RAMAKRISHNA MISSION VIDYAMANDIRA
(Residential Autonomous College affiliated to University of Calcutta)
B.A./B.Sc. FIFTH SEMESTER EXAMINATION, MARCH 2021
THIRD YEAR [BATCH 2018-21]
Date : 13/03/2021
MICROBIOLOGY [Honours]
Time : 11.00 am – 1.00 pm
Paper : V [Gr.A]
Full Marks : 50

Answer **any five** questions of the following :　　　　　[5×10]

1. a) Phenylketonuria (PKU) is a metabolic disorder caused by an autosomal recessive gene. Before having children, a couple consulted a genetic counsellor because the man has a brother with PKU and the woman has a sister with PKU. There are no other known cases in their families. They ask the counsellor to determine the probability that their first child will have PKU. What is the probability?

   b) Cite an example of a monohybrid experiment where the phenotypic ratio in F2 generation coincides with the results of a dihybrid experiment. Show the results in a checker board.

   c) How can you prove that random heterochromatiizationoccurs in one of two X-chromosomes in human during development?

   d) In a test cross of a dihybrid 75.5% of the progeny flies were of parental type. What should be the actual percentage of parental types? Why does the observed value deviate from the expected value?　　　[3+3+2+2]

2. a) Using any eukaryotic microbe as an experimental material how can it be concluded that genes may remain outside the nucleus?

   b) Performing genetic experiments one can infer that the bacterial (*E. coli*) genomic material is circular. How is it possible?

   c) Whereas a pair of genes that govern a pair of contrasting character is called an allele pair then why are the VNTRs considered to be allelic?

   d) How can you prove that radial looping of 30nm filaments occurs during third level of chromatin organization?　　　[3+3+2+2]

3. a) How did Morgan prove that the gene for eye colour of *Drosophila* is located on X-chromosome?

   b) In specialized transduction gal$^+$transductants may or may not be stable. Why?

   c) In Cot analysis neither the initial concentration, Co nor the $t_{1/2}$ is constant but their product is constant. Explain.

   d) A gene of economic interest is cloned in a low copy number plasmid and this plasmid is used for transformation of bacteria. Use of this transformed bacterium for commercial production of gene product may pose a risk for lower yield due to creation and growth of the cured cells. How can this problem be solved?　　　[3+3+2+2]

4. a) Design a genetic experiment by which it can be proved that the state of DNA is altered during uptake for transformation.

   b) In deletion mapping why did S. Benzer and his group crossed between different deletion mutants and between the deletion and point mutants?Explain with proper diagram.

   c) If a single *E. coli* cell containing the F$^-$factor is added to a culture of F$^-$ cells, a large population of cells become F$^+$, but in case of R-plasmid only 0.02% of a population of cells containing R$^-$plasmids are competent donors. Why is this deviation?

d) A lac$^+$ bacterial strain has a Dna(Ts) mutation, which prevents colony formation at 42°C. An F'lac$^+$ plasmid is introduced into the strain by means of conjugation. The culture is grown for many generations at 30°C and then 10^6 cells are plated at 42°C. A few colonies arise and these are of growing at both 30°C and 42°C. How was it happened? [3+3+2+2]

5. a) What do mean by competence of bacteria? How is it developed?

   b) What are Selection and counter selection markers? Explain the two with an experiment. [(2+3)+(2+3)]

6. a) What is the significance of E value in BLAST?

   b) Mention the steps involved in data base similarity searching with respect to any proteinsequence.

   c) Differentiate between local and global alignment process.

   d) What are primary and secondary databases for Bioinformatics? [3+3+2+2]

7. a) What are the various conclusions we can draw after looking the patterns from any Dot Matrix?

   b) What do you mean by derivative databases of NCBI?

   c) Write down the statistical significance of Z-score in FASTA. [4+2+4]

8. Write a short note on Baltimore classification of viruses. 'Reverse transcriptase inhibitors are better therapeutic agents than CD4 receptor blockers for HIV infection' – explain. What do you mean by plaque forming unit and multiplicity of infection? Differentiate viroids and virusoids. What is meant by cytopathic effect? What is phage typing? [1.5+1.5+2+2+1+2]

9. Describe strand displacement replication process of adenovirus. Write a short note on SV40 large T antigen. 'CXCR4 or CCR5 are required for better infectivity of HIV'- explain. Describe major strategies for antiviral therapy. What do you mean by antigenic drift and antigenic shift? Define circular permutation and terminal redundancy. [1.5+1.5+1.5+1.5+2+2]

10. a) An F'lac$^+$/Str^s is mated with a lac$^-$Str^r recipient that also carries a dnaG(Ts) mutation. Mating is at a non-permissive temperature. After 30 minutes of mating, streptomycin and an inducer of lac operon are added. Will any β-galactosidase be made in the culture? Briefly explain your answer.

    b) If, in a particular cell type, rifampicin were to inhibit DNA transfer, what would you conclude about the transfer mechanism?

    c) If ColE1 plasmid could be altered to contain insertion sequences homologous to sequences in the chromosome, such that it could integrate in the chromosome, would Hfr-like cells arise?

    d) Replication of unintegrtedF, but not integrated F, is inhibited by exposing *E. coli* to acridine orange. Make use of this finding

       i. To obtain F$^-$ from F$^+$ cells.

       ii. To identify colonies as F$^+$, Hfr, or F$^-$.

    e) A strain carrying F'gal$^+$, which forms red colonies in MacConkey- galactose agar (Gal- colonies are white), is mutagenized and plated. A few colonies are found that are slightly smaller and more intensely red. Further study shows that they have ten copies of F'gal$^+$ per cell rather than usual number. What types of mutations have occurred? Explain briefly. [2+2+2+2+2]

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