ADVANCED ENVIRONMENTAL BIOTECHNOLOGY
(BIOT 5142)

Time Allotted : 2½ hrs   **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
<u>any 4 (four)</u> from Group B to E, taking <u>one</u> from each group.

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

Group – A

1. Answer any twelve: **12 × 1 = 12**

    Choose the correct alternative for the following

    (i)   In ethanol production by alcoholic fermentation conversion of dextrin to glucose is known as
          (a) Saccharification   (b) Liquefaction
          (c) Partial hydrolysis   (d) All the above.

    (ii) The output of electrodialysis will be
          (a) Brine   (b) Mineral water and brine
          (c) Deionised water and brine   (d) Demineralised water.

    (iii) To regenerate a cation resin it should be washed with
          (a) HCl   (b) NaCl
          (c) NaOH   (d) None of the above

    (iv) In sanitary landfill technique the biological activity occurs in the following order:
          (a) aerobic, methanogenic, anaerobic   (b) aerobic, anaerobic, methanogenic
          (c) methanogenic, anaerobic, aerobic   (d) methanogenic, aerobic, anaerobic

    (v)   Which is not true for reverse osmosis?
          (a) Demineralization of water
          (b) Semi-permeable membrane
          (c) External pressure applied is less than the osmotic pressure
          (d) External pressure is applied to the concentrated region.

    (vi) Which group of pesticide is present in the plant *Chrysanthemum cinerariifolium*?
          (a) DDT type organochlorines   (b) Organophosphorous
          (c) Carbamates   (d) Pyrethroids.

    (vii) Which of the following compounds is NOT an organic pollutant?
          (a) Dioxin   (b) Insecticides
          (c) Arsenic   (d) Polychlorinated biphenyls.

(viii) Conversion of Cr(VI) to Cr(III) by microbes is an example of
      (a) Biosorption   (b) Removal through pumps
      (c) Enzymatic detoxification   (d) Absoprtion.

(ix) Itai Itai disease is associated with
      (a) Arsenic pollution   (b) Chromium pollution
      (c) Mercury pollution   (d) Cadmium pollution.

(x) Aromatic hydrocarbons without any substitution are converted to
      (a) Catechol   (b) Sulphur
      (c) Organic amids   (d) None of these.

Fill in the blanks with the correct word

(xi) Oil paints contains salts of _____.

(xii) The enzyme _____ is inhibited by organo-phosphorous pesticides.

(xiii) The major component of London type smog is _____.

(xiv) The protein metallothionein has repeating units of _____.

(xv) Bioventing is an example of _____ bioremediation.

Group - B

2. (a) State the role of the following enzymes in prevention of oxidative damage caused by persistent organic pollutants. (i) superoxide dismutase, (ii) catalase, (III) peroxidase.   *[(CO1)(Understand/IOCQ)]*

   (b) Arsenic has a very high affinity towards the –SH groups and it causes oxidative damage. Is there any relation between the two properties? Explain your answer.   *[(CO1) (Relate/HOCQ)]*

   (c) State two structural features that make an organic compound persistent.   *[(CO1)(Discuss/IOCQ)]*

6 + 4 + 2 = 12

3. (a) What are the components of photochemical smog or Los Angeles smog? Which type of weather condition is favoured to create photochemical smog? Discuss the chemical reactions that take place in photochemical smog.   *[(CO3)(Understand/IOCQ)]*

   (b) Compare Los Angeles smog with London smog.   *[(CO4)(Compare/HOCQ)]*

(2 + 1 + 6) + 3 = 12

Group - C

4. (a) A feed solution at 25°C contains 3500 mgNaCl/L(ρ= 999.5 kg/m³). The permeability constant A_w= 3.5x10⁻⁴ kg solvent/s.m².atm and A_s= 2.5x10⁻⁷ m/s. Using a ΔP=35.5 atm, calculate the fluxes, solute rejection R and product solution concentration in mg NaCl/L (osmotic pressure= 1.937atm).   *[(CO2)(Apply/IOCQ)]*

   (b) Define reverse osmosis?   *[(CO4) (Remember/LOCQ)]*

(3 + 3 + 2 + 2) + 2 = 12

5. Experiments at 25°C were performed to determine the permeabilities of a cellulose-acetate membrane. The laboratory test section shown in figure has membrane area $A = 2.00 \times 10^{-3} m^2$. The inlet feed solution concentration of NaCl is $C_1 = 10.0 kg$ NaCl/m^3 solution (10.0g NaCl/L, $\rho_1 = 1004$ 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 ($\rho_2 = 997$ kg solution/m^3) and its measured flow rate is $1.92 \times 10^{-8} m^3$ solution/s. A pressure differential of 54.42 atm is used. Calculate the permeability constants of the 1 membrane and the solute rejection R. (Given $\pi = 7.48$ atm). *[(CO3)(Compute/IOCQ)]*

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Group - D

6. (a) Describe the role of arsB and arsC in conferring arsenic resistance to a bacteria.
[(CO3)(Describe/IOCQ)]
   (b) Discuss the application of biological systems for removal of arsenic from drinking water. *[(CO4)(Discuss/IOCQ)]*
   (c) The extracellular polysaccharides (EPS) can protect a bacterial cell from lead toxicity and at the same time, it can be used for removal of lead from contaminated site. Comment on the above statement. *[(CO3)(Comment/HOCQ)]*

(2 + 2) + 5 + 3 = 12

7. (a) Describe the aerobic pathway for degradation of phenol. How does it differ from the anaerobic pathway? *[(CO3)(Remember, Differentiate/LOCQ, HOCQ)]*
   (b) Define oxidative and reductive dehalogenation for degradation of organochlorine compounds. *[(CO4)(Remember/LOCQ)]*

(6 + 2) + 4 = 12

Group - E

8. (a) Illustrate with a flow chart production of ethanol by anaerobic digestion.
[(CO5) (Remember/LOCQ)]
   (b) Write a short note on silviculture. *[(CO5)(Remember/LOCQ)]*

9 + 3 = 12

9. Area 1 was sampled and the following specimens were collected.

order	description	Number of individuals (n)
Orthoptera(grasshopper)	green with red legs	8
Orthoptera (grasshopper)	brown with a yellow stripe	7
Lepidoptera (butterfly)	large, blue	3
Lepidoptera (butterfly)	small, blue	5
Coleoptera (beetle)	red and blue	15

These are the specimens collected from Area 2.

order	description	Number of individuals (n)
Hymenoptera (wasp)	black	12
Hymenoptera (wasp)	purple	21
Hymenoptera (bee)	striped	5
Orthoptera (grasshopper)	green with red legs	25
Orthoptera (grasshopper)	brown with a yellow stripe	2
Lepidoptera (butterfly)	large blue	17
Lepidoptera (butterfly)	small blue	9

Infer statistically which area is more diverse? *[(CO5)(Analyse/HOCQ)]*

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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	27.08	46.87	26.04

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.