RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. SIXTH SEMESTER EXAMINATION, JULY 2021

THIRD YEAR [BATCH 2018-21]

Date : 10/07/2021 **MICROBIOLOGY (HONOURS)**

Time : 11.00 am - 3.00 pm **Paper : VII** Full Marks : 100

Group - A

Unit - I

Answer **any three** questions of the following : [3×10]

1) a) How do the modern explanations on homologous recombination differ from the Holiday model?
   b) Do you think that both of the IS-like modules in composite transposon are essential for transposition?
   c) Which genes in any higher animals regulate homeostasis in relation to embryonic development? Answer with suitable examples.
   d) How do the tautomers of bromouracil exhibit differential effect in induced mutagenesis? (3+2+2+3)

2) a) How can the Hardy-Wienberg law be applicable to find out the genotype for any phenotypic traits?
   b) Design a genetic experiment to prove the presence of IS-element in bacteria.
   c) "Body plan of the growing embryo of higher animals are determined long before fertilization". Can you prove this by a genetic experiment?
   d) Reversion studies are the most suitable to test the mutagenecity of chemicals. –Why? (3+3+2+2)

3) a) How can you raise *met*- transition and transversion mutants in *E. coli*?
   b) State the mechanisms of destabilization of Hardy-Wienberg equilibrium by the natural and man-made environmental changes.
   c) How do the RecA and RecBCD enzymes participate in homologous recombination?
   d) State the mechanisms of removal of dimers induced to form by means of UV-irradiation. (3+3+2+2)

4) a) Can you design a genetic experiment to differentiate the back mutation from the suppressor mutation?
   b) Though the proofreading function of DNA polymerase eliminate the probabilities of misincorporation yet a few error still remains in the daughter DNA. How are these eliminated?
   c) How does the method of transduction play a role in the creation of *v-onc* genes?
   d) How do *bicoid* and *hunchback* genes play roles in the development of *Drosophila* embryo? (3+3+2+2)

5) a) How can you prove whether a mutant arose by means of point or deletion or transposition mutation?
   b) How does RecA protein exercise it's effect in different kinds of repair system?
   c) Briefly write down the molecular mechanism of homologous recombination.
   d) "Reciprocal translocation of chromosome arms may lead to cancer development". –How does it arise? (3+3+2+2)

6) a) How did McClintock prove the existence of jumping genes?
   b) Why is p53 considered as guardian of the genome?
   c) How do alkylating agents exercise their effects to generate point mutation?
   d) How is homologous recombination and gene conversion related? (3+2+3+2)

Unit - II

Answer **any two** questions of the following : [2×10]

7) a) Schematically represent the genomic organization of Lambda phage and describe molecular events required for lysogenic to lytic switching.

b) There are several approaches to study the relationship between two persons A and B. Evolutionary psychologists focus on the genetic relation between A and B, and social psychologists study the social factors of human relationships. However, many anthropologists disagree strongly with the genetic claim. They argue while there is indeed a genetic basis to human social behaviour, this does not mean that such behaviour is genetically determined - Comment on this. (5+5)

8) a) Theoretical studies have shown that in an ecosystem signalling costs paid at the equilibrium are neither sufficient nor necessary to maintain signal honesty, and that honesty can evolve through differential benefits, as well as differential costs – Explain.

b) What is cytopathic effect?

c) What is reciprocal altruism?

d) Explain game theory considering pray-predator relationship. (4+2+2+2)

9) a) Hamilton's rule states that altruistic behaviour will be selected for if rb>c, where b are the benefits to the recipient, c the costs to the donor, and r is the relatedness between them – explain.

b) What do you mean by molecular evolution? Give an example.

c) Write a short note on speciation. (4+4+2)

10) a) What is resource partitioning?

b) Ecologists are often required to estimate the number of species in a region or designated area. A number of diversity indices are available for this purpose and are based on sampling the area using quadrats or other means, and estimating the total number of species from these samples. How can we estimate the number of a particular species in a given area?

c) What is phage display? (1+6+3)

Group - B

Unit - III

Answer **any three** questions of the following : [3×10]

11) a) Write down the function of i) EDTA and ii) SDS in DNA extraction buffer.

