RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. SIXTH SEMESTER EXAMINATION, MAY 2018

THIRD YEAR [BATCH 2015-18]

Date : 06/05/2018 **MICROBIOLOGY (Honours)**

Time : 12 noon – 3 pm **Paper :** VII [Gr-A] Full Marks : 60

UNIT-I

(*Answer **any four** questions*) [4×10]

1. a) An F′-plasmid with *lac*$^-$ (*lac* z$^+$ *lac* y$^-$) gene(s) was introduced into an *E.coli* cell with *lac*$^-$ (*lac* z$^-$ *lac* y$^+$) phenotype but no complementation occurred. Now, another plasmid with *lac*$^+$ (*lac* z$^+$ *lac* y$^+$) gene(s) was introduced into a *gal*$^-$ (polar) *lac* z$^-$ cell and as a result the cell showed a *gal*$^-$ (polar) *lac*$^+$ phenotype. But after many generations of growth a few *gal*$^+$ *lacz*$^-$ (polar) cells appeared.
   i) What may be the reason for no complementation in the first case? [2]
   ii) What may be the reasons for appearance of *gal*$^-$(polar) cells? [2]
   b) How did Watson and Crick explain the origin of spontaneous mutation while presented the double helical model for DNA? [3]
   c) Define Prime factors. How are they created? [1+2]

2. a) During site specific recombination what happens when :
   i) Two sequences are in same direction. [1·5]
   ii) Two sequences are in opposite direction. [1·5]
   b) In a survey of blood group the following frequency was observed, A = 0·53, B = 0·13, O = 0·26 and AB = 0·08. Calculate the frequencies of A, B and O alleles. [5]
   c) How was it proved that the target molecule for UV-irradiation is the nucleic acid and not the protein to bring a germicidal effect? [2]

3. a) An Amp^r plasmid whose replication is temperature-sensitive is introduced into an Amp^s cell by $CaCl_2$ transformation method. After growth for many generations, 10^7 cells are plated on agar containing ampicillin at 42°C. Fifty colonies were formed. [3]
   i) Write three mechanisms that could explain the presence of these colonies.
   ii) Which mechanism would not occur in RecA$^-$ cell?
   b) What will be the consequences if UV irradiated bacterial cells are:
   i) Exposed to normal blue light (wavelength > 300 nm). [1]
   ii) Kept in dark in non nutrient buffer for sometime [1]
   c) You intend to change a particular amino acid in a polypeptide to make it commercially viable. Schematically show the steps of the techniques you will follow. [3]
   d) Justify the statement : "Gene mutations can occur outside the coding sequences & still influence gene expression." [2]

4. a) A fluctuation test is carried out for two different genes A and B. The following data are obtained for gene A, 22 of 40 cultures has no mutants, with N = $5·6\times10^8$. For gene B, 15 of 37 cultures had no mutants, with N = 5×10^8. What are the mutation rates for the two genes? [3]
   b) What are AC-Ds elements? Mention the major functional difference between them. How can you use antibiotic resistance markers to follow transposition. [1+2+2]

c) What is the evidence that transposition in bacteria includes a replicative step? [2]

5. a) In bacteria revertants may arise either by back or suppressor mutation. In which case the frequency of revertants will be lowest and why? How does the suppression of sense codons work to yield revertants? [3]
   b) What are the various factors responsible for the conversion of protooncogenes to oncogenes? [2]
   c) Differentiate between a Carcinoma and a lymphoma. [2]
   d) "Tumor-suppressor genes are said to be the care-taker of the genome". Explain this with a suitable example. [3]

6. a) The survival curve of *uvr*$^+$ *rec*A$^-$ *E.coli* cells is more steeper than the *uvr*$^-$ *rec*A$^+$ cells —Why? Suggest a mechanism of action for this type of difference. [1+2]
   b) Transposons may act as a biological mutagen. Can you design an experiment in support of this? [3]
   c) How does the structure of *cytochrome c* help in phylogenetic tree construction? [2]
   d) Mention two basic mechanism of transposition in prokaryotes. [2]

7. a) Explain the game theory with the example of hawk-dove model and write down the Hamilton's rule with a suitable example. [1·5+1·5]
   b) How can a *c-src* be converted to a *v-src* leading to manifestation of fibrosarcoma in chickens? [3]
   c) What is the significance of tautomerism in mutation? [2]
   d) Mention the characteristic features of *his*$^-$ mutants used by Ames to study the mutagenicity of chemicals. [2]

8. a) In humans chronic myelogenous leukemia (CML) is associated with a particular type of chromosomal aberration? Name the type of aberration and how does it arise? [2]
   b) During ascospore analysis of *Neurospora*, Mitchell observed a deviation in the allelic ratio. For example, where majority of asci exhibited ascospores with an allelic ratio of $m_1^+ : m_1 = 4:4$ and $m_2^+ : m_2 = 4:4$, a few asci showed, $m_2^+ : m_2 = 6:2$ and $m_2^+ : m_2 = 5:3$. How were these deviations explained? [3]
   c) What is the role of "*chi* site" in homologous recombination? [2]
   d) Why are mutant reversion studies more sensitive than forward mutation studies for detection of mutagenic properties of chemicals? [3]

UNIT-II

(*Answer **any two** questions*) [2×10]

9. a) Glucosylation of Hydroxymethyl cytosine residue is essential for the survivility of T4 phages in wild type *E.coli* cells. Justify the statement. [3]
   b) Give the idea about the packaging of polio virus? [2]
   c) What are the opportunistic infections associated with AIDS? [2]
   d) What are the diseases associated with HTLV1 and HTLV2? [2]
   e) Why are filamentous phages called male specific phages? [1]

10. a) Why is SV40 known to be associated with human cancer? [2]
    b) What do you understand by the term "Superinfection Immunity"? What role does host coded enzyme RNaseIII play in the process of Retroregulation? [1·5+1·5]
    c) Why do antiviral drugs generally exhibit host toxicity? [2]

d) How does the nutrient rich medium help the lytic cycle of phage lambda. [2]

e) Name one virus bearing segmented genome and packaging all segments in separate virions. [1]

11. a) It is difficult to develop a single flu vaccine —Comment on the statement. [2]

b) What is the function of small RNA's present in adenovirus? How can these cause transformation of cells? [2+2]

c) Why mosquitoes cannot transmit HIV? [2]

d) What strategies are taken by the T odd phages to introduce its genetic material into the host? [2]

12. a) Discuss the disease causing mechanism of P_rP^{Sc}. [3]

b) What are the functions of T antigen and how is it autoregulates the early gene expression? [3]

c) What are the antiretroviral agents present in market? [2]

d) How does SV40 replicate in human system? [2]

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