Ahmedabad University

School of Arts and Sciences

BIO103 Microbiology

End Term Examination 2024 (Winter Semester)

Total Marks = 50 **Time – 2 hours**

Date: 28-04-2024
No. of printed pages: 6

IMPORTANT INSTRUCTIONS

- **All Questions of Section-I are compulsory. For the MCQ's, only one option is correct**
- **Section-II contains 7 questions (each Qs. is of 5 marks). Answer any 6. In case you answer all the 7, the first 6 you have attempted will be evaluated.**
- **Read the questions carefully. Refrain from malpractices. Wish you all the best!**

Section-I **1 X 20 = 20**

1. Which of the following scientist used the term 'animalcules' to describe microorganisms?
   (a) Edward Jenner
   (b) Robert Hook
   (c) Antony van Leeuwenhoek
   (d) John Needham

2. The Pasteur Effect –
   (a) is related to the germ theory of disease
   (b) is related to sugar fermentation
   (c) is related to the process of pasteurization
   (d) is related to the development of anthrax vaccine

3. While culturing bacteria on solid media (petri plate), one of the precautionary measures exercised is storing the inoculated culture upside down. What is the reason for this? (your answer should strictly be limited to one line).

4. Which of the following is not a water borne disease?

   (a) Malaria
   (b) Typhoid
   (c) Hepatitis A
   (d) Cholera

5. Which of the following best represents the hierarchy of levels of biological classification?
   (a) Phylum, kingdom, class, order, genus, species, family
   (b) Kingdom, phylum, class, order, family, genus, species
   (c) Class, order, kingdom, phylum, family, genus, species
   (d) Kingdom, phylum, family, class, order, genus, species

6. Type strain is the representative member of a particular strain. (True/False)

7. Which of the following techniques may be used to understand the genetic similarity between 2 species of micro-organisms?
   (a) Colony morphology
   (b) pH optimum and growth range
   (c) Nucleic acid hybridization
   (d) Staining behavior

8. An organism which obtains energy by breaking chemical compound, uses inorganic compound as the oxidizing donor source, and carbon dioxide as the carbon source is termed as:
   (a) Chemolithoautotroph
   (b) Chemoorganoautotroph
   (c) Chemoorganoheterotroph
   (d) Photolithoautotroph

9. A phylogenetic tree may be rooted or unrooted, and contains branches and nodes. What does the nodes signify? (Write a one line answer).

10. Which of the following is the largest subgroup of the phylum Proteobacteria?

    (a) Deltaproteobacteria
    (b) Gammaproteobacteria
    (c) Betaproteobacteria
    (d) Alphaproteobacteria

11. Mollicutes are a class of bacteria which cannot make peptidoglycan. Which phylum do they belong to?
    (a) Firmicutes
    (b) Actinobacteria
    (c) Spirochaetes
    (d) Crenarchaeota

12. How is N-acetyl muramic acid related with N-acetyl glucosamine? (Write one line answer)

13. *Candida albicans* is known to cause opportunistic infections in AIDS patients. They reproduce asexually and are not known to produce sexual spores. Which of the following groups do they belong to?

    (a) Basidiomycota
    (b) Ascomycota
    (c) Deuteromycota
    (d) Zygomcota

14. Baltimore classification divides viruses into 6 groups. Which of the following groups contain single stranded RNA as their genome with negative polarity?
    (a) Group VI
    (b) Group V
    (c) Group IV
    (d) Group III

15. Which of the following is generally not involved in inter species quorum sensing in bacteria?
    (a) Acyl homoserine lactone
    (b) Indole
    (c) AI-2
    (d) AI-3

16. You are performing total count of your bacterial sample in a Petroff-Hausser counting chamber (without any dilution). Among the 25 squares in the middle 1 mm^2 area, you have counted the numbers in 5 squares. The total number you have counted in these 5 squares is 50. What is the count of your sample (in terms of cells/ml)?
    (a) 1.25×10^3
    (b) 12.5×10^4
    (c) 1.25×10^6
    (d) 1.25×10^5

17. Which of the following is a selective media for Gram –ve bacteria?
    (a) Mannitol Salt Agar
    (b) MacConkey's Agar
    (c) Eosin Methylene Blue Agar
    (d) Both (a) and (b)
    (e) Both (b) and (c)
    (f) Both (a) and (c)

18. Organisms which do not require oxygen for their growth but grow better in its presence are known as:
    (a) Aerotolerant anaerobe
    (b) Facultative anaerobe
    (c) Microaerophile
    (d) Obligate anaerobe

19. Antiseptic compounds are chemicals which inhibit the growth of micro-organisms. In line with the above definition, which of the following cannot be considered as antiseptic?
    (a) 0.25%-0.5% $AgNO_3$
    (b) 2%-7% Iodine
    (c) 1%-2% Phenol
    (d) Neomycin

