RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. FOURTH SEMESTER EXAMINATION, AUGUST 2021

SECOND YEAR (BATCH 2019-22)

Date : 07/08/2021 **MICROBIOLOGY (Honours)**

Time : 11.00 am – 1.00 pm **Paper : VIII [CC 8]** Full Marks : 50

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

1. a) What is meant by conditional lethal mutation? How can these mutants be helpful in intragenic mapping?

   b) In specialized transduction the frequency of *lambda dgal* produced remains between 10-6—10-8. How can this frequency be increased in laboratory?

   c) In Hfr x F- conjugation in *E.coli* the plateau value for early marker remains around 50% per 100 Hfr cells. Why?

   d) Can you design an experiment to prove that almost all the Hfr cells participate in the mating?

   How can you map genes using the data of time of entry mapping and transduction mapping?

   [(1+2)+3+2+2]

2. a) Design an experiment to prove that some kind of competence factors are produced at the late log phase of bacterial growth which make the remaining cells to be competent for transformation.

   b) If the two marker genes are closely linked then how can their positions be known following the time of entry mapping?

   c) Present an experiment as a proof of 'abortive' transduction in *Salmonella typhimurium.*

   d) Mention two cases where complementation analysis is not helpful to find out the number of genes associated with a metabolic process. [4+2+2+2]

3. a) In Mendelian genetics a pair of contrasting characters of an organism governed by a pair genes on homologous chromosomes is considered as an allelic pair. Then why are the VNTRs also called alleles though they are not associated with any phenotypic trait?

   b) How can the structural units of chromatin fibres be revealed following successive enzymatic digestion?

   c) In Cot analysis neither the initial concentration, Co nor the t1/2 are constant but their products always remains constant. Explain how it is possible.

   d) How can you understand whether a reversion is due to back mutation or suppressor mutation?[3+3+2+2]

4. a) How can you raise transition, transversion and frameshift mutants from a culture of *Salmonella typhomurium.*

   b) Design an experiment to prove the presence of recombination repair system in *E coli.*

   c) Transposition is the principal method in acquisition of multidrug resistance in bacteria. State the probable mechanism for this.

   d) State the functions of histone tail domain of nucleosome.

e) How do the late competence genes play a major role in transformation? [2+2+2+2+2]

5. a) Which features were incorporated by Bruce Ames to *Salmonella typhimurium* to make it an excellent system to study the mutagenic potentiality of chemicals?

b) Write down the "C-value" of a diploid cell at G1 phase,prophase, metaphase and telophase.

c) A culture of *E coli* was irradiated and subsequently exposed to blue light. What would be the change in genetic constitution of this organism?

d) Write the role of exinuclease in repair of damaged DNA. [3+3+2+2]

6. a) What will happen if chloramphenicol or some other protein synthesis inhibitor is added to a plasmid containing bacterial culture?

b) How will you determine the incompatibility group of plasmid?

c) A strain carrying *F'gal*$^+$, which forms red colonies 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 the usual number. What types of mutations have occurred?

d) Plasmids contained in Rec$^+$ cells frequently dimerize. A dimer can then be isolated and transferred by $CaCl_2$ technique to Rec$^-$ cell in which it will be stable and not revert to the monomer. If a monomer plasmid has a copy number of ten, what will the copy number of dimer be?

e) How does the copy number of R1 plasmid regulate its copy number in a living cell?

f) How will you find the ***ori*** region of a plasmid? [1+2+2+1+2+2]

7. A Hfr strain with genotype *met- his+ leu+ trp+* and that transfers the met gene very late was mated with a *leu- met+ trp- his-(Ts)* recipient. The *his(Ts)* mutation introduces a requirement for histidine at 42^{o}C. After mating for several hours, the mixture was diluted and plated on minimal media with four (4) different supplements.

The supplements in the plates and the number of colonies per plate are the following:

Serial number	Supplements added	Number of colonies per plate
(i)	His+Trp	250
(ii)	His+Leu	50
(iii)	Leu+Trp	500
(iv)	His	10

a) What is purpose of the met- mutations in the Hfr strain in this experiment?

b) Which genes entered first, second and third?

c) You know the relative order of the three genes, but you know nothing about their exact location on the chromosome, what type of experiment will tell you where these markers are located on the chromosome?

d) What are F prime (F ′) plasmids? [2+3+2+3]

8. a) The post-infection decision of bacteriophage lambda is a critical event. If lysis is chosen, the decision is irreversible and, hence, the role of the decision circuit is complete. If, however, the choice is lysogeny, that fate needs to be actively maintained over the long term, using a small subset of the decision gene network. Explain how this coordinated establishment and maintenance of lysogeny is obtained.

b) High MOI will promote lysogeny - Justify.

c) Induction is a process by which a temperate phage switches from the lysogenic state to the lytic pathway, typically in response to a perturbation such as damage to the host cell's DNA. Describe molecular events related to this switching. [5+2+3]

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