

Khulna University, Khulna, Bangladesh
Biotechnology and Genetic Engineering Discipline
Year:1st Term: I Examination-2026, Session:2025-2026
Course No. 051207 BGE-1101

Course Title: Introduction to Biotechnology and Genetic Engineering
Full Marks:60 Time: 03 hours Credit:3.0

Section: A

(There are four questions in this section. Answer any three questions.)

	Questions Description	Marks
1.	(a) Briefly explain the color codes of biotechnology. [L1, L5, CLO2].	03
	(b) Discuss the multidisciplinary nature of biotechnology using the biotechnology tree. [L4, CLO2, 3].	03
	(c) "Biotechnology interventions in Bangladesh are primarily focused on enhancing agricultural productivity, food security, and industrial self-sufficiency."-Elaborate this statement. [L4, CLO 2, 3].	04
2.	(a) What is restriction endonuclease? Why does restriction endonuclease not destroy their own cell DNA? [L5, CLO 2, 3].	04
	(b) What is rDNA technology? Illustrate the process of rDNA technology. [L1, 2, CLO1].	03
	(c) Compile different DNA editing tools used in genetic engineering. [L1, CLO1, 3].	03
3.	(a) How agricultural biotechnology serves human welfare? Provide specific examples. [L1, L4, CLO 2, 3].	03
	(b) Discuss the mechanisms of biocontrol of plant pathogen, insects and pests. [L1, L2, CLO2, 3].	04
	(c) Define GMO. Briefly explain the role of GM crops in attaining food security. [L1, L5, CLO 1, 3].	03
4.	(a) What are fermentation, fermented foods and single cell protein (SCP)? [L1, CLO2].	02
	(b) Describe the use of different engineered enzymes in food industries. [L6, CLO 1, 2].	03
	(c) Briefly explain different sources and applications of SCPs. [L1, L5, CLO 2, 3].	03
	(d) What are the key health benefits of fermented foods? [L1, CLO 1, 2].	02

Section-B

(There are four questions in this section. Answer any three questions.)

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| 5. | (a) | What is covalent immobilization? Discuss its industrial applications with suitable examples. [L2, L3, CLO3]. | 02 |
| | (b) | Compare free enzymes and immobilized enzymes in terms of efficiency, stability, and industrial application. [L4, CLO3]. | 03 |
| | (c) | Design a flow diagram for industrial production and purification of invertase enzyme from microbial sources.[L6, CLO3]. | 05 |
| | | | |
| 6. | (a) | What are recombinant vaccines? Mention two examples of recombinant vaccines. [L1, CLO3]. | 03 |
| | (b) | Compare conventional vaccines and recombinant vaccines in terms of safety, efficiency, and production. [L4, CLO3]. | 03 |
| | (c) | Discuss the applications of biotechnology in the production of therapeutic proteins and blood products. [L2, L3, CLO3]. | 04 |
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| 7. | (a) | What is meant by renewable energy sources? List four major types of renewable energy sources. [L1, CLO1]. | 02 |
| | (b) | Why second-generation biofuels are considered more sustainable than first-generation biofuels? [L2, CLO1]. | 02 |
| | (c) | Propose an improved biotechnological strategy to enhance ethanol yield from plant biomass. [L6, CLO2]. | 06 |
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| 8. | (a) | What is in situ bioremediation? Explain how microbes degrade hydrocarbons in oil polluted environments.[L1, L2, CLO2]. | 03 |
| | (b) | How can <i>pseudomonas</i> species be applied in heavy metal detoxification? Explain with biochemical mechanisms. [L3, CLO2]. | 03 |
| | (c) | Explain different biosafety levels. Why do we need to maintain such levels? [L6, CLO3]. | 04 |

Khulna University, Khulna, Bangladesh
Biotechnology and Genetic Engineering Discipline
Year:1st Term: I Examination-2026, Session:2025-2026
Course No. 051207 BGE-1103 Course Title: Cell Biology
Full Marks:60 Time: 03 hours Credit:3.0

Section: A

(There are four questions in this section. Answer any three questions.)

