

**BITS PILANI, INTERNATIONAL ACADEMIC CITY, DUBAI**  
**III YEAR BIOTECH FIRST SEMESTER, 2012-2013**  
**COMPREHENSIVE EXAMINATION**

Course Title : Biophysical Chemistry

Course No: BIOT C339

Date: 6.01.2013

Total Marks: 40

Time: 3 Hours

Weightage: 40%

1. Answer all questions sequentially

2. Useful data :  $c = 3 \times 10^8$  m/s,  $h = 6.626 \times 10^{-34}$  J s,  $1 \text{ amu} = 1.660 \times 10^{-27}$  Kg,  
 $R = 0.0821$  liter·atm/mol·K,  $g = 9.81$  ms<sup>-2</sup>  
Atomic mass H=1, C=12, O=16

1.(i) Amino acid with an amide on the side chain does not produce basic solution.

Why?

(ii) The X-ray of wavelength 71 pm was used for an experiment. If the interplanar distance from KI is 353 pm, calculate the angle  $\theta$  for the first order diffracted beam.

(iii) Explain Tanford's approach used to quantify the polarity of amino acid.

(iv) Write the bond length and bond angle of weak hydrogen bonds.

[1+1+2+1M]

2.(i) Explain the factors that stabilize the quaternary structure of proteins.

(ii) Write the expression for free energy of coulombic interaction between two charges  $Q_1$  and  $Q_2$  separated by a distance  $r$ .

(iii) The force constant of  $^1\text{H}^{19}\text{F}$  is  $970 \text{ Nm}^{-1}$ . Calculate the fundamental vibrational frequency as well as the zero point energy.

(iv) Write any 2 major interactions involved in the tertiary structure formation of proteins with example.

[2+1+3+2M]

3.(i) Explain the common structural features of secondary structure of DNA.

(ii) Describe the various phases in a monolayer pressure-area isotherm.

(iii) What are X-rays? How are they created?

(iv) Calculate the molar mass of a non-volatile solute if, at 25°C, its solution containing  $1.6 \text{ gm/dm}^3$  has an osmotic pressure of 83 torr.

[3+2+3+2M]

4.(i) Explain the chiral features of nucleic acids.

(ii) Give the practical importance of dielectric studies in medical field. Write the outcome of the dielectric relaxation studies on aqueous DNA solutions.

(iii) Calculate the  $R_C$  and  $R_G$  for a freely jointed randomly coiled polymer chain if the number of monomeric units are 4000 and the bond distance is 163 pm.

(iv) Explain the heteropolymer collapse theory of protein folding.

[2+2+2+2M]

- 5.(i) Draw the two enantiomers of the amino acid alanine.
- (ii) The change in Gibbs energy that accompanies the oxidation of  $C_6H_{12}O_{6(s)}$  to carbon dioxide and water vapour at  $25^\circ C$  is  $-2828 \text{ kJ/mol}$ . How much glucose does a person of mass  $60 \text{ Kg}$  need to consume to climb through  $12 \text{ m}$ ?
- (iii) With a neat diagram describe the rotating crystal method used to study the diffraction of crystal.
- (iv) The shape of hair is determined in part by the pattern of disulphide bonds in its major portion, keratin. How are curls induced?
- (v) Explain the terms (a) Rayleigh scattering (b) Aquaporins. [1+2+3+1+2M]

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**BITS PILANI-DUBAI, INTERNATIONAL ACADEMIC CITY, DUBAI**  
**III YEAR BIOTECH FIRST SEMESTER, 2012-2013**

**TEST- 2 (Open book)**

Course Title : Biophysical Chemistry

Course No: BIOT C339

Date: 9.12.2012

Total Marks: 20

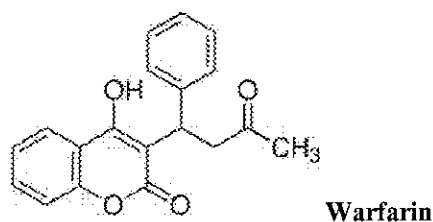
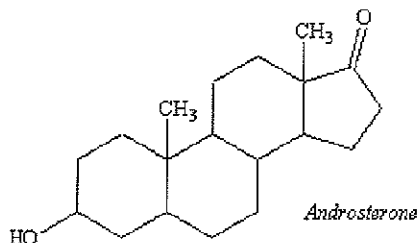
Time: 50 min

Weightage : 20%

1. Answer all questions sequentially

2. Only prescribed Text book and original hand written Notes are allowed.

1. A biochemical engineer isolates a bacterial gene fragment and dissolves a 17.6 mg sample of the material in enough water to make 31.5 mL of solution. The osmotic pressure of the solution is  $4.47 \times 10^{-4}$  atm at 25.0 °C. What is the molar mass of the gene fragment? (3M)
2. Write the interactions disrupted in proteins while denaturation is carried out by heat. (1M)
3. Identify the chiral centres and indicate the number of stereoisomers possible for the structures given below. (3M)



