Khulna University

School: Life Science **Discipline: BGE** **Program: BSc**
Year: 3rd **Term: II** **Examination Year: 2026** **Session: 2024-2025**
Course code: 0512 07 BGE- 3201 **Course Title: Fermentation and Bioreactor Design**
Total Marks: 60.0 **Time: 3.0 Hours** **Credit: 3.0**

- *Figures in the margin indicate full marks. Questions are of equal value.*
- *Use separate sheet for each section.*

SECTION- A

There are 04 (four) Questions in this section. Answer any 03 (three) Questions.

Question No.		Question Description	Marks	Level (L1-L6)	CLO No.
1	a)	What do you mean by viable cell count method? Explain with proper illustration that viable cell count method provides better batch growth curve.	04	1.2	1,2
	b)	Why reaction stoichiometry is important in making media? Explain with logic.	02	1,2	1,2
	c)	Classified and explain media with respect to chemical design. Write the role of inducers and inhibitors in fermentation media.	04	4,1	3,4
2	a)	What do you understand by inoculum development? Illustrate the process of inoculation of a plant fermenter from a pilot fermenter.	04	1,2	3,4
	b)	What is cell approximation? What are the cases of 'actual case' and 'most idealized case' of cell approximation?	02	1	3
	c)	Draw a fermenter with necessary parts. Interpret the role of each part.	04	3,5	5
3	a)	The specific growth rate for inhibited growth in a chemostat is given by the following equation: $$\mu = \frac{\mu_{max} S}{K_s + S + \frac{IK_s}{K_I}}$$ Where, S_0= 10 g/l, K_S= 1 g/l, I= 0.045g/l, μ_m= 0.40h^{-1}, K_I= 0.01 g/l and $Y_{x/S}$= 0.012 $\frac{g\ cells}{g\ substrate}$. Calculate the dilution rate for maximum cell productivity and washout dilution for a sterile feed condition.	05	3	4
	b)	Draw the relationship of cell concentration (x) and substrate concentration (S) with dilution rate (D). Discuss on dilution rate for maximum productivity, washout dilution and operating dilution rate.	03	3,2	3
	c)	Define and explain Monod equation.	02	1.2	4
4	a)	Write a brief note on types of bioreactors.	04	1	2
	b)	State and explain the importance of cell recycling in chemostat.	03	1,2	4
	c)	Compare between batch and continuous reactor.	03	5	5,9

SECTION - B

There are 04 (four) Questions in this section. Answer any 03 (three) Questions.

Question No.		Question Description	Marks	Level (L1-L6)	CLO No.
5	a)	What is solid state fermentation? Compare between solid state and liquid state fermentation.	03	1,5	1
	b)	Explain ethanol and lactate fermentation pathway in yeast and human respectively.	03	2	2
	c)	List the components of a bioreactor mentioning their functions.	04	4	3
6	a)	What is phase boundary? Explain cellular oxygen demand and critical oxygen concentration.	04	1,2	1
	b)	What is KLa? How can you measure KLa in solid-liquid mass transfer system?	03	1	3
	c)	Why filtration sterilization is important? Discuss the advantages of HEPA filter and membrane filter.	03	1,2	4
7	a)	What is bioprocess scalability? Discuss the phenomena to scale up of a bioprocess?	03	1,2	4
	b)	Discuss the challenges in scaling up of a bioprocess.	03	2	6
	c)	To scale up of a fermenter from 200 L to 1500 L capacity, occupancy in small scale = 56%, occupancy in large scale = 60%, time for small scale =3 min, time for large scale =3 min, blender speed for smaller scale =10rpm, total revolution of small scale = 30. Calculate blender speed for large scale.	04	3	4
8	a)	Define optimization. Discuss the graphical method of calculating optimization.	04	1,2	3
	b)	Design a process of production and recovery of monocular antibody from a bacterial culture.	03	4	3
	c)	What is process economics? How can you estimate cost of a bioprocess?	03	1	3

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Khulna University

School: Life Science **Discipline: BGE** **Program: BSc**
Year: 3rd **Term: II** **Examination Year: 2026** **Session: 2024-2025**
Course code: 0111 07 BGE- 3203 **Course Title: Technology Transfer**
Total Marks: 60.0 **Time: 3.0 Hours** **Credit: 3.0**

- *Figures in the margin indicate full marks. Questions are of equal value.*
- *Use separate sheet for each section.*

SECTION- A

There are 04 (four) Questions in this section. Answer any 03 (three) Questions.

