RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College under University of Calcutta)

B.A./B.SC. SECOND SEMESTER EXAMINATION, MAY 2012

FIRST YEAR

Date : 21/05/2012 **MICROBIOLOGY (Honours)**

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

[Use Separate Answer Books for each group]

Group - A

Answer **any two** from question no. 1-4 and **any two** from question no. 5-8

1. a) State the relationship between generation time and mean growth rate of a bacterium in batch culture. [2·5]
   b) What are the advantages of a semi-logarithmic growth curve over an arithmetic growth curve. [2·5]
   c) Why is para amino-benzoic acid required for the growth of many micro-organisms? [2·5]
   d) Why do auxotrophs require growth factors? [2·5]

2. a) What should be the essential constituents for the growth of a common heterotrophic bacterium in a solid medium? [2]
   b) Distinguish between antiseptics and antibiotics. [2]
   c) What are the three possible effects of an antimicrobial agent on a bacterial culture. [3]
   d) Why is milk pasteurized and what are the possible methods employed for pasteurization of milk? [1+2]

3. a) How does depth filter reduce the microbial population in solutions? [2]
   b) What is tyndallization? [2]
   c) What is penicillinase? What is its function? [2]
   d) What is phenol coefficient? [2]
   e) How do phenolic compounds kill microorganisms? [2]

4. a) In *Drosophila sp.* Vestigial wing (vg) is recessive to its normal wing (+) alleles. From a cross conducted during summer, 123 vg flies, 138 normal flies appear. The same experiment in winter produces 374 vg flies and 262 normal type flies. Using appropriate statistical tests, determine the impact of environmental factors on this result. [5]
   b) What is meant by ANOVA? What advantages does it have over T test? [1+2]
   c) Mention the different types of chi-square. [1]
   d) What is critical region? [1]

5. Why is penicillin more effective against a growing culture than on a stationary phase culture? Briefly describe the mode of action of penicillin. [2+3]

6. a) What is meant by VBNC organism? [2]
   b) Name two antibiotics that inhibit the protein synthesis in bacteria, stating their binding sites. [1+2]

7. a) If two heterozygous tall pea plants are crossed with each other, what is the probability that out of 20 saplings, 12 will be tall and 8 will be dwarf. [3]
   b) What is meant by binomial distribution and normal distribution? [2]

8. Design an experiment to enumerate the number of viable bacteria present in 1g sample of soil by pour-plate method. [5]

Group – B

Answer **any five** :

9. a) What do you mean by specific activity of a radioisotope? What is its unit? [2]
   b) Write down the equation relating free energy, entropy and enthalpy. [2]
   c) Distinguish between extrinsic fluorophor and intrinsic fluorophor. [2]

d) C^{14} has a half life of 5700 years. Calculate the fraction of the C^{14} atoms that decays (i) per year (ii) per minute. [2]

e) What is isobestic point? [1]

10. a) Carry out the following conversions: [2x3]
    i) Glucose to mannose
    ii) Aldopentose to aldohexose

    b) What is invert sugar and why is it named so? [3]

11. a) Define saponification number. A 250 mg sample of pure olive oil required 47.5 mg of KOH for complete saponification. Calculate the average MW of the triglycerides in the olive oil. [2+3]

    b) What happens when animal fat is treated with caustic soda? [2]

    c) Give examples of one complex lipid and one derived lipid. [2]

12. a) What happens when – [2x3]
    i) Fructose is treated with phenylhydrazine
    ii) Methyl glucoside is treated with periodic acid.

    b) Give the structure of one reducing and one nonreducing disaccharide. What is inulin? [1+1+1]

13. a) What is the physical basis of IR spectra? [2]

    b) Calculate the number of modes of vibration for (i) CO_2 and (ii) H_2O. [1+1]

    c) Why is the cuvette used in IR experiments made up of salt crystals and not glass? [1]

    d) Why does ethidium bromide fluoresce significantly only when it is intercalated in double stranded nucleic acid? [2]

    e) What is density gradient equilibrium centrifugation? [2]

14. a) What methodologies would you adopt if you want to – [4x1]
    i) Separate the proteins in a crude mixture on the basis of their net charge
    ii) Separate the proteins on the basis of their size (molecular weight)
    iii) Desalt the protein sample
    iv) Concentrate the protein sample on the basis of their size.

    b) Explain the origin of bonding and antibonding molecular orbitals. [2]

    c) Define Gibb's free energy. Comment on the nature of a process if at a constant temperature and pressure its ΔG is (i) zero (ii) positive (iii) negative [3]

15. a) You are working in a spectrophotometer with a sample which is highly concentrated, what type of deviations can be observed compared to the dilute sample? What is the reason for the deviation? [3]

    b) What is the basis of fluorescence in a protein? [2]

    c) What is the utility of osmotic pressure in human body? [2]

    d) Draw the schematic diagram of a spectrofluorometer with proper labelling. [2]

16. a) A solution having concentration of 64 µg/ml of a substance of molecular weight 212 has an absorbance of 0.27 at 540 nm in a one centimetre cuvette. Find the value of the molar extinction coefficient. [3]

    b) You wish to identify spots on a paper chromatogram by contact with X-ray film. You could choose H^3 or C^{14}, which one would you choose and why? [2]

    c) Explain Donnan equilibrium. Cite one example where Donnan membrane phenomenon plays a significant role in human physiology. [2+2]

17. a) Describe the Acrolein test for detecting presence of glycerol. [2]

    b) β-D-glucopyranose undergoes oxidation with bromine at a faster rate than α-D-glucopyranose — Explain. [3]

    c) Equillibrium mixture of D-glucopyranose contains 50% of α form whereas in water it is 38% — comment on this result. [3]

    d) Write down the structure of a heteropolysaccharide. [1]