b) Explain the chemistry behind the acrylamide gel polymerization.

c) Calculate Tm of the given primer sequence: AGACTCAGAGAGAACC.

d) How colour test does useful for selection of YAC transformed yeast cell?

e) What are Isoschizomers? Discuss with examples. [(1+1)+3+1+2+2]

12) a) What is alpha complementation?

b) How triparental mating does useful to make co-integrate vector from Ti plasmid?

c) What is a bifunctional vector? Explain with an example.

d) For detecting the proteins in blotting membrane what are the use of primary and secondary antibodies?

e) The optimum temperature for ligation of nicked DNA is 37°C, but experimentally sticky end ligation is done in the range of 4℃ - 15℃. Why? (2+2+2+2+2)

13) a) A cell contains lots of RNA called RNA pool. You have been asked to isolate a specific mRNA from that RNA pool. Which specific procedure you supposed to use?

b) For obtaining glycosylated recombinant protein of less than 50 Kd molecular weight, what could be the choice of expression system?

c) Theoretically, gene expression is controlled by promoter. But when transgenes are expressed in unrelated or distantly related organisms, their coding sequences may markedly affect the level of their expression. Explain this fact.

d) How does Spi phenotype is useful for selecting recombinant?

e) T4 DNA ligase is a more versatile DNA ligase compared to E.coli DNA ligase— explain.(1+1+3+3+2)

14) a) How CAD protein is useful as a dominant marker?

b) Explain the working principle of qPCR.

c) What do you mean by "star activity" of restriction endonucleases? Explain with example. (3+5+2)

15) a) Explain optical transfection process in detail.

b) What are Bicistronic IRES vector? Explain.

c) How does cryoprotectants are useful in chemical mediated gene transfer process? (4+3+3)

16) a) Explain in detail what are the modifications required for the generation of replication-defective viral vectors from wild type virus for in vivo gene transfer?

b) What is gutless vector? Explain.

c) Explain the electroporation method of E.coli transformation. (3+3+4)

Unit - IV

Answer **any one** question of the following : [1×10]

17) a) write short notes on:

i) ELISA ii) RIA iii) RIST

b) What do you mean by antibody affinity? [(3+3+3)+1]

18) a) You have identified a bacterial protein antigen that confers protective immunity to a pathogenic bacterium and have cloned the gene that encodes it. The choices are either to express the protein in yeast and use this recombinant protein as a vaccine or to use the gene for the protein to prepare a DNA vaccine. Which approach would you take and why?

b) While on a backpacking trip you are bitten by a poisonous snake. The medevac comes to airlift you to the nearest hospital, where you receive human immunoglobulin treatment (gammaglobulin or antiserum) against the poisonous snake venom. You recover from your snakebite and return home for some TLC. One year later during an environmental studies field trip, you are bitten once again by the same type of snake. Please answer the following questions:

i) Since you fully recovered from the first snakebite, are you protected from the effects of the poison this second time?

ii) Immunologically, what occurred the first time you were bitten and treated for the bite?

iii) Compared to the first snakebite, are you more sensitive, less sensitive, or equally sensitive to the venom from the second bite?

c) Molecular mimicry is one mechanism proposed to account for the development of autoimmunity. How has induction of EAE with myelin basic protein contributed to the understanding of molecular mimicry in autoimmune disease?

d) Describe at least three different mechanisms by which a localized viral infection might contribute to the development of an organ-specific autoimmune disease. [2+(1+1+1)+2+3]

Unit - V

Answer **any one** question of the following : [1×10]

19) a) What is the rationale behind treating a penicillinase producing pathogen with a combination of amoxycilin and clavulanic acid?

b) What happens if squalene epoxidase enzyme is inhibited by terbinafine?

c) How does a pyrophosphate analogue drug work?

d) What role does gp41 play in AIDS?

e) What may happen if furin protease mutant cells are inoculated with *Bacillus anthracis*? (2+2+2+2+2)

20) a) Write down the associated disease, producer and role of the following molecules in pathogenesis

i) Opacity proteins

ii) Neuraminidase

iii) CdtB

b) Name the intracellular form of *Leishmania* sp. $[(\frac{1}{2}+\frac{1}{2}+2)\times 3]+1$

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