RAMAKRISHNA MISSION VIDYAMANDIRA
(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. SECOND SEMESTER EXAMINATION, MAY 2017
FIRST YEAR [BATCH 2016-19]
Date : 18/05/2017   **MICROBIOLOGY (Honours)**
Time : 11 am – 3 pm   **Paper : II**   Full Marks : 100

[Use a separate Answer Book for each group]

Group – A

Answer **any three** questions [3×10]

1. a) What is meant by 'thermal death time'?   2
    b) How do catalase and superoxide dismutase help in bacterial growth?   1½+1½
    c) Which nutritional type does cyanophyceal belong and why?   1+2
    d) What is the difference between selective and differential culture media?   2

2. a) Classify bacterial world in terms of oxygen requirement and tolerance.   2
    b) Ethylene oxide is a sterilant – explain the statement.   2
    c) Write down the difference between depth filter and membrane filter.   2
    d) What is chloramine? Give an example.   2
    e) What do you mean by phenol coefficient?   2

3. a) Define CFU.   2
    b) How does pH affect bacterial growth?   2
    c) Explain the relationship between mean generation time and growth rate of bacteria.   3
    d) Why bacterial growth and reproduction are considered synonymous?   1
    e) What happens in a chemostat if the dilution rate exceeds the maximal growth rate of the organism?   2

4. a) You are given the following data: 6

Variable	X	Y
Mean	47	96
Variance	64	81

Correlation coefficient (*r*) between *X* and *Y* = 0.36
Determine the equation of regression line.
Calculate *Y* when *X* = 50 and *X* when *Y* = 88.

   b) Body length (cm) of fishes of a species was obtained from two ponds. They were measured as follows: 4

Pond A	20	24	20	28	22	20	24	32	24	26
Pond B	12	10	8	10	6	4	14	20	10	6

Calculate the mean difference is total body length between the fishes of two ponds and show whether it is significant or not.

5. a) Mention two important characteristics of chi-square.   2
    b) What do you mean by coefficient of correlation?   2

c) What is meant by binomial distribution of probability? 2

d) Why microorganisms face difficulty in growing at low a_w values? 1

e) Briefly differentiate the viable count and total count of bacteria. Why viable count is more sensitive than a microscopic count? 2+1

6. a) Why is meant by a regression line? 2

b) Variances of two distributions are additive but not the standard deviation – Explain with example. 2

c) (i) Draw the structure of the sulphonamide functional group and mention the enzyme that is inhibited by this group of antimicrobials. 1+1

(ii) Why is moist heat more effective than dry heat? 1

d) Write down three modes of antibiotic resistance. 3

Group – B

Answer **any four** questions [4×10]

7. a) Define specific activity of a radioactive substance. 2

b) What is the specific activity of pure C^{14} in terms of DPM/g, Ci/g and Ci/g–atom?
(Given, $\lambda = 2.31 \times 10^{-10}$ min^{-1}, $1Ci = 2.22 \times 10^{12}$ DPM). 3

c) State S.I. unit of Radioactivity. 1

d) Write down the relation between Half-life and average-life of a radioactive substance. 1

e) What is Radioimmunoassay (RAI)? 2

f) Write down in brief about Radiotion protection. 1

8. a) Briefly describe with line diagram the application of "Liquid Scintillation Counter" for measurement of radioactivity. 3

b) What is called fluorescence quenching? Name one each of extrinsic and intrinsic flurophores and indicate their applications in biology. 1+2

c) State the unit of sedimentation. 1

d) What is the difference between centrifugation and ultra centrifugation? 2

e) What is electrophoresis? 1

9. a) State Lambert-Beer law. Define molar extinction coefficient and sate its significance. 3

b) You are supplied with two bacterial DNA of differnet (G+C) content and each suspended in 0.05 M and 0.50 M phosphate buffers at pH 7.6. Carry out an experiment to determine the melting temperatures T_m of four such samples using an UV spectrophotometer. Interpret your observations. 4

c) Dialysis is molecular filtration – comment. What are the factors that affect rate of dialysis? While purifying a protein, you sometime need to employ 'ultrafiltration' technique – mention a use. 3