Question No.		Question Description	Marks	Level (L1-L6)	CLO No.
1	a)	Define technology and technology transfer.	02	1	1
	b)	Evaluate the extent to which artificial intelligence can replace human involvement in managing technological systems.	04	5	1
	c)	Propose a new technology that addresses a real-world problem while meeting the core objectives of technology.	04	6	1
2	a)	Define learning and name the major theories and laws of learning.	02	1	1
	b)	Analyze the relationship between universities and industries in the technology transfer process with a suitable example.	04	4	1
	c)	Design an appropriate pyramid model to explain the stages of the affective domain of Bloom's taxonomy with suitable descriptions.	04	6	2
3	a)	Differentiate among formal, informal, and non-formal education with suitable examples.	03	2,3	2
	b)	Develop your own interpretation of philosophy of education by explaining the fundamental questions it should address.	03	6	2
	c)	Evaluate the claim that technology does more harm than good in modern classrooms. Support your judgment with reasoned arguments.	04	5	
4	a)	Illustrate the communication process with a suitable diagram and explain it using an example.	03	3	4
	b)	Examine how various principles of teaching contribute to enhancing teaching quality in different learning contexts.	04	4	3
	c)	Briefly discuss about the uses, advantages and disadvantages of lecture method of teaching.	03	2	3

SECTION – B

There are 04 (four) Questions in this section. Answer any 03 (three) Questions.

Question No.		Question Description	Marks	Level (L1-L6)	CLO No.
5	a)	Define innovation, adoption, and diffusion of technology. Explain the characteristics and types of innovation with suitable examples.	04	1	1
	b)	Describe the diffusion of innovation process, including adopter categories and the major factors affecting adoption and innovation.	03	2,3	2
	c)	Discuss the approaches for planning extension/technology transfer campaigns and explain the commercialization and dissemination of biotechnological innovations among farmers.	03	4,6	2
6	a)	Describe how social systems and communication play role in diffusion of innovation?	04	4	2
	b)	Discuss the different tools of technology assessment and describe their importance in evaluating technological development.	03	2,3	2
	c)	Explain the process of technology development and acquisition and evaluate their significance for industrial and agricultural advancement.	03	1	1,2
7	a)	Identify the major problems and issues of technology transfer and suggest possible measures for effective transfer and diffusion of technology.	03	4,6	2
	b)	Define technique, technology transfer, and diffusion of technology. Explain the concepts of recognize-how and planning in technology transfer.	04	1	1
	c)	Discuss the importance of material transfer agreements (MTA) and analyze the major problems and issues associated with technology transfer in biotechnology sectors.	03	5,6	4
8	a)	Explain the concepts of patents, trade secrets, trademarks, copyrights, and masks in intellectual property management.	04	1,2	2
	b)	Discuss the process of transferring and controlling intellectual property (IP) and explain the importance of capacity building in IP management in agricultural and livestock related biotechnology sectors.	03	3,4	4
	c)	Describe the methods of acquiring protection for improved germplasm and inbred lines and evaluate their significance in biotechnology commercialization and innovation development.	03	5,6	4

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Khulna University

School: Life Science **Discipline: BGE** **Program: BSc**
Year: 3rd **Term: II** **Examination Year: 2026** **Session: 2024-2025**
Course code: 0512 07 BGE- 3205 **Course Title: Bioinformatics**
Total Marks: 60.0 **Time: 3.0 Hours** **Credit: 3.0**

- *Figures in the margin indicate full marks. Questions are of equal value.*
- *Use separate sheet for each section.*

SECTION- A

There are 04 (four) Questions in this section. Answer any 03 (three) Questions.