4. A 70% alcohol solution is used as a disinfectant on the skin. Justify. (2M)
5. Write any 2 changes observed in the properties (physical or chemical) of proteins upon denaturation processes generally. (2M)
6. Give the equation for Fick's first law of diffusion. (1M)
7. Give the salient features of the biological semi-permeable membranes. (2M)
8. Write the importance of Gibbs energy in biological reactions. (2M)
9. Give the use of (R) and (S) enantiomer of thalidomide. (2M)
10. Explain the following terms with an example.  
(a) Polyelectrolytes (b) Heat shock Proteins (2M)

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**BITS PILANI, INTERNATIONAL ACADEMIC CITY ,DUBAI**  
**III YEAR BIOTECH FIRST SEMESTER,2012-2013**  
**TEST- 1 (Closed book)**

Course Title :Biophysical Chemistry

Course No:BIOT C339

Date:15.10.2012

Total Marks:25

Time: 50 min

Weightage:25%

Useful Data:  $c = 3 \times 10^8$  m/s ,  $e = 1.602 \times 10^{-19}$  C,  $\epsilon_0 = 8.854 \times 10^{-12}$  J<sup>-1</sup>C<sup>2</sup>m<sup>-1</sup>, 1 amu =  $1.660 \times 10^{-27}$  Kg,

Answer all questions sequentially

1. Write the reaction for ala + gly → (2M)
2. What form of glutamic acid would you expect to predominate in: (a) strongly acidic solution (b) strongly basic solution (c) at its isoelectric point (pI 3.2) ? (2M)
3. It is incorrect to break up hydrogen bond length to the hydrogen bond atom radii. Why? (2M)
4. Give an example for the disulphide cross links in biomolecules. What does the disulphide linkage impose on structure ? (2M)
5. Describe the experiment used to determine the hydrogen bond energy in biomolecules in water. (3M)
6. The wavenumber of the fundamental vibrational transition of <sup>2</sup>H<sup>127</sup>I is 1640 cm<sup>-1</sup>. Calculate the force constant of the bond. (5M)
7. Give the expression for (i) Lennard Jones Potential and (ii) Zero point energy for a particle undergoing harmonic motion. (2M)
8. Calculate the attractive force between a pair of K<sup>+</sup> and Br<sup>-</sup> ions that are located on equilibrium distance between each other. Assume the ionic radius of the K<sup>+</sup> ion to be 0.133 nm and that of the Br<sup>-</sup> ion to be 0.196 nm. (5M)
9. Differentiate between the strong and weak hydrogen bonds. (2M)

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4. Mention the various phases in a monolayer pressure-area isotherm. (1M)
5. Which analysis is done to get information regarding the conformation of hydrocarbon chain of the lipids? (1M)
6. What is meant by Chargaff's rule? (1M)
7. Mention any 2 forces that favour the aggregation state in bilayer and monolayer. (1M)

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**BITS, PILANI – DUBAI CAMPUS**

**FIRST SEMESTER 2012 – 2013**

Course Code: BIOT C339

**THIRD YEAR QUIZ-2**

Date: 20.11.2012

Course Title: Biophysical Chemistry

Max Marks: 7

Duration : 20 minutes

Weightage: 7%

Name: ..... ID No: ..... Sec / Prog: .....

**Instructions:** (if any) Over writing will be taken as wrong answer

1. What is meant by glycosidic bond? (1M)

2. Schematically illustrate the formation of phosphodiester bond. (1M)

3. Give the equation for the free energy associated with transfer of protein from aqueous solution to lipid membranes. (1M)

4. Mention the various phases in a monolayer pressure-area isotherm. (1M)
5. Which analysis is done to get information regarding the conformation of hydrocarbon chain of the lipids? (1M)
6. What is meant by Chargaff's rule? (1M)
7. Mention any 2 forces that favour the aggregation state in bilayer and monolayer. (1M)

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**BITS, PILANI – DUBAI CAMPUS**

**FIRST SEMESTER 2012 – 2013**

Course Code: BIOT C339

**THIRD YEAR**

Date: 6.11.2012

Course Title: Biophysical Chemistry

**QUIZ-1**

Max Marks: 8

Duration : 20 minutes

Weightage: 8%

Name: ..... ID No: ..... Sec / Prog: .....

**Instructions:** (if any) Over writing will be taken as wrong answer

1. Who first proposed the alpha helix and beta sheet structures by using experimental bond angles and bond distances? (1M)
2. What is meant by Pitch in the alpha helix geometry of proteins? Give its relation with the gradient angle. (1M)
3. Write the significance of cubic symmetry in protein structures. (1M)
4. Schematically represent all the major interactions involved in the tertiary structure of proteins. (2M)

5. Calculate the number of modes of vibration for ethyne molecule. (1M)

6. Give the structural features of myoglobin molecule – the oxygen carrier in muscle. (1M)  
(any 4 points).

7. Symmetry selected by proteins depend upon certain factors. Mention these factors. (1M)

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