In Paper II of BINC – 2015, Candidates have to answer 20 questions out of a total of 55 questions divided into three sections as below. Each question will carry 10 marks.

Section A: Bioinformatics (Answer any 10 out of 25 questions)

Section B: Biology, Chemistry & Physics (Answer any 5 out of 15 questions)

Section C: Mathematics, Statistics & IT (Answer any 5 out of 15 questions)

SECTION – A

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 2×10^{-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 database structure of Gen Bank and how it can be used to make discoveries.

b) Give the importance of OMIM andSNP database (DbSNP). Describe briefly these databases. (5+5)

4. a) Give examples of protein- protein interaction databases and describe their utility in understanding protein- protein interactions. (6)

b) How does species 2000 databases different from ICTV database? (4)

SECTION – B

5. a) 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?

b) 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 Syndromes 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)

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 ∈ amino group in lysine is 9.2, what will be the percentage of the lysine that will have a ∈ 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 X 10^{-5} ML^{-1}. The measurement was done in a cuvette of length 2 cm. (4)

1) What is the molar absorptivity?

2) What is the percentage of light that reaches the detector?

c) The activation energy for the hydrolysis of sucrose is 107 $kJmol^{-1}$ in the presence of H^+. When the enzyme saccharase is added, the activation energy is 36 $kJmol^{-1}$. What is the order of magnitude change in the rate of the reaction of the enzyme catalysed to the H^+ catalysed reaction? (2)

SECTION – C

9. a) Find the transpose of matrix where

$$A = \begin{bmatrix} -1 & 0 & 1 \\ 3 & 4 & 7 \end{bmatrix} \cdot \begin{bmatrix} 4 & 2 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$$

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 mol^{-1}) reacts with a solution of sodium hydroxide

(.002 mol^{-1}). The velocity constant of the reaction is 3 min^{-1}. If x is the concentration of ethyl acetate, which is reacting 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 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)

11. Write a **C or Perl or Java or Python** program to compute the transpose of a 3 X 3 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 or Python** program to check if a given 3 X 3 matrix is symmetric. A matrix shown below is symmetric if A2 = B1, A3 = C1, B3 = C2. (10)

A1	A2	A3
B1	B2	B3
C1	C2	C3