

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College under University of Calcutta)

B.A./B.SC. THIRD SEMESTER EXAMINATION, DECEMBER 2012

SECOND YEAR

MICROBIOLOGY (Honours)

Date : 14/12/2012

Time : 11 am – 2 pm

Paper : III

Full Marks : 75

(Use separate answer-book for each group)

Group – A

UNIT-I

(Answer **any two** questions from 1 to 4)

1. a) Briefly explain the function and orientation of cholesterol in plasma membrane. 2½
b) Why a cell cannot depend only on diffusion as a means of getting nutrients into the cell? 2
c) What are the marker enzymes of mitochondria? 1
d) Mention some important differences between prokaryotic and eukaryotic ribosomes. 2
2. a) Na^+ is smaller in size than K^+ . Because of its smaller size, one would expect Na^+ be able to penetrate any pore which permits K^+ . However, it does not happen. Explain why? 2
b) Briefly explain the role of mitochondrial protein cytochrome c in apoptosis. 2
c) What is endoplasmic reticulum? Describe the types and structure of endoplasmic reticulum. 3½
3. a) What are the three common types of membrane lipids? 1½
b) What are the important features of the fluid mosaic model of membrane structure? 3
c) What are inclusion bodies? 2
d) What are the functions of membrane carbohydrates? 1
4. a) Why is it said that all biological membranes are asymmetric? 2
b) Mention a few important differences between eukaryotic cilia and flagella. 2
c) Why do cells of organisms living at low temperature have higher proportions of unsaturated fatty acids in their membrane than do cells living at higher temperature? 1½
d) State at least one similarity and difference between symport and antiport. 2

UNIT-II

(Answer **all** the questions)

5. a) What is meant by 'biologically active DNA'?
b) What is meant by abortive transcription? 1½+1½=3
6. a) What do you mean by codon degeneracy? 2
b) How many GTP molecules are required for each ribosomal cycle? 1

UNIT-III

(Answer **any three** questions from 7 to 12)

7. a) Many of the gene products involved in DNA synthesis were initially defined by studying mutant *E. coli* strains that could not synthesize DNA.
i) The *dna E* gene encode the α subunit of DNA polymerase III. What effect is expected from a mutation in this gene?

- ii) The *dna Q* gene encodes the ϵ subunit of DNA polymerase III. What effect is expected from a mutation of this gene?
- iii) What will happen in replication if the gene for pyrophosphatase is mutated? 3
- b) Using autoradiography J. Cairns presented a 'θ' like structure of a replicating DNA in *E. coli* cell. Such 'θ'-structure can be resulted either from unidirectional or bi-directional mode of replication. How can you prove the correct mode of replication? 3
- c) Write down the mechanistic differences between the topoisomerase I and topoisomerase II. 2
8. a) Which reaction is catalysed by amino acyl tRNA synthetase? 2
- b) Describe the role of G-proteins in translation in bacteria. 2
- c) Write down the 3 termination codons. 1½
- d) What are the functions of DNA gyrase and DNA topoisomerase I enzymes. 2
- e) Name one inhibitor of DNA gyrase. ½
9. a) What is an operon? What are the genetic elements of a *lac* operon? 1+1
- b) Predict the effects of deleting the following regions of DNA. 1½×3
- i) The gene encoding *lac* repressor
- ii) The *lac* operator
- iii) The gene encoding CAP
- c) Define attenuation. Cite an example where attenuation is involved in gene regulation. 1+½
10. a) The *trp* operon in *E. coli* is a repressible operon. Let us suppose that this operon is in a derepressed state but the amount of tryptophan present in the cytoplasm is not enough to support normal growth. What measure will it take to synthesize the requisite amount of tryptophan. In brief write the mechanisms. 4
- b) Write down the characteristic features of the non-ribosomal peptide gramicidin synthesis. 2
- c) How can you prove the presence of β -galactosidase in a culture of *E. coli* cells? 2
11. a) Design an experiment to show that transcription proceeds in 5' → 3' direction. 4
- b) Write the base sequences of DNA that are recognised by σ^{70} and σ^{32} subunit of *E. coli* RNA polymerase during transcription. 2
- c) How does rifampicin kill the endoparasite *Mycobacterium tuberculosis*? 2
12. a) How did Khorana and his colleagues prove the triplet nature of genetic code? 3
- b) What will happen in translation if the 5' AAG 3' codon is changed to 5' UAG 3' codon? 2
- c) Why is poly(A) tailing of eukaryotic mRNA necessary? 1
- d) Describe the ρ -independent transcription termination in *E. coli*. 2

Group – B

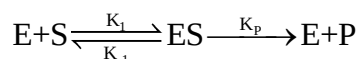
(Answer any three questions from (a) to (f))

13. a) i) How NAD(P)^+ can be prepared biochemically? What is the function of NAD(P)^+ ? 3
- ii) Coenzyme can be considered as special class of substrate – Justify the statement. 2
- iii) What do you mean by E.C. 1.2.1.23? 1
- b) i) What is suicide inactivation? Give example. 2+1
- ii) What is activation energy? How enzymes lower the activation energy and act as biocatalysts? 2+1

c) The following data were recorded –

[s] M	V [nM x litre ⁻¹ x mm ⁻¹]
6.25 x 10 ⁻⁶	15
7.50 x 10 ⁻⁵	56.25
1.00 x 10 ⁻³	60
1.00 x 10 ⁻²	74.9
1.00 x 10 ⁻²	75

- i) Estimate the K_m and V_{max} . 2
- ii) What would 'V' be at $[s] = 2.5 \times 10^{-5}$ M and $[s] = 5.0 \times 10^{-5}$ M? 2
- iii) What would 'V' be at 5×10^{-5} M if the enzyme concentration is doubled? 1
- iv) The above data were recorded over a 10 minute period. Verify that 'V' represent a true instantaneous velocity. 1
- d) i) What do you mean by prosthetic group of enzyme? 2
- ii) What is apozyme? 2
- iii) What is the significance of metal ions in enzyme activity? 2
- e) i) What are the international classes of enzyme? 3
- ii) What is turn over number? 2
- iii) What is the basic difference between regulatory enzyme and allosteric enzyme? 1
- f) i) Given the reaction –



Where,

$$K_1 = 1 \times 10^7 \text{ M}^{-1} \text{Sec}^{-1}$$

$$K_{-1} = 1 \times 10^2 \text{ Sec}^{-1}$$

$$K_p = 3 \times 10^2 \text{ Sec}^{-1}$$

Calculate

- (i) K_s 1
- (ii) K_m 1
- (iii) Can K_p be very much greater than K_1 ? 2
- ii) In which type of reversible enzyme inhibition does V_{max} decrease with increasing inhibitor concentrations, but the enzyme affinity remain constant? 2

(Answer **any two** questions from (a) to (d))

14. a) i) State the characteristics of non-faecal coliforms. 2
- ii) How would you determine the MPN of water? 3
- iii) Name one indicator microorganism of water. 1
- b) i) How can you sterilize air of an enclosed space? 3
- ii) Why is air not a suitable medium for growth and reproduction of bacteria? 2
- iii) What are aerosols? 1
- c) i) Define BOD. 2
- ii) What is sewage? 2
- iii) Discuss the microbial activities that occur in a septic tank. 2
- d) i) Why it needs 15 to 20 min air exposure for development of color in positive VP test? 2
- ii) What are the characteristics of an indicator organism? 4