Question No.		Question Description	Marks	Level (L1-L6)	CLO No.
1	a)	Define bioinformatics. Why is bioinformatics considered essential rather than optional in modern biological research?	04	1,4	1
	b)	A researcher retrieves a protein sequence from a database but later finds it contains errors. Identify potential causes and explain how these errors affect downstream analysis.	03	1	1
	c)	Evaluate the limitations of bioinformatics in real-world biological research.	03	1	1
2	a)	Differentiate between orthologs and paralogs.	02	1	1
	b)	Explain why the construction of a "true phylogenetic tree" becomes computationally difficult as the number of taxa increases.	03	1	1
	c)	Explain the principles and steps involved in UPGMA tree construction.	05	1	1
3	a)	What is highest resolution genome map?	02	3	1
	b)	What are the advantages of pyrosequencing over Sanger sequencing method?	03	4	5
	c)	What is base calling? Discuss key aspect during base calling.	03	2	1
	d)	What are the unique features of Linux over Windows operating system?	02	2	1
4	a)	Define Next Generation Sequencing (NGS). Discuss the advantages and disadvantages of NGS compared with traditional Sanger sequencing.	05	1	1
	b)	What is the difference between gene assembly and genome assembly?	03	5	2
	c)	What are Phred quality score?	02	2	3

SECTION - B

There are 04 (four) Questions in this section. Answer any 03 (three) Questions.

Question No.		Question Description	Marks	Level (L1-L6)	CLO No.
5	a)	State the differences between global and local alignment.	02	1	1
	b)	Describe the scopes of the prominent resources of NCBI and EBI briefly.	04	1	1
	c)	Briefly explain the dynamic programming method of pair-wise sequence alignment.	04	1	1
6	a)	How do we obtain PAM and BLOSUM scoring matrix?	02	2	3
	b)	What is database similarity search? With a hypothetical query discuss BLAST protocol.	04	3	4
	c)	'Ab initio-based gene prediction mechanism relies on gene content and gene signal'-elaborate.	04	4	5
7	a)	How GC bias and TESTCODE can predict coding regions?	04	1	1
	b)	Briefly describe the use of the Markov model in gene prediction.	03	1	1
	c)	Diagram the gene prediction outcomes for real and predicted genes.	03	1	1
8		Write short notes on the following- a) Homology modeling b) SWISSPROT c) Position specific scoring matrix (PSSM) d) Dot matrix algorithm	2.5x4=10		

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Khulna University

School: Life Science **Discipline: BGE** **Program: BSc**

Year: 3rd **Term: II** **Examination Year: 2026** **Session: 2024-2025**

Course code: 0512 07 BGE 3207 **Course Title: Medical and Pharmaceutical Biotechnology**

Total Marks: 60.0 **Time: 3.0 Hours** **Credit: 3.0**

- *Figures in the margin indicate full marks. Questions are of equal value.*
- *Use separate sheet for each section.*

SECTION- A

There are 04 (four) Questions in this section. Answer any 03 (three) Questions.

Question No.		Question Description	Marks	Level (L1-L6)	CLO No.
1	a)	Define the following terms with one example each in pharmaceutical manufacturing: (i) Good Manufacturing Practice (GMP), (ii) Quality Assurance (QA), (iii) Quality Control (QC), (iv) In-process control	4	2	1
	b)	A batch of recombinant insulin shows variation in purity between the start, middle, and end of filling. Analyze how failure of in-process controls could lead to this problem and suggest corrective actions.	6	4	1
2	a)	Explain the principle of a microbiological agar diffusion assay for determining the potency of an antibiotic.	4	2	1
	b)	You are tasked to produce a biopolymer (e.g., polyhydroxybutyrate) using recombinant *E. coli*. Describe the key steps involved, including gene selection, expression system, fermentation, and recovery.	6	3	1
3	a)	Compare live attenuated vaccines with subunit vaccines in terms of immune response, safety, and manufacturing challenges.	5	4	1
	b)	During quality control of an inactivated viral vaccine, the sterility test passes but the potency test fails. Evaluate the possible causes and decide whether the batch can be reprocessed or must be rejected. Justify your answer.	5	5	1
4	a)	Describe the production process of recombinant human insulin using *E. coli,* including downstream processing.	5	3	1
	b)	A patient presents with symptoms of a genetic disease. Compare how conventional diagnostic methods (e.g., clinical examination, culturing) differ from molecular techniques (e.g., PCR, sequencing) in detecting the cause. Which would you recommend for rapid and accurate diagnosis? Justify.	5	4	1

SECTION – B

There are 04 (four) Questions in this section. Answer any 03 (three) Questions.

