

**Sample paper for BINC :  
SHORT TYPE : PAPER II**

**BIOINFORMATICS : (40%)**

1.
  - a) What do you understand by sensitivity and specificity in BLAST? (3)
  - b) Suppose in a BLAST search you got an E-value of about  $2 \times 10^{-10}$ . What does this E value mean? Name two parameters that determine the E-value. (4)
  - c) Briefly explain the major differences between BLAST method and PSI-BLAST method. (3)
  
2.
  - a) What is dynamic programming algorithm? (2)
  - b) What is the basic difference between Needleman-Wunsch and Smith-Waterman algorithm? (4)
  - c) What are BLAST and FASTA? (4)
  
3.
  - a) State the data base structure of GenBank and how it can be used to make discoveries.
  - b) Give the importance of OMIM and SNP database (DbSNP). Describe briefly these databases. (5+5)
  
4.
  - a) Give examples of protein-protein interaction databases and describe their usefulness in protein-protein interactions. (6)
  - b) How species 2000 database is different from ICTV database? (4)

**BIOLOGY (20%)**

5. Golgi generates two types of vesicles that are destined for lysosomes and plasma membrane. In what way the two types of vesicles differ from each other? Describe the mechanism by which these vesicles find and fuse with the right target. (4+6)
  
6. If Down's syndrome occurs in 1 out of 700 births and Turner's syndrome in 1 out of 5000 cases, answer the following-
  - i. What are the chances that two cases of Down's syndrome occur in one hospital on the same day? (3)
  - ii. If the number of births in a country is 3,50,00,000, how many cases of Down's syndrome are likely to be recorded among the new born? (3)
  - iii. If Down's syndrome and Turner syndrome are randomly distributed, what are the chances that the newborn will be found with both syndromes? (4)

**Physical & chemical sciences: (20%)**

7. a) Draw a peptide group and show where water molecules can be bound non-covalently. (4)
- b) Between the two molecules, water and carbon dioxide, which one has a dipole moment? Is carbon-dioxide IR active? Give reason. (4)
- c) Between electrostatic and van der Waals energies, which effect will be felt at longer distances? (2)
8. a) If the pKa of the  $\epsilon$  amino group in lysine is 9.2, what will be the percentage of the lysine that will have a  $\epsilon$  protonated amino group at a pH of 7.0 (4)
- b) A molecule shows an absorbance of 1.00. The concentration of the solution is  $2 \times 10^{-5} \text{ ML}^{-1}$ . The measurement was done in a cuvette of length 2 cm (4)
- 1) What is the molar absorptivity?
- 2) What is % of light that reaches the detector?
- c) The activation energy for the hydrolysis of sucrose is  $107 \text{ kJmol}^{-1}$  in the presence of  $\text{H}^+$ . When the enzyme saccharase is added, the activation energy is  $36 \text{ kJmol}^{-1}$ . What is the order of magnitude change in the rate of the reaction of the enzyme catalysed to the  $\text{H}^+$  catalysed reaction? (2)
9. a) Find the transpose of matrix A where  $A = \begin{bmatrix} -1 & 0 & 1 \\ 3 & 4 & 7 \\ 1 & 1 & 2 \end{bmatrix}$ .  $\begin{bmatrix} 4 & 2 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$
- b) Can the equation  $3x + 4y - 2z = 6$  be written in the form of –
- (i) dot product of two vectors;
- (ii) cross product of two vectors? If yes find the vectors and interpret their geometrical relation, if any. If not, why?
- c) Find the roots of the quadratic equations:  $x^2 - 5x + 6 = 0$
- d) Find the area of the triangle formed by the x-axis, the y-axis and the line  $x + 3y = 6$ . (3 + 3 + 2 + 2)
10. a) A solution of ethyl acetate ( $0.01 \text{ mol}^{-1}$ ) reacts with a solution of sodium hydroxide ( $0.002 \text{ mol}^{-1}$ ). The velocity constant of the reaction is  $3 \text{ min}^{-1}$ . If x is the concentration of ethyl acetate, which is reacted in time t, then we can write the equation as follows:
- $$t = \int dx / [3(0.01-x)(0.002-x)]$$
- If initially the concentration x is zero (at  $t=0$ ) find the time taken for the

concentration to be  $0.01 \text{ mol}^{-1}$ .

b) Find the stationary points of the following functions and determine their nature:

(i)  $x^3 - 12x + 5$

(ii)  $e^x \cos(x)$

(5+5)

**IT: (20%)**

11. Write a **C or Perl or Java** program to compute the transpose of a 3X3 matrix. A matrix and its transpose are shown below. (10)

A1	A2	A3
B1	B2	B3
C1	C2	C3

Matrix

A1	B1	C1
A2	B2	C2
A3	B3	C3

Transpose

12. Write a **C or Perl or Java** program to check if a given 3X3 matrix is symmetric. A matrix shown below is symmetric if  $A_2=B_1$ ,  $A_3=C_1$  and  $B_3=C_2$ . (10)

A1	A2	A3
B1	B2	B3
C1	C2	C3