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LIST OF COURSES

MCB411: Environmental and Petroleum Microbiology
MCB413: Microbial Genetics
MCB414: Virology
MCB415: Pharmaceutical Microbiology and Antimicrobial Agents
MCB416: Epidemiology and Public Health Microbiology
MCB417: Research Methods in Microbiology

*Not included
MCB411- Environmental and Petroleum Microbiology

Answer “Yes” or “No”

1. Sulfur oxidizing bacteria cause corrosion of metal by producing sulfuric acid
2. Plugging of formation pores in bituminous (hydrocarbon deposit) can enhance oil recovery
3. Keratinolytic bacteria are responsible for biodeterioration of cellulose fibre
4. Grid sampling is used to obtain fomite samples
5. Impaction is the trapping of airborne particles in a solid matrix
6. Surface active compounds produced by petroleum biodegradation can enhance tertiary oil recovery
7. Sulfate reducing bacteria can cause biodeterioration of paints
8. Cellulase produced by bacteria is an extracellular enzyme
9. Diagenesis is a process involved in corrosion of metals
10. Halophiles are involved in biodeterioration of raw hide in leather industry

List

11. The microbial products that enhance the tertiary petroleum recovery
12. The activities of SRB in petroleum industry
13. Steps involved in microbial bioleaching process

14. The damages caused by microorganisms as biodeteriogens in leather industry

15. The pathways of biodegradation of alkane

16. The processes involved in corrosion caused by microorganisms

17. The methods for air sampling

18. The impacts of oil pollution on human, wild life and soil microorganisms

19. The activities of *C. resinae* in a jet fuel tank.

20. Two bacteria involved in “land farming”

Answer:

1. Yes
2. No
3. No
4. No
5. Yes
6. Yes
7. No
8. Yes
9. No
10. Yes

11. The microbial products such as gases (CO$_2$ and CH$_4$), solvents like ethanol and butanol, organic acids or sulfuric acid, polymers, surface active compounds.

12. The hydrogen sulfide, formed as a result of sulfate reducing bacterial activity induced corrosion of metal pipelines and aircraft fuel pumps.
Hydrogen sulfide causes hydrogen cracking because of diffusion of hydrogen into inclusions in the steel during rolling process. This can cause failures in steel pipelines containing high levels of hydrogen sulfide, and is thus of concern to the off shore oil industry.

13. Metal extraction, metal recovery and conversion of Fe\(^{2+}\) to Fe\(^{3+}\) in oxidation pond using \textit{T. ferrooxidans}.

14. Discoloration, perforation, formation of red spots, formation of green, yellow brown, dark brown, grey shades on leather and leather products.

15. **Monoterminal, subterminal and diterminal**

16. Setting up of concentration cells, Release of metabolic products and role of sulfate reducing bacteria

17. **Impingement, impaction, centrifugation, filtration and deposition.**

18. In soil, an oil spill kills the herbaceous vegetation of the affected area immediately.

   Trees and woody shrubs are destroyed more slowly via their root system.

   Biodegradation activity deprives plant roots of vital oxygen. In aquatic environment, oil spill spreads over the surface of water forming oil-slick. The slick prevents the passage of oxygen as well as reduces the penetration of light (sun), thus depriving aquatic organisms of the above two vital needs. Photosynthetic organisms die off, while anaerobiosis sets in producing toxic products like H\(_2\)S that could accumulate to inhibitory levels killing aquatic animals like fish. Crude oil contains mutagenic, carcinogenic and growth inhibitory chemicals.

19. \textit{C. resinae} is able to metabolize hydrocarbons of chain length C9 to C19 including n-alkanes, branched alkanes, cyclic and aromatic rings. Its mycelial habit allows it to grow over surfaces where water is present, and at the fuel/water interface where it can become associated with the fuel by the formation of an emulsified layer. The layer so formed has an affinity for the fuel due to the production of surface active compounds, and the mycelial
pellicle so then be carried into the fuel distribution system of the aircraft causing disastrous results.

20. *Pseudomonas* sp. and *Bacillus* sp.
MCB413: Microbial Genetics

1. A. Differentiate between the following. Use appropriate examples and illustrations to buttress your answer;
   i. Gene transfer and genetic recombination.
   ii. Vertical and horizontal gene transfer.
   iii. Generalized and specialized transduction.
   iv. Gene mapping and gene sequencing.
   v. Plasmid and cosmid vectors.

B. State two important factors/features required for each of the following microbial gene transfer/genetic transformation mechanisms.
   i. Transformation.
   ii. Conjugation.
   iii. Transduction.
   iv. Recombination by incompletely linked genes
   v. Recombination by independent assortment

2. A. Describe the steps/procedures you would employ for isolating and cloning a desired gene of interest from bacteria. Clearly indicate the aim of each step and the reagents/equipment required for each procedure.
   B. Explain why two selectable markers are usually required during gene cloning.
   C. Give two examples of how gene cloning can be applied in medical and agricultural researches.

