RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. FIFTH SEMESTER EXAMINATION, DECEMBER 2017

THIRD YEAR [BATCH 2015-18]

Date : 15/12/2017 **MICROBIOLOGY [Honours]**

Time : 11 am – 1 pm **Paper : V [Gr-A]** Full Marks : 50

Answer <u>any four</u> questions from <u>Question Nos. 1 to 8</u> : [4×10]

1. a) In 1952, a woman in Bombay needed a blood transfusion. On examination of her blood she was proved to lack both the A and B antigens and thus her blood was of "O" group. But partial pedigree analysis revealed that one of her parents was type AB and the genotypically the blood of woman was of type "B". State the reasons behind this genotypic and phenotypic differences. [3]

   b) AnF′ (Ts) *lac*$^+$ plasmid has a temperature sensitive mutation in its replication system. [1+2]

      i) What is the phenotype of an F′ (Ts) *lac*$^+$ / *lac*$^-$ cells at 42°C?

      ii) An F′ (Ts) *lac*$^+$ / *lac*$^-$ *gal*$^+$ strain is grown for many generations and then plated at 42°C, Some *lac*$^+$colonies form at 42°C. How have these formed?

   c) How do eukaryotic cells solve the "end replication problem"? [3]

   d) An Hfr×F$^+$ mating never leads to transfer of all the chromosomal and markers from donor to recipient. Explain. [1]

2. a) In *Drosophila*, a cross between the eye-colour mutants, brown and scarlet produced offsprings with brick-red-coloured eye. But mating among the F_1 progeny flies yielded a F_2 phenotypic ratio – brick red : scarlet : brown : white = 9:3:3:1. Explain this result with checker board. [3]

   b) In an *E.coli* auxotroph A could grow only on a medium containing thiamine and an auxotroph B could grow only on a medium containing leucine. How would you test whether DNA from A could transform B? [3]

   c) Yeast plasmids have been constructed using pBR322 which can replicate and maintained in yeast cells. How was it possible? [2]

   d) What is transformasome? [2]

3. a) In the jimsonweed, purple flowers are dominant to white. Self-fertilisation of a particular purple flowered jimsonweed produces 28 purple flowered and 10 white flowered progeny. What proportion of the purple-flowered progeny will breed true? [2]

   b) A recombinant plasmid pSC134 was constructed combining $ColE_1$ and pSC101 origin of replication. What would be the result in terms of copy number with proper explanation.

      i) if it is introduced into the pol A$^+$ and pol A$^-$ cells.

      ii) if a pSC101 plasmid is introduced into a cell containing the pSC134. [3]

   c) What is meant by multigene family? Cite an example. [2]

   d) Multiple F$^+$ *E.coli* colonies have appeared on the nutrient agar surface of a petriplate. Design an experiment to fishout the colonies which bear Hfr cells. [3]

4. a) In yeast, *Saccharomyces cerevisiae*, there are several types of petite mutants. Two crossing experiments between haploid petite and haploid normal were carried out. In some cases the progeny fungi showed a segregation ratio – petite : normal = 1 : 1, but in other all the progeny were of normal size. What would be the explanation for these results? [3]

   b) In a certain transformation experiment, two markers 'x' and 'y' were being co-transformed at very high frequency. Design an experiment to find out whether 'x' and 'y' are being carried on the same or different DNA pieces? [3]

c) In a cot analysis of eukaryotic genome, the following results were obtained—

	Fast Component	Slow component
% in genome	25	45
$cot_{1/2}$	0·0013	630

What are the kinetic complexicity and number of copies of fast component?
[*E.coli* genome size = $4{\cdot}2 \times 10^6$ bp. $cot_{1/2} = 4$] [2]

d) A gene codes for an enzyme catalysing a particular biochemical reactions. Two mutant alleles are identified. One is dominant to the wild type allele while the second one is recessive. Explain the statement in terms of the enzyme phenotype. [2]

5. a) How did Bridges prove that Y-chromosome is *Drosophila* bears no role in sex determination? [3]

b) Four Hfr strains transferred their genes in the order as follows—
Strain 1 : Q W D M T;
Strain 2 : A X P T M;
Strain 3 : B N C A X;
Strain 4 : B Q W D M
What is the order of the gene? [2]

c) Analysis of DNA of a bacterial virus indicates it contains 33% A, 26% T, 18% G and 23% C. Interpret the results and explain whether they violate Chargaff's principles. What predictions can you make about the habitat of a certain bacterium through determination of Tm of its DNA? [1+1]

d) Write down the flow chart of a database processing pathway. List out the importantance of various biological databases. [1·5+1·5]

6. a) What is meant by genetic anticipation? Cite two examples. What is meant by pleiotropy? [2+1]

b) In specialized transduction, the frequency of formation of λdgal is between 10^{-5} to 10^{-6}. How can the frequency be increased to about 50%? [3]

c) You have been given two genomes one from an eukaryote and other from a prokaryote, however their identify is undisclosed. Design an experiment to find this out. [3]

d) What do you mean by a DNA scaffold? [1]

7. a) In human, sex determination is of XX – XY type where females possess two "X" and males one "X" and one "Y" chromosomes. But, there are human males who exhibit two "X" chromosomes in their cells. State the reasons behind this anomalous result. [2]

b) S. Benzer and his colleagues, while trying to map different mutant loci in bacteriophage T4 rII mutants they obtained a puzzling result. While doing a control experiment in which *E.coli* K12 bacteria, the restrictive host, were simultaneously infected with pairs of different rII mutants, occasionally the K12 bacteria exhibited lysis. How did Benzer explain this result? [3]

c) i) How does 16S rRNA sequence helps to identify an organism? [2]

ii) "Pairwise allignment follows both global and local allignment algorithm" —Explain. [1]

d) You have purified a protein induced under heat stress in filamentous fungus and have managed to sequence it also. Can you design any in silico approach to predict the functionality of the protein? [2]

8. a) What is the difference between multiple allelic and polygenic inheritance. Cite proper examples. [2+1]

b) Multidrug resistance is a serious concern in modern times. Briefly state the mechanism of creation of multidrug resistant bacteria in nature. [3]

c) What do you mean by superinfection immunity? *E.coli* λ plaques are frequently turbid. Explain. [2+1]

d) What is FASTA? [1]

Answer <u>any one</u> question from <u>Question Nos. 9 & 10</u> **:** [1×10]

9. a) How will you determine the site of assembly of the viruses? [2]

b) Explain why are viruses as good as non-living outside host cells? [2]

c) What do you mean by P^{32} suicidal rate? [1]

d) Lytic cycle in bacteriophages can be induced by an abundance of nutrients for the host. Explain the molecular basis of this phenomenon. [2]

e) What do you mean by terminal redundancy and cyclic permutation? [3]

10. a) How will you determine the latent phase and eclipse phase in a single step growth curve? [3]

b) Why are virus heads made up of symmetrical protein subunits? [2]

c) What is meant by Titre value of a particular viral infection? [2]

d) Study of molecular evolution of viruses is possible based on DNA or RNA sequences — Justify. [3]

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