

A part

- I. (6%) 1. Explain how the process of DNA replication is coordinated with cell wall septation.
 (4%) 2. Compare and contrast bacterial structures: (a) S-layer, (b) capsule, (c) Gram-negative outer membrane, (d) Gram-positive cell envelope.
- II. Explain (5%) 1. next generation DNA sequencing and (5%) 2. metagenomics.
- III. (6%) 1. Describe how a microorganism might derive carbon and energy from the lipids and proteins in its diet.
 (4%) 2. Beer is produced by yeast fermentation of grain to ethanol. Why must the process of beer production be anaerobic? Why are such large quantities of ethanol produced with a relatively small production of yeast biomass?
- IV. (10%) Describe three useful techniques for determining microbial taxonomy and phylogeny.
- V. (10%) Explain the following terms: (2%) 1. Catabolite repression; (2%) 2. posttranslational regulation; (4%) 3. global regulatory systems; (2%) 4. small RNA regulation.

B Part

- I. (10%) Explain and compare the following pairs of terms:
 1. swarming vs swimming 2. opportunistic and frank pathogens
 3. commensalism and mutualism 4. ectomycorrhizae and endomycorrhizae
 5. chemical oxygen demand (COD) and biochemical oxygen demand (BOD)
- II. (10%) At least five major groups of antibacterial drugs can be classified based on their mechanisms of action. (1) Please describe what the mode of action is for each of these five major groups. (2) When two antibacterial drugs are used, additive or synergistic effect might occur. Please discuss the mechanisms underlying these effects.
- III. (10%) Pick up the best answer from (A) to (I) for each question
 (A) *Saccharomyces cerevisiae* (B) Diatom (C) Acellular slime mold
 (D) Cellular slime mold (E) *Rhizopus oryzae* (F) *Streptomyces*
 (G) *Bacillus subtilis* (H) *Frankia* sp. (I) *Rhizobium* sp.
1. Its life cycle includes a distinct stage with a form of a plasmodium
 2. Belongs to Ascomycota, which produces asci containing 4 haploid ascospores during sexual reproduction
 3. The high G+C Gram Positives with aerial hyphae and exospores
 4. belongs to *Stramenopila*, and has distinct, two-piece cell walls of silica
 5. The Gram positive bacteria, which can form root nodule to fix nitrogen
- IV. (8%) The major histocompatibility complexes (MHC) are involved in recognition of foreign cells, eg., pathogens. (1) What are the major histocompatibility complexes? (2) MHC molecules can inform the immune system of the presence of nonself by binding and presenting foreign peptides through a process called antigen processing. Please discuss how MHC molecules are involved in antigen processing.
- V. (12%) Please briefly describe the following techniques used in the clinical microbiology laboratory for pathogen identification. (1) ribotyping (2) The indirect enzyme-linked immunosorbent assay (ELISA) (3) Immunoblotting (4) The double diffusion agar assay