the design principles of a continuous sterilization system, highlighting the heating stage to attain sterilization temperature, the holding period at the required temperature, and the cooling stage to bring the medium back to fermentation temperature.	5	CO3	K2
5.a.	Discuss the theoretical basis used for predicting yield coefficients in biochemical and fermentation processes.	5	CO4	K1
b.	Calculate the theoretical biomass and product yield coefficients for ethanol fermentation by Saccharomyces cerevisiae based on the overall reaction: $C6H12O6 \rightarrow 2\ C2H5OH+2\ CO2$	5	CO4	K2
	(OR)			
c.	Explain the important factors that should be considered during the design of a fermenter for efficient bioprocess operation.	5	CO4	K1
d.	Compare the different impellers used in bioreactors with respect to their construction and the flow patterns generated during mixing.	5	CO4	K3
6.a.	Describe the role of bioprocess engineering in the development and production of biofuels.	5	CO3	K1
b.	Explain how bioprocess engineering helps in environmental protection through waste treatment, pollution control, and sustainable processing techniques.	5	CO4	K2
	(OR)			
c.	Discuss the thermodynamic behaviour of biological reactions involving different electron donors and electron acceptors, and explain how variations in reaction free energy influence biochemical processes.	5	CO3	K1
d.	Explain the method of calculating free-energy changes in biological reactions using the standard free energies of formation of reactants and products.	5	CO4	K2

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