RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. FIFTH SEMESTER EXAMINATION, DECEMBER 2016

THIRD YEAR [BATCH 2014-17]

Date : 14/12/2016 **MICROBIOLOGY [Honours]**

Time : 11 am – 1 pm **Paper : V (Gr- A)** Full Marks : 55

[Use a separate Answer Book for <u>each Unit</u>]

<u>Unit - I</u>

(*Answer <u>any three</u> questions*) [3×11]

1. a) In 1952, a woman in Bombay needed a transfusion. Her blood group was type "O". But the partial pedigree analysis revealed that one of her parents was type "AB". Subsequent investigation showed that she was genetically type "B" but functionally type "O".
   Give an explanation for this abnormal result. [3]
   b) In humans, there are exceptional females with one X- and Y-chromosome and exceptional males with two X-chromosomes in their diploid cells.
   What are causes behind these anomalous results? [3]
   c) What are transformasomes? In which phase of bacterial growth is competence induced? [2+1]
   d) How is mutation conceptually different from polymorphism? [2]

2. a) In the cross, Aa Bb Cc Dd x Aa Bb Cc Dd, in which all genes undergo independent assortment, what proportion of offsprings are expected to be heterozygous for all four genes? [2]
   b) How can you make a non-conjugative plasmid of *E. coli* to be mobilizable? [2]
   c) In a certain transformation experiment between $a^+b^+c^+$ donor and $a^-b^-c^-$ recipient, a^+b^+ co-transformants were obtained at a very high frequency. Are these enough as the evidence to conclude that *a* and *b* are being carried in the same fragment? If no, what additional experiment needs to be carried out? Explain. [2]
   d) In *E. coli* four Hfr strains donate the following markers in the order donated:

Strain 1:	M	Z	X	W	C
Strain 2:	L	A	N	C	W
Strain 3:	A	L	B	R	U
Strain 4:	Z	M	U	R	B

   All these strains were derived from the same F^+ strains. What is the order of these markers on the circular chromosome of original F^+? [3]
   e) "Pseudogenes are dead ends of evolution of genome" – Justify. [2]

3. a) In summer squash three types of fruit-coat colour are observed – white, yellow and green. A cross between the white and green fruit-coat coloured plants yield all the F_1 progeny white. The crossing between the two F_1 progeny plants produced F_2 phenotype in the ratio – white : yellow : green = 12 : 3 : 1.
   Explain and present the result in a checker board. [4]
   b) While working in the lab, you find six deletion mutants of *Neurospora crassa* that are auxotrophic for lysine. The *A* and α spores for each mutant are mated with each other to form a dikaryon (a diploid cell) and plated on minimal madia.

A) Assuming that you made no errors while performing the crosses, fill in the expected outcomes of yet to be completed complementation tosts. (+ = growth on minimal media, – = no growth on minimal media). [3]

	1	2	3	4	5	6
1	–	–	?	+	?	?
2		–	+	?	?	–
3			–	?	–	?
4				–	+	?
5					–	+
6						–

The crosses where outcomes have to be predicted are indicate by '?' signs.

B) How many genes are important for lysine production (as evident from the crosses)? [1]

c) How can you make a λdgal to establish a lysogenic relationship? [2]

d) What is a mobilizable plasmid? [1]

4. a) How can you discriminate the genome of an eukaryote and a prokaryote using *Cot* curve analysis? [3]

b) In calico cat, the coat-colour is X-linked. Cats, heterozygous for coat colour exhibit a mosaic pattern of black and yellow-orange patches on their coat. How do these patches arise? [3]

c) Present a genetic experiment by which you can prove that nature of DNA is altered during transformation? [3]

d) Integration of *F* factors into the *E. coli* chromosome is limited only at certain sites of homology. What are there sites? [2]

5. a) Write differences between the LINES and SINES. [2]

b) Design an experiment by which it can be proved that a trait is not controlled by the genes present in the organelle. [2]

c) An HFr strain with genetype 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 42^0C. After mating for several hours, the mixture was diluted and plated on minimal media with four different supplements. The plates were incubated at 24^0C. The supplements in the plates and the number of colonies per plate are the following: [3]

His + Trp 250
His + Leu 50
Leu + Trp 500
His 10

(i) What is the purpose of the met^{-} mutation in the Hfr strain in this experiment?

(ii) Which genes entered first, second and third?

(iii) What type of gene mapping will tell you the order of genes?

d) A recessive mutation in an X-linked gene results in hemophlia, marked by a prolonged increase in the time needed for blood to clot. Suppose that two phenotypically normal parents produce three normal daughters and a son affected with haemophilia. [2+2]

(i) What is the probability that all the daughters are heterozygous carriers?

(ii) If one of the daughters mates with a normal male and produce a son, what is the probability that the son will be affected?

6. a) In a test-cross of a dihybrid, the number of recombinants never exceed 50%. Explain why? [2]

b) An $F'(Ts)\, lac^{+}$ plasmid has a temperature – sensitive mutation in its replication system.

(i) What is the phenotype of an $F'(Ts)\, lac^+/lac^-$ cell at 42^0C?

(ii) An $F'(Ts)\, lac^+/lac^-\ gal^+$ strain is grown for many generations and then plated at 42^0C. Some lac^+ colonies form at 42^0C. How have these formed? [2]

c) Define conditional lethal mutation in respect of mapping of fine structure of gene. [2]

d) The F_2 progeny from a particular cross exhibit a modified dihybrid ratio of 9:7 (instead of 9:3:3:1). What phenotypic ratio would be expected from a testcross of the F_1 progeny? [2]

e) What is super infection immunity? Why does it happen? [1½+1½]

Unit – II

(*Answer <u>any two</u> questions*) [2×11]

7. a) Immobilized enzymes can be used for unlimited number of times without loss of efficiency – True or False. Explain. [2½]

b) Mention three basic aims of Preservation. How fungi can be stored for a long period of time? [2+1½]

c) Why is isolation of intracellular enzyme a trickier process than that of extracellular enzymes? [2]

d) The material chosen for building a fermentor and its overall design are both important for the success of a fermentation process. Justify this with the help of example. [3]

8. a) Why some microorganisms are called industrial microorganisms, not all? [2]

b) Differentiate between cryopreservation and lyophilisation. [2]

c) What is a GMO? [2]

d) Why screening is done? Compare in between Primary Screening and Secondary Screening. [2+2]

e) What is mother of Vinegar? [1]

9. a) How will you isolate an antibiotic precursor from a natural sample (mention in a flow chart). If your isolate is a fungi, then mention the probable cost effective macronutrients and choose a suitable fermentor. [3+3]

b) Why $CaCO_3$ is used in amylase production? [2]

c) Aeration, Agitation, adding antifoam agents – necessary for Vitamin B_{12} production – why? [3]

10. a) Why is glucose applied in later phase of industrial penicillin production? [2]

b) Sometimes mild agitation can be beneficial for anaerobic culture. Why? [2]

c) Why pH of fermentation media for production of α-amylase enzyme is maintain near neutrality? [2]

d) Compare the state of importance of trophophase and idiophase with respect to fermentation. [3]

e) What are the byproducts of alcohol industry? [2]

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