BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
FIRST SEMESTER 2023-24
MICROBIOLOGY (BIO F212)
COMPREHENSIVE EXAMINATION (PART-B, OPEN BOOK)

Total Marks: 50 **Max. Time: 135 minutes** **Date: 13.12.2023**

Note: 1. *Start answering every question from a fresh page*
2. *Answer all parts of the same section and question together, in sequence.*
3. *Answer briefly and to the point. No marks will be given without justification.*

Section-1

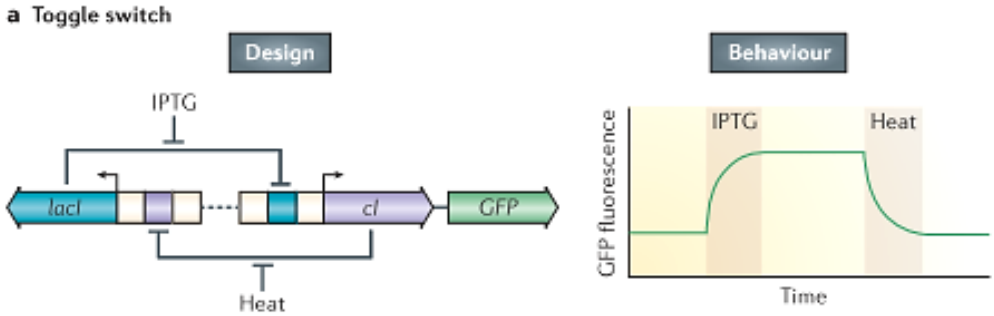
Q1. (a) Mining industries produce vast waste streams that pose severe environmental pollution challenges. Some of the toxic wastes include sulfates, causing acidification and containing insoluble metals. Conventional techniques of treatment are usually inefficient and unsustainable. A biological technique employing the use of microorganisms is a competitive alternative to treat mine wastes and recover toxic heavy metals. Suggest the type of bacteria and metabolisms that can be used to solve the above-mentioned wastes. **[3]**

(b) During a visit to the wastewater treatment plant, you noticed that after the physical removal of particulate wastes and subsequent purification in secondary treatment by biological methods, water is released directly into water bodies. Being aware of environmental concerns, which additional biological treatment(s) do you think to be conducted before releasing water? **[3]**

(c) You have been asked to sterilize a given a food product and ensure that the food must be free of *Clostridium botulinum* for which you need to calculate 12D. The D value of the given organism at 121 ^{o}C is 0.235 min. When the same sample is autoclaved at 116 ^{o}C the D value of the same changes to 2.35 min. Calculate the Z value based on the above information. **[3]**

(d) How does the microbiome of vaginal tract determine women's health. Why before puberty or after menopause women are more prone to bacterial vaginosis? **[3]**

Q2. List the nature and function of each regulatory component in the given figure a. Explain the figures (circuit and graph) based on the expression pattern of genes and the nature of regulatory components. **[4]**



Q3. A scientist isolates a bacterial strain supposed to be causing respiratory tract infections from a patient sample. If untreated, this infection can lead to the death of the patient. How will you estimate the lethality of this isolate? Is it possible to generate an attenuated version of this isolate without inducing any mutation or genetic alteration to develop a vaccine? **[4]**

Q4. Two different auxotrophic strains of *E. coli* A and B, which are met$^-$ leu$^-$ trp$^-$ and bio$^-$ phe$^-$ tyr$^-$ respectively, are mixed and grown for six hours in a medium devoid of one or more of the above mentioned amino acids for which the strain A and B are mutant. After growth, the researcher obtained the following results: (i) 60% of the resultant strain was prototroph for bio, phe, tyr, and leu; (ii) 20% of the resultant strain was prototroph for bio, phe, tyr, leu, and met; whereas none of the resultant colonies were prototroph for all amino acid mutants. Provide suitable explanation for these results. Note that the experiment was based on conjugation only (not transformation or transduction). **[5]**

Section-2

Q5. (a) During an experiment, *E. coli* lawn was grown in nutrient agar in two petriplates labelled A & B. The plate A media was freshly prepared, whereas petriplate B was stored at room temperature for a week. 30 µL of lambda phage culture was dropped on one-day old bacterial lawn at 10 different sites in both these petriplates. The plaque formation was observed on the next day in case of petriplate A whereas plaque appeared after 1 hour in petriplate B. Discuss the possible reason at molecular level behind these observations. **[6]**

(b) *Hepatovirus*, causative agent of "Hepatitis A" is a type of Picornaviruses (Family Picornaviridae) and commonly transmitted via contaminated food or drinking water. Discuss the steps at the molecular level by which this virus multiply in a person suffering from "Hepatitis A" disease. **[6]**

(c) Based on your learning in this course, suggest which one among virus and viroid would have originated first. Justify your answer. **[4]**

Q6. (a) In Microbiology Laboratory, you were given two stock culture flasks (X & Y) of *Bacillus subtilis* maintained on 50 mL of nutrient broth medium in each. You took equal amount of culture inoculum and sub-cultured properly in 50 mL of fresh nutrient broth media separately. After incubation at 37 ºC, you found that culture inoculum taken from stock flask X grows faster in comparison to that of stock flask B. Discuss the possible reason(s) behind such observation. **[4]**

(b) For isolation of genomic DNA from two given bacteria A and B, addition of lysozyme was mandatorily suggested for the lysis of bacteria A, while it was not mandatory for bacteria B. What could be the reason for such suggestion? Based on the information given, identify the bacterial types. **[5]**

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All the Best