20. Which of the following structures in bacteria is required for attachment to surfaces?
    (a) Cell wall
    (b) Capsules
    (c) Flagella
    (d) Endospore

Section-II **5 X 6 = 30**

1. (a) As a scientist, you have to experimentally show that DNA is the genetic material. Describe the experiment you will perform (with reference to rationale, procedure, expected observations, and conclusion).
   (b) Both Griffith's experiment and Avery, McCarty and Macleod's experiment deal with pieces of evidence for the process of transformation. What is the difference in terms of the conclusion of these 2 experiments? **[4+1=5]**

2. (a) What are phenons?
   (b) In pursuit of understanding the relatedness of 2 organisms X and Y, you are performing Numerical Taxonomy based on 20 different observable characteristics. You find that 4 characters are present in both X and Y, 7 characters are present in X but not in Y, 5 characters are present in Y but not in X, and 4 characters are neither present in X nor Y. Calculate the S_{SM} and S_J between X and Y. Show all the steps for your calculation.
   (c) What is polyphasic taxonomy? **[1+3+1=5]**

3. (a) A yeast cell can live 'two lives'. Justify this statement in the context of the life cycle of yeast.
   (b) *Leishmania donovani* is an unicellular protozoan parasite with a dimorphic life cycle. What does dimorphic mean in this context? **[4+1=5]**

4. (a) You have inoculated 20 cells of the bacteria X in nutrient media. After growing this culture for 6 hours, you counted the total number of cells and found that 400000 cells are now present in the media. Given this information, calculate the (i) number of generations, (ii) generation time, and (iii) mean growth rate constant of X. Elaborate and explain all the steps which you use to reach the answer. Writing down only the values will not suffice; you also need to write the unit of your calculated values (write the values upto 3 decimal places). {The log values (which you may require) are as follows: log 1 = 0; log 2 = 0.301; log 3 = 0.477; log 4 = 0.602}.

(b) You are performing continuous culture of a micro-organism. The volume of the culture vessel in 1000 ml. Initially, you kept the flow rate of fresh medium at 20 ml/hour (condition 1). However, the yield of the product was not upto the mark and hence you increased the flow rate to 50 ml/hour (condition 2). Answer the following questions:

(i) What is the dilution rate in condition 1 and 2?

(ii) Will the Generation Time of the micro-organism vary among condition 1 and 2? How and why? **[3+2=5]**

5. Describe the classification of microorganisms based on temperature. Explain each of the descriptive terms with examples. **[5]**

6. An organism A obligatorily depends on organism B for its living. Organisms C and D are also benefitted from their association with each other but they can live without each other. Organism D is in turn benefitted from its association with B but this association doesn't cause any harm or help to B. The organism E earns its living by stealing nutrients from C and thus causes harm to C. However, the organism F secretes some chemicals which doesn't allow E to grow but F and G have similar nutritional requirements and if present together, G can outrun the growth of F.

(a) Draw a schematic diagram to explain all the interactions between the different organisms.

(b) If G is present, how will it affect the relationship between C and D? Explain.

[3+2=5]

7. (a) You need to sterilize a microbial culture media but you do not have access to an autoclave or pressure cooker. Explain what procedure you will follow to sterilize your media and then use it for culturing the organism of your interest. Also describe how this method will lead to sterilization.

(b) You have discovered a new disinfectant Z. You want to find out its effectiveness compared to phenol. You did a series of experiments with this newly discovered disinfectant on the growth of a pathogenic strain of *Staphylococcus*. You inoculated 500 cells of this pathogenic *Staphylococcus* each into the media with different dilutions of phenol and disinfectant Z and allowed them to grow for different time points. You have obtained the following results:

DISINFECTANT	DILUTION	CELL COUNT IN THE BACTERIAL CULTURE AFTER EXPOSURE FOR:		
		2 min	7.5 min	10 min
Phenol	1:95	1×10^6 cells/ml	0	0
	1:105	1.5×10^6 cells/ml	0	0
	1:110	2×10^6 cells/ml	0	0
	1:115	3×10^6 cells/ml	1.5×10^6 cells/ml	0
	1:125	4×10^6 cells/ml	2×10^6 cells/ml	2×10^5 cells/ml
Disinfectant Z	1:100	0	0	0
	1:200	0	0	0
	1:300	3×10^4 cells/ml	0	0
	1:400	0.3×10^6 cells/ml	0	0
	1:500	3×10^6 cells/ml	2×10^6 cells/ml	0

What is the phenol coefficient (in decimals) of disinfectant Z at (i) 2 minutes, (ii) 7.5 minutes and (iii) 10 minutes? Thoroughly explain your answer for each time point. **[2+3=5]**