# RAMAKRISHNA MISSION VIDYAMANDIRA

**(Residential Autonomous College under University of Calcutta)**

**B.A./B.SC. SECOND SEMESTER EXAMINATION, MAY-JUNE 2013**

**FIRST YEAR**

Date : 20/05/2013 **Microbiology (Honours)**

Time : 11am – 2pm Paper : II Full Marks : 75

## (Use separate answer book for each group)

## Group – A

Answer any **two** questions from Q. No. 1 to 4

1. a) Define growth factors. 2
   b) What are the major classes of growth factors? 2
   c) Name one bacterium requiring heme as the growth factor. 1
   d) A bacterial culture increases in number from $10^2$ to $10^8$ in 4 hours. Calculate the generation time of the bacterium. 3
   e) Differentiate between a chemostat and a turbidostat. 2

2. a) Differentiate between facultative anaerobes and aerotolerant anaerobes. Explain why certain *Thiobacillus* species fail to grow if the pH of the medium is not acidic. 2+1
   b) What are mixotrophs? Give one example. 2+1
   d) What are the contributory factors of stationary phase formation? 2
   e) What is synchronous culture? 2

3. a) How can you isolate gram positive and gram negative bacteria from a mixed culture without using any methodology based on staining? 2
   b) Your culture broth has been contaminated with a *Bacillus* sp. Describe a suitable method to destroy it completely. 2
   c) What is oligodynamic action of metals? 2
   d) What is the advantage of using chloramine over liquid chlorine in treatment of water? 2
   e) What is the mode of action of phenol in controlling microorganism? 2

4. a) What do you mean by the term antibiotic? 2
   b) Archaea are insensitive to penicillin – Why? 2
   c) State the mechanism of tetracycline resistance in bacteria. 3
   d) What is a disinfectant? How is the potency of a disinfectant determined? 1+2

Answer any **one** question from Q. No. 5 to 6

5. a) A bag contains 4 white balls and 2 black balls, another contains 3 white balls and 5 black balls. If one ball is drawn from each bag, find the probability that (a) both are white (b) one is white and one is black. 3
   b) What does standard deviation of a given dataset signify? 2
   c) Worked out *t* test to find whether or not the mean oxygen consumption (*ml* / *h*) of 10 carp fishes varied before or after irradiation. The data are given below:

| Fish No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Before irradiation | 3.2 | 2.7 | 2.9 | 3.0 | 2.8 | 2.9 | 2.8 | 3.2 | 3.1 | 3.0 |
| After irradiation | 2.7 | 2.5 | 2.6 | 2.6 | 2.5 | 2.6 | 2.4 | 2.8 | 2.5 | 2.5 |

$t_{0.05(18)} = 2.101$ $t_{0.05(19)} = 2.093$
$t_{0.05(17)} = 2.110$ $t_{0.05(9)} = 2.262$ 5

6. a) What is meant by Type I error and Type II error in statistical hypothesis testing? 2
   b) A pure dwarf (tt) pea plant was crossed with a heterozygous (Tt) tall pea plant. Calculate the probability that out of 30 saplings, 20 will be tall and 10 will be dwarf. 3
   c) Mention the characteristics of contingency chisquare. 3
   d) Explain the terms ANOVA, ANCOVA & MANCOVA. 2

## Group – B

Answer any **five** questions

7. a) What is reverse osmosis? 2
   b) What are the events that take place when radiation reacts with matter? 2
   c) The half life of a radio element is 231 minutes. How long will it take for $^{9}/_{10}^{th}$ fraction of a sample of this element to decay? 3
   d) State the second law of thermodynamics. 2

8. a) Discuss the criteria of spontaneity of a chemical reaction with respect to the equation relating enthalpy and entropy. 3
   b) What is active transport? How can it be compared with facilitated diffusion? 1+2
   c) For a reaction at 27ºC, $\Delta G = -12$ Kcal and $\Delta H = -17.5$ Kcal. Find out $\Delta S$. 2
   d) Define specific activity of a radioisotope. 1

9. a) How use of scintillation cocktail can help monitor radiation in a liquid scintillation counter? 2
   b) Explain Donnan equilibrium. Cite one example where Donnan membrane phenomenon plays a significant role in human physiology. 2+2
   c) The parietal cells of the stomach contain membrane "pumps" that transport hydrogen ions from the interior of the cell (pH = 7.0) to the surrounding medium to make gastric juice (pH = 1.0). Calculate the free energy required to transport 1 mole of hydrogen ions. 2
   d) What are "ionophores"? 1

10. a) Glycerol is also called a lipid — Justify. 2
    b) Write down a short note on Leukotriene. 4
    c) What is Reichert-Meissl number? 3

11. a) i) What are the amino acids that show strong absorption in the ultraviolet region? 1
    ii) When a protein containing a few such amino acids is kept in polar or nonpolar solvent, their UV spectral characteristics differ. Explain such observations with the help of a diagram. 2
    b) i) What is meant by fluorescence? 1
    ii) Name one each of extrinsic fluor (fluorophore) used to study structural aspects of macromolecules like proteins and DNA. 1
    iii) Define the term Wave number, a way of expressing frequency in infrared spectroscopy. 1
    c) i) State the Principle of ultrafiltration of Protein. 1
    ii) Explain its utility while purifying a soluble Protein. 1
    iii) 'Ultracentrifugation is used to purify a membrane bound protein' – comment. 1

12. a) What happens when glucose is treated with (i) phenyl hydrazine 3
(ii) acetic anhydride at 0ºC in presence of zinc chloride 2
b) State the action of the enzyme diastase over starch. 2
c) Why is sucrose known as invert sugar? 2

13. a) Define iodine number. You are given two oil samples extracted from coconut and sunflower. In which case do you expect a higher iodine number and why? 1+1
b) A 250 mg sample of a pure olive oil required 47.5 mg of KOH for complete saponification. Calculate the average MW of the triglycerides in the oil sample. 4
c) What are derived lipids? State the biological importance of any one such lipid molecule. 2+1

14. a) What is the basis of high phosphoryl group transfer potential of ATP? 2
b) Glucose-6-phosphate was hydrolysed enzymatically (at pH 7 and 25ºC) to glucose and inorganic phosphate. The concentration of glucose-6-phosphate was 0.1M at the start. At equilibrium, only 0.05% of the original Glucose-6-phosphate remained. Calculate the $K'eq$ and $\triangle G'$ for hydrolysis of glucose-6-phosphate. 4
c) What will be the immediate consequence of inactivating all the $Na^+ / K^+$ ATPases of a cell? How does the cell utilise the $Na^+$ gradient created by the $Na^+ / K^+$ ATPase? 2+1

15. a) You are working with a sample which is highly concentrated. What kind of deviation might be observed in an absorbance vs. concentration plot of the sample? 2
b) What is isosbestic wavelength? State one use of this wavelength in practical analysis. 2+1
c) A solution containing $10^{-5}$ M ATP has a transmission 0.702 (70.2%) at 260nm in a 1 cm cuvette. Calculate: (i) Transmission of the solution in a 3cm cuvette (ii) Absorbance of the solution in a 1cm cuvette. 2+2

16. a) Define quantum yield of a fluorophore. 2
b) A researcher speculates that protein A interacts with high affinity with protein B. Using your knowledge in spectrofluorimetry and its applications, design an experiment to test this speculation. 3
c) The prokaryotic ribosome consists of 30S and 50S subunits. What does 'S' indicate? What is the dimension of S? 1+1
d) Differentiate between native PAGE and SDS-PAGE. 2