ADVANCED ENVIRONMENTAL BIOTECHNOLOGY
(BIOT 5142)

Time Allotted : 3 hrs   **Full Marks : 70**

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> from each group.*

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) To regenerate a cation resin it should be washed with
(a) HCl
(b) NaCl
(c) NaOH
(d) Any of the above.

(ii) Nitrosomonas bacteria converts
(a) NH^{4+} to NO_2^-
(b) NO_2^- to NO_3^-
(c) NH^{4+} to NO_3^-
(d) None of the above.

(iii) The micro-organism used in bioleaching of several minerals is
(a) Acetobacter vinelandii
(b) Acidithiobacillus ferrooxidans
(c) Aspergillus niger
(d) Bacillus subtilis.

(iv) Which of the bioremediation process involves plants?
(a) Composting
(b) Land filling
(c) Phytoremediation
(d) Incineration.

(v) A diversity index is
(a) a mathematical measure of species diversity in a given community
(b) based on species richness and abundance
(c) measured by Shannon index
(d) All the above.

(vi) Which one is the major source of chromium is environment?
(a) Leather industries
(b) Automobile exhausts
(c) Paper industry
(d) Fertilizers.

(vii) Which enzyme is inhibited by organophosphorous pesticides?
(a) Acetyl choline synthetase
(b) Acetyl choline esterase
(c) Acetyl choline transferase
(d) Fattyacyl CoA synthetase.

(viii) Which protein is coded by the gene mer A?
(a) Organomercurial lyase
(b) Mercuric reductase
(c) Mercury transport proteins
(d) Organomercurial synthetase.

(ix) Which of the following pairs have techniques of ex situ bioremediation?
(a) Bioventing and biopile
(b) Biopile and windrows
(c) Bioventing and bispurging
(d) Biosprunging and biopile.

(x) In situ bioremediation involves
(a) degradation of pollutants directly by microbes
(b) collection of pollutants from the polluted site and then degradation by bacteria
(c) degradation of pollutants under laboratory condition
(d) degradation of pollutants only by genetically engineered microbes.

Group - B

2. (a) Describe the acute toxicity mechanisms caused by xenobiotics.
[(CO1)(Describe/IOCQ)]
   (b) Mercury is usually disposed as mercuric chloride in environment. However, a large quantity of organomercurials are found in victims of mercury pollution. Correlate the two observations. [(CO1)(Correlate/HOCQ)]
8 + 4 = 12

3. (a) Write different forms of arsenic that are found in nature. Which form is the most toxic form? [(CO1)(Remember/LOCQ)]
   (b) Describe how As(V) is converted to MMA and DMA in our system.
[(CO1)(Describe/IOCQ)]
   (c) Arsenic is the only heavy metal whose source of contamination is natural rather than man made. Justify the statement. [(CO1)(Justify/HOCQ)]
2 + 5 + 5 = 12

Group - C

4. (a) Explain in detail the process employed to remove hardness of drinking water.
[(CO2)(Understand/LOCQ)]
   (b) Describe how solid waste is managed by manual composting methods.
[(CO2)(Understand/IOCQ)]
6 + 6 = 12

5. Experiments at 25°C were performed to determine the permeabilities of a cellulose-acetate membrane. The laboratory test section membrane area $A = 2.0 \times 10^{-3}$ m^2. The inlet feed solution concentration of NaCl is $C_1 = 10$ kg NaCl/m^3 solution (density= 1004 kg solution/m^3). The water recovery is assumed low so that the concentration C_1 in the entering feed solution flowing past the membrane and the concentration of the exit feed solution are essentially equal. The product solution contains $C_2 = 0.39$ kg NaCl/m^3 solution (density = 997 kg solution/m^3) and its measured flowrate is 1.92×10^{-8} m^3 solution/s. A pressure differential of 54.42 atm is used. Calculate the permeability constants of the membrane and the solute rejection R ($\pi = 7.48$ atm). [(CO2)(Evaluate/HOCQ)]
12

Group - D

6. (a) What are BTEX compounds?   [(CO3)(Remember/LOCQ)]
    (b) Describe the pathways for degradation of alkanes with subterminal hydroxylation.
                                                                     [(CO3)(Understand/IOCQ)]
    (c) Mixed culture works better for degradation of pollutants than a pure culture. Justify
         the statement.   [(CO2)(Justify/HOCQ)]
                                                                     2 + 6 + 4 = 12

7. (a) Describe biosorption processes by algae and fungi.   [(CO3)(Describe/IOCQ)]
    (b) Differentiate between metabolism dependent and metabolism independent biosorption.
                                                                     [(CO3)(Differentiate/HOCQ)]
                                                                     (4 + 4) + 4 = 12

Group - E

8. (a) Explain biogas production by anaerobic digestion.   [(CO6)(Explain/LOCQ)]
    (b) Enumerate different sources of biomass used to produce energy.
                                                                     [(CO6)(Enumerate/LOCQ)]
                                                                     8 + 4 = 12

9. (a) Work out the value of Simpson's Diversity Index, **D,** for a single quadrat sample of
         ground vegetation in a woodland from the given data:

Species	Number (n)
A	81
B	2
C	2
D	2
E	1
Total (**N**)	

                                                                     [(CO5)(Analyze/IOCQ)]
    (b) Define Shannon's diversity index and Shannon's equitability.
                                                                     [(CO5)(Remember/LOCQ)]
                                                                     8 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	39.5	30.20	30.20

Course Outcome (CO):

After completion of the course the students will be able to:
1. Understand the of the cause and effect of environmental pollution in details
2. Explain the conventional processes of waste treatment

3. Interpret the role of microbes in pollution control
4. Develop biotechnological process for waste treatment
5. Recognize the importance of biodiversity
6. Comprehend the concept of green technology.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.