	Questions Description	Marks
1.	(a) Define cell biology. Describe the applications of cell biology in animal science.[L1, CLO2]	03
	(b) State modern cell theory. Compare cell theory and organismal theory. [L1, 2, CLO1].	03
	(c) What are archaea? Draw and Label a comparative diagram showing the structural differences between and archaeal cell and bacterial cell. [L1, 5, CLO1].	04
2.	(a) Define cell signaling. Analyze how mechanical and biochemical signaling differ in their mechanisms and cellular responses. [L1, 3, CLO2, 3].	03
	(b) Define receptor in cell signaling pathway with examples. Identify the functions of receptor proteins in signal transduction. [L1, CLO2, 3].	03
	(c) Discuss how endocrine and paracrine signaling differ in terms of signal transmission distance and physiological roles. [L2, CLO2, 3, 4].	04
3.	(a) Define cell cycle. Briefly describe the resting phase of cell cycle with diagram. [L1, 4, CLO3].	04
	(b) What are 3 reasons why cells divide? [L2, CLO3].	03
	(c) Mention various check points of cell cycle. Write the significance of the check points. [L5, CLO 2, 3].	03
4.	(a) List the major enzymes involved in eukaryotic DNA replication. Mention the function of DNA ligase in DNA replication. [L1, CLO 2, 3].	03
	(b) Illustrate the process of leading and lagging strand synthesis with appropriate diagram. [L3, CLO2, 3, 4].	05
	(c) Differentiate between meiosis I and meiosis II[L2, CLO2, 3].	02

Section-B

(There are four questions in this section. Answer any three questions.)

5.	(a) Analyze the roles of the cell wall and cell membrane in maintaining the shape and survival of a plant cell. [L4, CLO1].	04
	(b) Illustrate the structure of mitochondria and explain its functions in the cell. [L2, CLO1].	03
	(c) Assess the composition of the cytosol and how its components contribute to various cellular functions. [L5, CLO1].	03

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| 6. | (a) | Evaluate the importance of the phospholipid structure in maintaining cell membrane integrity and function under varying environmental conditions. [L5, CLO1]. | 04 |
| | (b) | Briefly describe the different types of protein molecules found in plasma membrane. [L2, CLO1]. | 03 |
| | (c) | Classify and define the different types of cytoskeleton. [L4, CLO1]. | 03 |
| 7. | (a) | Define nucleosome and chromatin. [L1, CLO2]. | 02 |
| | (b) | Justify the importance of the unique characteristics of the prokaryotic chromosome in maintaining the survival of prokaryotic cells. [L6, CLO2]. | 04 |
| | (c) | How could you classify chromosome according to the organisms that have separate sexes? Give examples. [L4, CLO2]. | 02 |
| | (d) | What is allocycle and heteropiconosys? [L1, CLO 2]. | 02 |
| 8. | (a) | Describe isochromosome and diplochromosome with appropriate diagram [L2, CLO2]. | 03 |
| | (b) | State the definition of karyotype. Compile the significance of karyotype. [L1, CLO2]. | 03 |
| | (c) | Do you agree that karyotype can identify chromosomal abnormalities of human? Give a list of six diseases in human with respective chromosomal abnormalities. [L6, L1, CLO2]. | 04 |

Khulna University, Khulna, Bangladesh
Biotechnology and Genetic Engineering Discipline
Year:1st Term: I Examination-2026, Session:2025-2026
Course No. 051207 BGE 1105 Course Title: Plant Physiology
Full Marks:60 Time: 03 hours Credit:3.0

Section: A

(There are four questions in this section. Answer any three questions.)

	Question Description	Marks
1.	(a) Define plant physiology. Explain the scope of plant physiology in Biotechnology and Genetic Engineering. (L2, CLO1).	04
	(b) Describe the effects of different cultural practices on crop physiology and yield performance. (L3, CLO1).	03
	(c) How does zinc (Zn) act as a cofactor in enzymatic activity and influence plant growth and development? (L4, CLO1, 2).	03
2.	(a) Mention the physiological role and deficiency symptoms of macronutrient with examples in tabular form. (L2, CLO1, 2).	03
	(b) Classify and enlist plant nutrients into macro and micronutrients with their major sources and chemical forms absorbed by plants. (L2, CLO1).	03
	(c) Illustrate the two reaction centers of photosystem II and photosystem I in plant photosynthesis. (L2, CLO3).	04
3.	(a) Describe the photosynthetic apparatus and explain how light energy is transformed into chemical energy during photosynthesis. (L3, CLO2).	03
	(b) How does the C4 (hatch-Slack) pathway minimize photorespiration in plants? Explain its mechanism. (L4, CLO3, 4).	04
	(c) Discuss the factors affecting photosynthesis and explain the significance of source-sink relationship in crop productivity. (L4, CLO 4).	03
4.	(a) Give a schematic representation of glycolysis pathway and discuss the importance of its rate-limiting step. (L3, CLO3, 4).	03
	(b) Define chemiosmosis and diagrammatically represent the electron transport chain and chemiosmosis process. (L1, CLO3).	04
	(c) Write down the significance of photorespiration. (L2, CLO4).	03

