

**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE PILANI
COMPREHENSIVE EXAMINATION**

First Semester 2022-23

Course No: BIOG523

Course Title: Advanced Applied Microbiology

Duration: 3 hours

Marks: 90

Date: 27.12.2022

NOTE: Submit answer sheet of CB and take fresh sheet for OB. Attempt all questions and their subparts in sequence. Be precise and answer in points. Give examples wherever possible.

Closed Book (Dur: 1 hr; Max. Marks: 30 (theory) + 10 Lab components)

- Q1. Justify following with appropriate reasoning. [5 x 2=10]
- a. Clostrum is considered very important for new-born babies.
 - b. With the appearance of teeth in oral cavity, microbial community shift also happens.
 - c. Sucrose is harmful for health of teeth
 - d. Increase in *E.coli* inside large intestine is harmful for individuals
 - e. Antibiotic resistance evolves via natural selection
- Q2. Define and justify the following terms with the help of suitable examples- [2 x 2= 4]
- a. Virulence
 - b. Pathogenicity Islands
- Q3.** Elaborate with the help of a suitable example and well labeled schematic diagram the response of a host cell to the invasion of a pathogen. Mention all molecules specific to the example that you think may be involved from pathogen and from host. [4]
- Q4. Discuss-
- a. The possible ways a drug or a compound may act against a pathogen [2]
 - b. Mechanism of action of Cephalosporins [3]
- Q5. Discuss with the help of examples. [2 x 2 = 4]
- a. How strain modification may help in increased yield of amino acids?
 - b. How process modification may help in production of different products from same raw material.
- Q6. In protein engineering, what is importance of the information of amino acids present in the active site/ binding cavity and the amino acids actually binding with substrate? [3]
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Open Book (Dur: 2 hr; Max. Marks: 50)

PART A

1. While working in synthetic biology, you aim to create a synthetic circuit that can generate red fluorescence (RFP) in response to a specific metabolite produced by a pathogen. To make it modular, you want it to express and accumulate RNA respective to RFP but not translated until other cytoplasmic metabolite/signal is provided. Propose a design to achieve the above goal mentioning the basis of the design, biobricks used, a suitable diagram, and its description. Note that do not suggest any other modification in the host genome. [10]
2. Bacterial communication is required for many pathogenic bacteria to accomplish infection and pathogenesis in the host. Explain possible strategies to interfere with the communication system of a certain pathogen that can have therapeutic potential. [6]
3. With the help of appropriate schematics, show the properties attributed by bacteria, cyanobacteria, and fungi that can have potential applications in sustainable agriculture. [6]
4. How is knowing the insect microbiome important? Explain, with an example, how we can exploit insect-associated microbes in managing human health. [3]

PART B

5. Bacterial resistance is a serious concern. Justify with appropriate example. [5]
6. In an incident recorded in the medical history of United States, a patient who sustained burns over 40% of his body during a house fire, succumbed to death. It was identified that the burn therapy was working fine but post three days of treatment, the patient developed sepsis (pus/smelly secretion from wounds) which increased and caused death. What do you assume may be the possible cause and why? [5]
7. Define nutrigenetics and its aim. How do the food nutrients help develop/ strengthen immunity through the help of gut microbiota? [4]
8. Discuss the observations made on gnotobiotic mice that proved the role of gut microbiota in adiposity. [5]
9. With the help of a flow- diagram/ chart detail how can you use IVET to determine the virulence of a pathogen like Streptococcus pneumonia. [3]
10. The solution to pollution problem due to much talked about “Parali/ Stubble” burning was shown by a team of Professor T V Ramachandra and his doctoral student Deepthi Hebbale from IISc, Bangalore. They used a marine cellulolytic bacterium to treat stubble for biofuel production. Hypothesize the possible process they may have used. [3]