3. A. Conjugation can occur between F− and any of the following cell types F+, HFr and F’, which of these are more likely to result in genetic recombination. Justify your answer for each of the three cell types.
   B. Discuss the implications of microbial recombination to global health.
SECTION A

1. A. Describe the various virus structures and major structural variation possible in the virus world. Give appropriate examples. (5 marks)

B. Outline the various genome types that a virus may have and state the genome replication strategy employed by each type. (4½ marks)

C. For each replication strategy stated in B above, indicate the immediate activity undertaken by a virus with that genome type upon infection of a host cell. (5½ marks)

D. Indicate the specific enzyme required for the activity in C above and the location within the host cell where this activity will take place. (5½ marks)

2. A. Discuss the various modes of virus transmission in plants, animals, and humans. Give appropriate examples in all cases. (5 marks)

B. Discuss virus-vector relationships with regards to virus transmission and clearly differentiate between the three major known relationship types. (10 marks)

C. Outline the major prevention and control strategies employed for common plant and animal and human viruses. (5 marks)
3. Compare one plant virus and one human virus of your choice under the following subheadings:
   i. Structure and genome type (2½ marks)
   ii. Transmission (2½ marks)
   iii. Host range (2½ marks)
   iv. Pathogenesis (2½ marks)
   v. Symptoms (2½ marks)
   vi. Diagnosis (2½ marks)
   vii. Prevention and control (2½ marks)
   viii. Global distribution (2½ marks)

SECTION B

4. A. Outline the infections caused by respiratory viruses (8 marks)
   B. What is the importance of the segmented genome in influenza viruses? (2 marks)
   C. Differentiate between the symptoms of influenza and rhinovirus infection. (2 marks)
   D. In one sentence describe the structure of enteroviruses. (3 marks)
   E. What is the manifestation of polioencephalitis? (2 marks)
   F. What is a dead end host? (2 marks)
   G. What is the main target of antiviral drugs? (1 mark)

5. A. Outline the effects of the Human Immunodeficiency virus on the immune system. (5 marks)
   B. Explain the pathogenesis of influenza. What are the symptoms and complications of this disease? (8 marks)
   C. What drugs are used in the treatment of influenza? (2 marks)
   D. Mention how each of the following viruses is transmitted: (5 marks)
      i) Hepatitis B virus
ii) Hepatitis B virus
iii) Mumps
iv) Measles
v) Flaviviruses

6. A. What are the functions of the host regulatory genes involved in tumor formation? (4 marks)

B. Explain how the alteration of one of these genes could result in cancer in humans with a specific example. (5 marks)

C. Mention 5 families of viruses involved in human cancers (5 marks)

D. Mention the viruses responsible for the following conditions: (6 marks)
   i. Koplik spots
   ii. Burkitt’s lymphoma
   iii. Leukemia
   iv. Western equine encephalitis
   v. Vesicular pharyngitis
   vi. Hand foot and mouth disease
SECTION A

1. Ms. Olorioko, a rising pharmaceutical microbiologist in a cosmetics company, was recently assigned the responsibility to choose antimicrobial agents to control microbial contamination in the company’s manufacturing facility and products.

a) Describe five factors that would influence her choices of antimicrobial agents to recommend to the company’s management. (5 marks)

b) Following her review of purchasing catalogues, Ms. Olorioko identified the following antimicrobial agents for her management’s consideration: p-hydroxybenzoic acid, isopropanol, hypochlorite, chlorhexidine, cetrimide, trichloromethane, hydrogen peroxide, and phenylmercuric acetate. In discussing the rationale for the selections, provide the use(s), advantages and disadvantages of each agent. (10 marks)

c) Describe five factors that may affect the activity of an antimicrobial agent approved for use in this company. (5 marks)

2. a) Identify two examples each of Gram-positive, Gram-negative and acid fast bacteria that are resistant to antibiotics. (6 marks)

b) What are the principal types of radiation employed in sterilization? List the characteristics of each type and their applications. (6.5 marks)

c) Discuss five approaches that may slow down the development of antibiotic-resistant pathogens. (7.5 marks)

3. a) Using illustration, describe typical survival curves for bacteria exposed to moist heat. (7.5 marks)

b) Discuss the clinical significance of bacterial multi-antibiotic resistance. (5 marks)

c) Describe low temperature plasma sterilization technology and identify its benefits over ethylene oxide in the sterilization of medical devices and surgical instruments. (7.5 marks)
SECTION B

4. a) In the production of penicillin G:
   i) What substrate is used? (1 mark)
   ii) At what stage is penicillin produced in the fermentation process? (1 mark)
   iii) Mention the organism used in the production of penicillin and why it is used? (2 marks)
   iv) Production of penicillin is exothermic, how is the temperature in fermenter reduced? (1 mark)
   v) What type of metabolite is penicillin? (1 mark)
   vi) Outline the downstream processing of penicillin G. (6 marks)

b) Differentiate between attenuated vaccines and inactivated vaccines; give examples. (3 marks)

c) List at least 10 materials used in the Kirby Bauer disk diffusion susceptibility test protocol. (5 marks)