Section-B

(There are four questions in this section. Answer any three questions.)

5.	(a) Classify plant growth regulators with suitable examples and mention their occurrence in plants. (L2, CLO1).	03
	(b) Explain the physiological and biochemical roles of auxins, gibberellins and cytokinins in plant growth and development.	04
	(c) Describe the role of florigen in flowering mechanism. (L1, CLO3, 4).	03

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| 6. | (a) | Define vernalization. Demonstrate the impact of vernalization. (L2, CLO2). | 03 |
| | (b) | Explain how temperature and light impact during flowering. (L2, CLO3). | 04 |
| | (c) | State the importance of photoperiodism in agriculture. (L3, CLO4). | 03 |
| 7. | (a) | Define vegetative and reproductive growth. Mention the importance of balanced growth in crop yield. (L1, 2, CLO 2). | 03 |
| | (b) | Explain how growth patterns affect crop productivity. (L4, CLO3, 4). | 04 |
| | (c) | Discuss the significance of growth studies in plant breeding. (L6, CLO3, 4). | 03 |
| 8. | (a) | Define germination test. Explain the principles of seed germination testing and mention the abnormal structures of germinated rice seed. (L1, 2, CLO 2, 3). | 03 |
| | (b) | What are biotic and abiotic stresses in plants? Describe the mechanisms by which plant tolerate salt and draught stress. (L1, L2, CLO 3, 4). | 04 |
| | (c) | Explain the different methods used to test seed viability including physical, chemical and biological approaches. (L3, CLO4). | 03 |

Khulna University, Khulna, Bangladesh
Biotechnology and Genetic Engineering Discipline
Year:1st Term: I Examination-2026, Session:2025-2026
Course No. 051207 Bot 1151 Course Title: Evolutionary and Functional Botany
Full Marks:60 Time: 03 hours Credit:3.0

Section: A

(There are four questions in this section. Answer any three questions.)

Q.	Questions Description	Marks
1.	(a) Briefly describe the biological evolution of life in earth. [L1, CLO1]	03
	(b) Enlist some evidences that support endosymbiotic theory. [L4, CLO1].	03
	(c) Briefly describe the phases of chemical evolution of life with appropriate diagram. [L6, CLO1].	04
2.	(a) Elucidate the identifying morphological traits of Orchidaceae. [L4, CLO2].	03
	(b) Compare and contrast between the key components of C3 and C4 leaves. [L3, CLO2].	03
	(c) Discuss the floristic region of Bangladesh. [L6, CLO2].	04
3.	(a) What is cytotaxonomy and chemotaxonomy? [L1, CLO1].	02
	(b) How can you differentiate between primary and secondary metabolite? [L4, CLO2].	02
	(c) "Plant taxonomy helps to conserve biodiversity". – Justify this statement. [L5, CLO 2, 3].	03
	(d) Explain the economic importance of family Orchidaceae and Cucurbitaceae. [L3, CLO 2].	03
4.	(a) Define ecology and ecosystem. [L1, CLO1].	01
	(b) Summarize the concepts and applications of molecular plant ecology. [L2, CLO2].	02
	(c) Mention the characteristic features of mangrove ecosystem. [L1, CLO1].	03
	(d) How does greenhouse effect cause global warming and climate change? Describe briefly. [L2, CLO2].	04

Section-B

(There are four questions in this section. Answer any three questions.)