Question No.		Question Description	Marks	Level (L1-L6)	CLO No.
5	a)	Briefly explain the strategies used for the cloning of a disease gene.	03	5	1
	b)	Mention five commercially available gene therapy products and state their modes of action.	03	1	1
	c)	Discuss the process of DigiCGA mentioning some of the application software and online tools related to it.	04	5	2
6	a)	Provide a list of molecular methods used to detect an unknown gene mutation.	03	1	1
	b)	Discuss the challenges of gene therapy.	04	6	1
	c)	Compare ZNF, TALEN and CRISPR/Cas9 mentioning their advantages and limitations.	03	4	1
7	a)	Define STR and VNTR. Mention their suitability as genetic markers.	03	1	1
	b)	"DNA fingerprinting technique has many applications in diverse fields from forensic to medical science." Elaborate this statement.	04	6	2
	c)	In a disputed paternity case, a child's STR profile is compared to the mother and a potential father. Does this man qualify as the biological father?	03	5	3
8	a)	Briefly explain the clinical progress of engineered cellular immunotherapies for autoimmunity.	04	5	3
	b)	"All biotechnological products are not patentable." – Justify this sentence.	03	5	1
	c)	What items shall be observed when someone is handling recombinants for storage and transportation?	03	1	3

Locus	Mother	Child	Alleged Father
TH01	6,9	6,7	7,8
TPOX	8,11	8,8	8,12
CSF1PO	10,12	12,13	11,14

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Khulna University

School: Life Science **Discipline: BGE** **Program: BSc**
Year: 3rd **Term: II** **Examination Year: 2026** **Session: 2024-2025**
Course code: 0512 07 BGE- 3209 **Course Title: Biopharmaceutical Chemistry**
Total Marks: 60.0 **Time: 3.0 Hours** **Credit: 3.0**

- *Figures in the margin indicate full marks. Questions are of equal value.*
- *Use separate sheet for each section.*

SECTION- A

There are 04 (four) Questions in this section. Answer any 03 (three) Questions.

Question No.		Question Description	Marks	Level (L1-L6)	CLO No.
1	a)	What is a biosimilar drug? Mention two examples of recombinant therapeutic proteins.	02	1	1
	b)	Explain the phases of drug metabolism with suitable examples.	04	2	2
	c)	Analyze the mechanism of action and therapeutic applications of monoclonal antibodies in modern medicine.	04	4	3,4
2	a)	Write short notes on: (i) Pharmacodynamics (ii) Half-life of drugs (iii) Therapeutic index.	03	1	1
	b)	Describe the possible routes of drug administration and their advantages.	03	4	3
	c)	Evaluate the importance of recombinant DNA technology in the production of insulin and growth hormone.	04	5	3,4
3	a)	What are antibiotics? Classify different types of antibiotics based on mode of action.	02	1	1
	b)	Explain receptor-ligand interaction and signal transduction in drug action.	03	2	2
	c)	Analyze the chemistry, mechanism and resistance pattern of β-lactam antibiotics.	05	4	2,3
4	a)	State the role of adjuvants in vaccine efficacy. Mention two applications of immunotherapy in disease treatment.	03	2	2,3
	b)	Describe the principles and types of vaccine development.	03	2	3
	c)	Assess the applications and limitations of mRNA-based vaccines in infectious disease control.	04	5	3,4

SECTION – B

There are 04 (four) Questions in this section. Answer any 03 (three) Questions.