5. a) What is a Parenteral preparation? What are the advantages of using a parenteral route in administering certain pharmaceuticals? (5 marks)

b) Mention the tests carried out to ensure the quality control of a parenteral product. (5 marks)

c) What are the consequences of microbial spoilage of pharmaceutical formulations? (3 marks)

d) What factors must be considered when selecting a preservative for a pharmaceutical preparation? (5 marks)

6. a) What are the objectives of sterility testing? (3 marks)

b) Mention the techniques used to test for the sterility of a pharmaceutical product. What factors must be considered in carrying out this test? (4 marks)

c) What is the objective of risk management in the pharmaceutical industry? Outline the steps involved in the hazard analysis critical control points (HACCP)? (8 marks)

d) Define the following: i) Selective toxicity (1 mark); ii) Quality (2 marks); iii) Quality control (2 marks)
1. a) What components of epidemiology will guide in intervention of a disease outbreak? What will be the goal of such intervention?
   b) Under what conditions will the following be appropriate; i. Primary intervention  ii. Secondary intervention iii. Tertiary intervention.
   c) Osteomalacia is a bone condition that describes why Muslim women have more complications during child birth. Describe the interplay between religion and environmental factors in predisposing to osteomalacia.

2. a) Name three diseases influenced by social or environmental factors. How can modification of these factors prevent or reduce the incidences of these diseases?
   b) What does the acronym BEINGS stands for? Why is genetic factors the most difficult to change while immunological factors are the easiest to change?
   c) Describe how computer games and television account for high rate of obesity?

3. a) Give four examples of unintended consequences from solution of earlier health problems? Suggest how these unintended consequences can be addressed.
   b) What is herd immunity? With illustrative diagram only show how herd immunity can reduce the incidence of a disease in a population.
   c) List the functions of the Hospital Infection Control program. What roles does a clinical microbiologist play in the Infection Control Committee?

4a) Define the following giving 2 examples each
   i. Foodborne Diseases  ii. Microbial toxins  iii. Food intoxication  iv. Pathogenicity
b) List the microorganisms that are associated with foodborne infection/intoxication.

c) Discuss the roles of the microbiologist in investigating foodborne diseases

5a) Discuss the epidemiology, laboratory diagnosis and control of any two foodborne pathogens

b) Discuss the global epidemiology of tuberculosis.

6a) What are Nosocomial Infections? List 5 microorganisms that are implicated in nosocomial infections

b) Discuss the epidemiology and diagnosis of a nosocomial pathogen

c) How can nosocomial infections be investigated?
1a. Define the term communication in the concept of research methodology

b. Enumerate the steps you would take as a researcher to maximize the use of library resources

c. Write short notes on the following as it relates to scientific research communication

(i). Reliability (ii) Originality (iii) Usability (iv) Credibility (v) Professional relevance

(20 Marks)

2a. Highlight strategies for effective scientific research communication

b. Identify the reasons why lots of literature resources are needed for a good research work

c. Write short notes on the following research terms:

(i) Review (ii) Systematic review (iii) Meta-analysis

(20 Marks)

3. (a)Four students (A, B, C, D) were asked to determine the zones of inhibition for some *E. coli* isolates against gentamicin at 1 mg/ml concentration. Below is typical data for measurements of the diameters of zones of inhibition (mm) from gentamicin for the *E. coli* isolates made separately by the students. Perform Anova and determine whether there is any significant difference between the sets of measurements taken by the four students.

\[
F_{3,36,0.05} (\text{critical}) = 2.872 \text{ and the value for } SSW \text{ and } SSb \text{ are } 45.2 \text{ and } 2.8
\]
(b) List

1. Types of inferences that inferential statistics can make
2. Types of rates used in a typical epidemiological studies
3. Importance of t test used in inferential statistics
4. Importance of descriptive statistics in conducting research
5. Importance of sample variance in interpreting experimental results  (20 Marks)

4. For use in class, it was decided that the activity would be performed in groups of four students. Each group inoculated two sets of ten plates, one set with an *E. coli* suspension adjusted to the 0.5 McFarland turbidity standards and the other set with a cell suspension adjusted to the 1McFarland turbidity standard. After incubation, the diameters of the zones of inhibition (mm) around the gentamicin disks were measured and tabulated as follows:

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The two critical values of t are 1.734 and 2.101 for 18 degrees of freedom.

a. Determine mean, variance and standard deviation

b. Also perform t test as measure of association and determine whether cell density has an effect on diameter of zone of inhibition. (20 Marks)

5a. Discuss the major types or approaches to scientific research (6 Marks)

b. What are the different errors that crops up in the research process (8 Marks)

c. Discuss the guidelines involved in selecting a workable research topic (6 Marks)

6a. Write short notes on the important chapters in a thesis using any field of Microbiology as an example. (10 Marks)

b. Choose a suitable title for any proposed research in your chosen field in (6a) above and discuss the contents of each of the chapters. (10 Marks)