Biomolecular Structure, Interaction & Dynamics
QUIZ 1 - Monsoon 2020

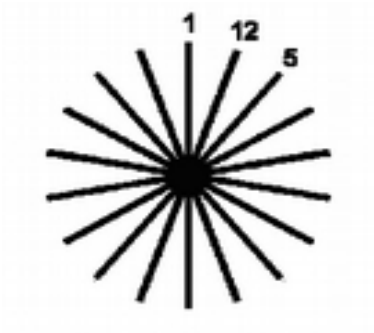
Time: 45 Minutes ***Max. Marks: 40***

*Answer **Question 1** and any **Three** from the rest*

Q1. a) Describe the allowed conformational space for the backbone torsions of an alanyl-alanine dipeptide. [**5**]

b) As Nature's chief engineer, you have been asked to design a five turn α-helix, half of whose circumference is buried in the interior of the protein. Draw the helical wheel projection of your prototype α-helix and its amino acid sequence. [**5**]

Q2.



Shown above is a helical wheel diagram which shows a schematic plan projection of '**n**' turns of a protein alpha helix. The positions of three of the residues are shown to provide a clue.

a) What is the value of 'n' in the above helix? [**1**]

b) What is the angle between two 'spokes' corresponding to consecutive residues. Hence fill in the rest of the residue numbers. [**2**]

c) Use the helical wheel and state whether the sequence below (from Calmodulin) could correspond to an amphipathic helix. **[7]**

RALRRLRTAAERAKRTLS

Q3. (a)Write short notes on Hard-spheres approximation, **[4]**

(b) Give one advantage and one disadvantage of NMR when compared to X-ray crystallography. [**4**]

c) Myoglobin and hemoglobin each bind oxygen and they have lot of similarities. However, they also have dissimilarities. One obvious difference between the two proteins is that myoglobin is a single polypeptide chain while vertebrate hemoglobins are tetrameric. The distribution of the surface residues is also different. Explain this difference. [**2**]

Q4. a) Draw a structure of a pentapeptide **Glu-Met-Arg-Thr-Gly** in its fully extended form and show one pair of donor and acceptor atoms which are involved in hydrogen bonds which lead to α - helix formation. How many atoms are there between a donor/acceptor pair in the above figure? How many residues are there? **[6+1+3=10]**

(b) name the carboxyl-terminal residue:

(c) give the number of charged groups at pH 7:

(d) give the net charge at pH 1:

Q5. What are reverse turns? What is their role in protein structures? Illustrate a typical β-turn. [**2+1+7=10**]

Q6. (a) Which of the following statements about the peptide bond are true? [**2]**

i) The peptide bond is planar because of the partial double-bond character of the bond between the carboxyl carbon and the nitrogen.

ii) There is relative freedom of rotation of the bond between the carboxyl carbon and the nitrogen.

iii) The hydrogen that is bonded to the nitrogen atom is trans to the oxygen of the carboxyl.

iv) There is no freedom of rotation around the bond between the alpha carbon and the carboxyl carbon.

b) Define helical parameters with the help of an illustration. [**2**]

c) The pitch of a double-helical B-form DNA is 3.4 nm and its twist is 36°. Find **'n'** and **'h'** for this helix? [**2**]

d) What is a hydrogen-bond? Elaborate with examples. **[4]**

RESOLVE TO PERFORM WHAT YOU OUGHT, PERFORM WITHOUT FAIL WHAT YOU HAVE RESOLVED