10. a) What is the absorption and emition spectra? 2

b) Draw a schematic diagrams of spectroflurimer. 3

c) Mention the application of radio isotopes in metabolic studies. 2

d) State the Definition of Red shift and Blue shift with diagram. 3

11. a) Calculate the saponification number of a fat of molecular weight 862. 2

b) What is Transition temperature? 3

c) Write down the structure of:– 3x1

      i)   Cardiolipin

      ii) Stearic acid

      iii) α-Linolenic acid

  d) Write a short note on Leukotrienes.   2

12. a) What are Prostaglandins?   3

    b) Differentiate between fat and oil.   2

    c) What are the differences between α amylase and β amylase?   3

    d) How would estimate glucose?   1

    e) What are storage polysaccharides?   1

13. a) What are Thromboxanes?   2

    b) What is cholesterol?   2

    c) β-D-glucose is more stable in aqueouse solution but less stable in methanol. – Justify.   3

    d) How will you distinguish between propane 1, 3-diol and ethylene glycol?   2

    e) What happen if lipid is treated with bromine water?   1

14. a) What will happen when Sucrose is treated with acid followed by Benedict reagent.   2

    b) How many HIO_4 molecules are required to digest raffinose?   2

    c) How will you prove that maltose have one and four glycosidic linkage?   2

    d) How will you convert arabinose to glucose?   2

    e) What is the function of heparin in mammals?   2

Group – C

Answer **any three** questions   [3×10]

15. a) Draw the basic structure of the major types of lipids found in cellular membranes. How do sphingolipids differ from glycerolipids? Which lipids are phospholipids? Which are glycolipids? How are these lipids organized into a bilayer? How is the bilayer important for membrane activities?   1½+½+½+½+½+½

    b) When a preparation of mitochondrial membranes was treated with high salt (0.6 M KCl), it was observed that 40% of the total protein in this preparation was solubilized. What kind of membrane proteins are in this soluble extract, and what forces normally hold them to the membrane? What kind of proteins constitutes the insoluble 60% and what forces hold these proteins in the membrane?   3

    c) The plasma membrane of an animal cell consists of 45% phospholipid and 55% protein (by weight). What is the mole ratio (moles of lipid / moles of protein) if the average molecular weight of phospholipids is 750 and the average molecular weight of membrane proteins is 50,000?   3

16. a) What is meant by the statement that the proteins of a membrane are distributed asymmetrically? Is this also true for the membranes carbohydrate?   1+1

    b) What are motor proteins?   2

    c) Write down the structure of cellulose.   2

    d) Draw the basic diagram of anchoring junction. Name the proteins involved in desmosome.   2+2

17. a) In an *in vitro* experiment on DNA replication, three kinds of dNTPs were used, in which either α– or β– or γ– phosphorus were labelled (^{32}p) respectively. Which dNTP will make the daughter DNA strand radio-labelled and how? 3

b) *E. coli* cells were grown for several generations in a medium containing heavy nitrogen (^{15}N) and then transferred to a medium with light nitrogen (^{14}N). The cells were allowed to grow for several generations and samples were harvested at intervals. From these samples DNA was extracted and their buoyant densities were measured by equilibrium centrifugation in caesium chloride. After one generation the extracted DNA exhibited an intermediate density which can support both the semi conservation and dispersive mode of replication. How was the dispersive mode of DNA replication nullified? 3

c) Contrast the role of DNA Polymerase I & III in bacterial replication. 2

d) What is the major difference between bacteria and eukaryotes that allows a eukaryotic cell to replicate its DNA in a reasonable period of time? 2

18. a) Briefly mention the structural peculiarities of *ori* C region of *E. coli* chromosome. 2

b) A 41.5nm long duplex DNA molecule in the B conformation adopts the A conformation upon dehydration. How long is it now? What is the approximate number of base pairs? 2+2

c) "Linking number of dsDNA is an integer but the twist and writhing number may or may not be an integer"— Explain this with suitable example. 4

19. a) "Lysosomes play a key role in organelle turnover" – Explain. 2½

b) Compare the properties and evolutionary history of the inner and outer mitochondrial membranes, the intermembrane space and the matrix. 3

c) Briefly describe the role of *cis*– and *trans*– network of Golgi complex. 2½

d) How can you convert a negatively supercoiled plasmid DNA into a positively supercoiled form? 2

20. a) Write down the differences between the RER and SER with respect to their morphology and function. 2

b) What are some of the major activities of peroxisomes? What is the role of catalase in these activities? 2+1

c) Describe the organization of the membranes of a chloroplast. How does this organization differ from that of mitochondria? 1½+1½

d) State the crucial step of Avery, McLeod and McCarty's experiment by which it was concluded that DNA is the genetic material of *Diplococcus pneumoniae* (= *Streptococcus pneumoniae*) 2

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