

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
Biostatistics and Biomodeling (BIO G532)
FIRST SEMESTER 2023–2024
MID-SEMESTER EXAM (CLOSED BOOK)

DATE: 10.10.23

Max Mark: 50

DURATION: 90 MINS.

1. a) Draw alanine tetra-peptide with LDLD configuration on C α atoms and with following torsion angle specification. **[5]**

$\psi_1(^{\circ})$	$\omega_1(^{\circ})$	$\phi_2(^{\circ})$	$\psi_2(^{\circ})$	$\omega_2(^{\circ})$	$\phi_3(^{\circ})$	$\psi_3(^{\circ})$	$\omega_3(^{\circ})$	$\phi_4(^{\circ})$
180	180	0	180	0	180	0	180	0

b) Mark the groups where you expect steric clash. **[1]**

c) Draw a helical wheel diagram of the following helical segment of a protein to know whether the helix is amphipathic or not? [Consider L, I, V, F, C, M, A, W as hydrophobic residues]. The single letter code of amino acids is also attached herewith. Please indicate the residue number in your drawing. **[4]**

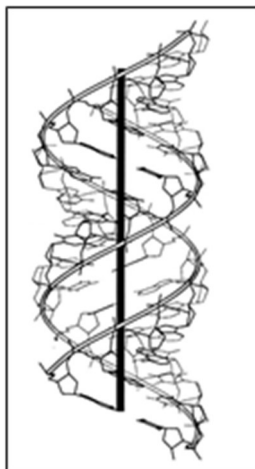
Ala-Arg-Leu-Lys-Ile-Tyr-Val-His-Ala-Glu-Asp-Asn-Phe-Ile-Ser-Cys-Gly-Ile-Ile

c) What factors influence the rotameric form (side chain conformation) of the amino acid side chain? **[3]**

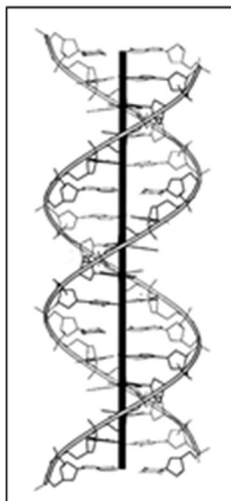
d) In nature γ -turns are frequently observed; however, the longer helix with i to $i+2$ hydrogen bond is never observed. Explain. **[2]**

2. a) Compare the following pairs i) alpha helix and DNA helix ii) C2' endo and C3' endo sugar pucker iii) Step parameters and basepair parameters. iv) Major and Minor groove of DNA **[4X1.5=6]**

b) What structural change will you perform to convert conformation I to conformation II of the following double helix DNA. **[4]**



I



II

- Q3. A) The standard deviation of a set of observations is $S = 1.5$. What is the variance? [1]
 B) The marks of 10 students in a particular examination are as follows: 10, 12, 15, 12, 16, 20, 13, 17, 15 and 10. Later, it was decided that 5 bonus marks will be awarded to each student. Compare the mean and standard deviation in the two cases [3]
 C) You and your lab partner record the following counts of stomata in 6 sunflower leaves: 88, 93, 90, 92, 75 and 78. You repeat the experiment with more number of leaves this time (10 leaves) and obtain the following readings: 67, 85, 90, 100, 72, 79, 99, 84, 75 and 78. Among the two experiments which data is more consistent? [3]

- Q4. A) Suppose you are a marine biologist studying a particular species of whales. The average length of this whale species is 60 feet and the standard deviation is 12 feet. The average length of whales is Normally distributed. [3]
 i. You find one member of this particular species of whales and measure it to find its length is 48 feet. What is the probability you find a whale smaller than this one?
 ii. One particular whale stands out to you because it has a z-score of 5.2. What does the z-score tell you?
 B) Heights of adult women have a mean of 63.6 inch and a standard deviation of 2.5 inch. If the data is **not** normally distributed: [4]
 i. what is the percentage of women with heights between 58.6 inch and 68.6 inch?
 ii. If 300 women are randomly selected, determine about how many are between 56.1 and 71.1 inches tall?

- Q6. A) A regression equation for left palm length (Y) and right palm length (X) for 55 college students gave an error sum of squares (SSE) of 10.7 and a total sum of squares (SST) of 85.2. What proportion of variation can be explained using this equation? [3]
 B) A biologist assumes that there is a relationship between the amount of fertilizer used and yield of tomatoes. Eight tomato plants of same variety were selected and treated weekly with x gm of solution dissolved in fixed quantity of water. The yield (y) was recorded [4]

Plant	A	B	C	D	E	F	G	H
x	1	2	3	4	5	6	7	8
y	4	4.5	5.5	6.5	7	7	7.5	8

According to you what kind of relationship exist between amount of fertilizer used and yield of tomato? Calculate the equation of least square regression line of y on x.

- Q7. Identify the Sampling method (random/ stratified/ systematic/ cluster) with justifications: [4]
 a) A psychologist is studying the sleep patterns of the 3960 students at her university. She lists the students by the neighborhood they live in. Further, she randomly selects six neighborhood and then randomly selects five students from each one.
 b) You need to sample elk in a large wilderness area. These elk occur in herds of many individuals, but the wilderness is vast, and they are found throughout it. You decide to sample random groups across the wilderness instead of sampling random individuals from each group. What type of sampling technique are you employing?