Question No.		Question Description	Marks	Level (L1-L6)	CLO No.
5	a)	Describe the drug-like properties such as lipophilicity, permeability, solubility, and bioavailability, along with the experimental techniques used for their assessment.	04	3	3
	b)	Explain the overall biopharmaceutical development process with a diagram.	04	6	3
	c)	What are the major types of challenges encountered in biophysical measurements?	02	5	3
6	a)	What are the biopharmaceutic considerations in drug product design based on the route of administration?	04	5	3
	b)	Define the following terms: (i) Pharmacogenomics (ii) Biotransformation (iii) Drug toxicity	03	1	1
	c)	Explain the role of cytochrome P450 enzymes in drug metabolism.	03	3	2
7	a)	What do you mean by active pharmaceutical ingredient (API)? Describe the production process of API precursors from whey.	05	2,6	3
	b)	Discuss the regulatory framework for NDA and ANDA drug approval processes.	03	3	3
	c)	If two APIs are pharmaceutical equivalents, can we assume that these two APIs are also identical?	02	4	3
8	a)	"Nanomedicine has revolutionized cancer therapy through the EPR effect" — Justify the statement.	03	5	4
	b)	Explain the stepwise mechanism of RNA interference (RNAi) in targeted drug delivery.	04	6	4
	c)	How does PEGylation reduce immunogenicity and improve bioavailability of drugs?	03	6	4

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Khulna University

School: Life Science **Discipline: BGE** **Program: BSc**
Year: 3rd **Term: II** **Examination Year: 2026** **Session: 2024-2025**
Course code: 0512 07 BGE- 3211 **Course Title: Molecular Breeding**
Total Marks: 60.0 **Time: 3.0 Hours** **Credit: 3.0**

- *Figures in the margin indicate full marks. Questions are of equal value.*
- *Use separate sheet for each section.*

SECTION- A

There are 04 (four) Questions in this section. Answer any 03 (three) Questions.

Question No.		Question Description	Marks	Level (L1-L6)	CLO No.
1	a)	Define mapping population. Discuss the importance of mapping populations in linkage mapping and quantitative trait loci (QTL) analysis.	05	1	1
	b)	Analyze why recombinant inbred line (RIL) populations are considered more efficient than F_2 populations for fine mapping studies.	05	1	1
2	a)	Compare single marker analysis (SMA), simple interval mapping (SIM), and composite interval mapping (CIM).	03	1	1
	b)	Define quantitative trait loci (QTL). Explain the significance of QTL mapping in molecular breeding.	04	1	1
	c)	Discuss different types of genetic markers used in molecular breeding with suitable examples.	03	1	1
3	a)	Define marker-assisted selection. Summarize the prerequisites of marker assisted selection.	03	1,2	2
	b)	Explain marker-assisted gene introgression with suitable examples.	03	1	1
	c)	Discuss the principles and importance of gene pyramiding in developing disease-resistant crop varieties.	04	1	1
4	a)	Describe the mechanism and applications of RNA interference (RNAi) in plant breeding.	05	1	1
	b)	What do you mean by cloning vector? Elaborate the features of a yeast artificial chromosomes.	05	1,6	3

SECTION - B

There are 04 (four) Questions in this section. Answer any 03 (three) Questions.

Question No.		Question Description	Marks	Level (L1-L6)	CLO No.
5	a)	What is (G × E)? Provide an explanation with figure.	03	1,5	2,3
	b)	Briefly explain how biotechnology assists molecular breeding of farm animals.	04	5	2,3,4
	c)	Mention different sequencing data analysis tools used in molecular breeding of animal.	03	1	2, 3
6	a)	Why do we use molecular genetic techniques in animal breeding?	03	1	2,3,4
	b)	Discuss the DNA markers frequently used in the program of marker-assisted selection in animal.	04	6	2
	c)	"Currently available DNA sequencing techniques are high-throughput". Explain this statement.	03	5	2
7	a)	Discuss the applications of PCR and DNA sequencing in molecular breeding.	04	3	2
	b)	Illustrate an ideal cattle mtDNA.	02	2	2
	c)	"Mammalian mtDNA transcription is a well-regulated process". Justify this statement.	04	5	2
8	a)	What are the key elements of a phylogenetic tree? Briefly discuss them with appropriate figure.	03	1,5	4
	b)	Explain the distance-based methods for construction of a phylogenetic tree.	03	5	4
	c)	What are paralogs and orthologs? How a romerogram show the diversity of taxa through time?	04	1	4

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