5.	(a) Discuss the cellular functions of mitochondria, endoplasmic reticulum, chloroplast, and Golgi complexes in a plant cell. [L3, CLO4].	04
	(b) Illustrate the distribution of vascular bundles in monocot and dicot plants. [L2, CLO2].	02
	(c) Briefly explain the plant tissue system with their functions. [L4, CLO2].	04
6.	(a) "The anther contains the reproductive and non-reproductive tissues". – Elaborate this statement. [L4, CLO3].	02
	(b) Mention the specific events occurred in phase I and phase II during anther development. [L1, CLO4].	02
	(c) Illustrate the morphological stages of microsporogenesis and microgametogenesis. [L2, CLO4].	03
	(d) "Different seed storage proteins are providing nutrition to the developing seedlings during germination"-justify this statement. [L5, CLO4].	03

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| 7. | (a) | Explain the major events of embryogenesis in the flowering plants. [L4, CLO4]. | 03 |
| | (b) | Analyze the role of pollen biotechnology in crop development. [L4, CLO4]. | 04 |
| | (c) | Provide any two examples of each of the following phytochemicals mentioning their source plant, chemical name and therapeutic properties- (i) Alkaloid (II) Glycosides (III) Volatile oils. [L2, CLO4]. | 03 |
| 8. | (a) | "Bangladesh is the land of medicinal plants". - justify this statement with appropriate examples. [L5, CLO4]. | 04 |
| | (b) | Illustrate disease triangle. [L2, CLO5]. | 02 |
| | (c) | Briefly explain the biotechnological interventions in plant disease management. [L6, CLO5]. | 04 |

Khulna University, Khulna, Bangladesh
Biotechnology and Genetic Engineering Discipline
Year:1st Term: I Examination-2026, Session:2025-2026
Course No. 053107 Chem 1151 Course Title: Inorganic and Biophysical Chemistry
Full Marks:60 Time: 03 hours Credit:3.0

Section: A

(There are four questions in this section. Answer any three questions.)

	Questions Description	Marks
1.	(a) Describe Rutherford's alpha particle scattering experiment. [L2, CLO1]. (b) Mention the properties of cathode rays. [L1, CLO1]. (c) The wavelength of red light is 700 nm. Calculate its frequency and wave number. [L5, CLO1].	05 03 02
2.	(a) What do you understand by atomic size, ionization energy and electronegativity of an element? Discuss how these properties change down a group for s-block elements? [L3, CLO1]. (b) Justify these statements- (i) Beryllium is harder than lithium. (ii) Be^{2+} ion gets more strongly hydrated than Li^+ ion. [L4, CLO1].	3+3=6 2+2=4
3.	(a) Explain the formation of ionic bond in sodium chloride (NaCl). Why this bond is considered ionic? [L3, CLO1]. (b) Why do hydrogen-bonded compounds have high solubility in water? (c) Show the solvation of sodium chloride in water. [L2, CLO1].	3+1=4 03 03
4.	(a) Narrate the characteristics of metallic bonding. [L1, CLO1] (b) Why the angle H-N-H in NH_3 molecule is 107.3° while the tetrahedral angle is 109.5° ? [L4, CLO1]. (c) Why do halogens act as strong oxidizing agents? [L2, CLO1].	04 04 02

Section-B

(There are four questions in this section. Answer any three questions.)

5.	(a) Define thermodynamics and discuss its important objectives and applications in Biochemistry. [L4, CLO2]. (b) Explain the term "system and surroundings". [L2, CLO2]. (c) Even in a resting state, the human body does not attain thermodynamic equilibrium with its environment. Using the concept of entropy, explain how living systems maintain order despite this tendency. [L6, CLO2]	04 02 04
6.	(a) Derive a relation between the relative lowering of vapour pressure and the molecular weight of the solute. [L5, CLO3]. (b) State the principle of solubility product. How the solubility of a salt is affected by the presence of a common ion? [L2, CLO3].	05 05

7. (a) State and explain Lowery-Bronsted theory and Lewis theory of acids and bases. In what way Lewis acid differs from Bronsted acid? 04
(b) Derive Henderson's equation to calculate the pH of a buffer solution. 04
(c) Describe the factors that influence the degree of dissociation. 02
8. (a) What is buffer solution? Explain the working mechanism of an acidic buffer solution using equilibrium concepts. [L1, CLO3]. 04
(b) Compare Thin Layer Chromatography (TLC) and Paper Chromatography in terms of principle, stationary phase, mobile phase, and applications. [L4, CLO3]. 04
(c) Calculate the pH of a solution containing 0.1 M ammonia and 0.1 M ammonium chloride ($K_b = 1.8 \times 10^{-5}$). [L3, CLO3]. 02

Khulna University, Khulna, Bangladesh
Biotechnology and Genetic Engineering Discipline

Year:1st Term: I Examination-2026, Session:2025-2026

Course No. 054107 Math 1153 Course Title: Mathematics

Full Marks:60

Time: 03 hours

Credit:3.0

Section: A

(There are four questions in this section. Answer any three questions.)

