



Daffodil International University
Faculty of Science & Information Technology
Department of Computer Science & Engineering

Final Examination, Spring 2026

Course Code: CSE115, Course Title: Introduction to Biology & Chemistry for
 Computation

Level: 1 Term: 1 Batch: 71

Time: 02:00 Hrs

Marks: 40

Answer ALL Questions

[The figures in the right margin indicate the full marks and corresponding course outcomes. All portions of each question must be answered sequentially.]

1.	A research team is comparing genes involved in oxygen transport across different species. They find that a hemoglobin gene in humans is very similar to a gene found in chimpanzees. However, within humans, they also observe two similar genes: one responsible for <u>adult hemoglobin</u> and another for fetal hemoglobin, which arose due to gene duplication. The team also isolates a specific DNA fragment related to oxygen transport and inserts it into a fast-growing microorganism to amplify the gene. During sequencing, they observed that the process uses modified nucleotides that terminate chain elongation, helping determine the DNA sequence. a) Identify which genes are <u>orthologs</u> and which are <u>paralogs</u> in this scenario. Justify your answer. b) List the four types of dideoxynucleotides (ddNTPs) used in the Sanger sequencing method. For each ddNTP, briefly explain its role/importance in DNA sequencing.		CO2
2.	A bioinformatics team receives a transformed DNA sequence from a compressed genome database. However, the original sequence is missing, and only the Burrows–Wheeler Transform BWT(T) output is available: BWT(T): ACTGA\$TA The team must reconstruct the original DNA sequence and analyze its structure for further processing. a) Using the given BWT(T) string, apply the LF-mapping technique step-by-step to reconstruct the original DNA sequence. b) After reconstructing the sequence, generate the Burrows Wheeler Matrix (BWM) and identify the <u>Suffix Array (SA)</u> corresponding to the original sequence.		CO3
3.	During a flu outbreak, <u>50 students</u> were tested with a <u>rapid flu test</u>. Later, PCR tests showed that <u>20 students were actually infected</u>.		CO3

	Among these 20 infected students, <u>15</u> were correctly identified as positive by the rapid test. (+) At the same time, a part of a viral protein was sequenced: LASTFLAG - Query Sequence: FLABBERGASTED - Target Sequence: LASTFLAG 		
	a) Calculate the sensitivity of the rapid test. What does the value of sensitivity mean?	[4]	
	b) Illustrate an algorithm that will find the match between query sequence and target sequence where $k=1$ and show the regions of similarity.	[6]	
4	Draw a phylogenetic tree showing the following relationships: - A and B are closely related. - C and D share a common ancestor. - E diverged earlier than the others. - The common ancestor of A & B is more closely related to C & D than to E.		CO3
	a) Write the corresponding Newick format for your phylogenetic tree.	[5]	
	b) If the branch lengths are as follows, include them in the Newick notation and draw the tree. - Branch between A and B = 0.1 - Branch between C and D = 0.2 - Branch connecting (A,B) to (C,D) = 0.3 - Branch connecting E to the rest = 0.5	[5]	