	Questions Description	Marks
1.	(a) Distinguish between explicit and implicit functions. [L1, CLO1].	03
	(b) Draw the plot and find the domain and range of the functions (i) $f(x) = 3 x - 4 + 1$ (II) $f(x) = -\sqrt{x - 1} + 1$ [L1, CLO1].	04
	(c) Prove that $\lim_{x \rightarrow 4} (2x - 2) = 6$ by applying (δ, ϵ) definition. Also find the value of δ when $\epsilon = 0.01$ [L5, CLO 1, 2].	03
2.	(a) Define continuity and differentiability of a function at a point. [L1, CLO2].	02
	(b) A function $f(x)$ is defined as follows: $f(x) = \begin{cases} -x^2 & \text{when } x \leq 0 \\ 5x - 4 & \text{when } 0 < x \leq 1 \\ 4x^2 - 3x & \text{when } 1 < x < 2 \\ 3x + 4 & \text{when } x \geq 2 \end{cases}$ Discuss the continuity and differentiability of $f(x)$ at $x = 2$ [L6, CLO2].	04
	(c) Find the increasing and decreasing regions of the functions below: (i). $f(x) = x^3 - 9x^2 + 24x$ (II). $f(x) = 3x + 4 $	04
3.	(a) Differentiate $\cos^{-1} \frac{1-x^2}{1+x^2}$ with respect to $\tan^{-1} \frac{2x}{1-x^2}$ [L5, CLO1,2].	03
	(b) State and prove Leibnitz's theorem. [L2, CLO2].	03
	(c) If $u = \sin^{-1} \frac{x}{y} + \tan^{-1} \frac{y}{x}$ then prove that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = 0$. [L2, CLO2]	04
4.	(a) Define successive differentiation of function with respect to a variable x . [L1, CLO2].	02
	(b) If $y = (\tan^{-1} x)^2$ then using successive differentiation prove that $(x^2 + 1)^2 \frac{d^2 y}{dx^2} + 2x(x^2 + 1) \frac{dy}{dx} - 2 = 0$. [L6, CLO2].	04
	(c) Find maximum and minimum values of a given function- $f(x) = 2x^3 - 15x^2 - 36x + 1$. [L1, CLO2]	04

Section-B

(There are four questions in this section. Answer any three questions.)

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| 5. | (a) | Use the method of substitution evaluating the following integrals
(i). $\int \frac{dx}{3+2\cos x}$ (ii). $\int \frac{xe^x}{(1+x)^2} dx$ (iii). $\int \sqrt{(x-2)(x-4)} dx$ [L5, CLO 1, 2]. | 10 |
| 6. | (a) | Write the properties of definite integrals. [L2, CLO1, 2]. | 03 |
| | (b) | Use the properties of definite integrals and show that
$\int_0^a f(x)dx = \int_0^a f(a-x)dx$ [L5, CLO 1.2]. | 03 |
| | (c) | Using the properties of definite integrals, evaluate $\int_0^\pi \left(x \sin x / 1 + \sin x \right) dx$
[L5, CLO 1,2]. | 04 |
| 7. | (a) | State fundamental theorem of definite integrals. [L3, CLO1, 2]. | 02 |
| | (b) | Evaluate the whole length of the asteroid $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$. [L5, CLO 1, 2]. | 04 |
| | (c) | Obtain the area of the cardioid $r = a(1 - \cos \theta)$. [L4, CLO 1, 2]. | 04 |
| 8. | (a) | Find the area enclosed between the graph of $y = \sin x$ and $y = 1 - \sin x$ for $0 < x < \pi$. [L1, CLO3]. | 05 |
| | (b) | Prove that $\Gamma(n+1) = n\Gamma n = n!$ [L6, CLO1, 2]. | 05 |