Formicidae	Primary Forest	Abandoned cacao plantations	Productive cacao plantations	Banana plantations
Acromyrmex sp. 1			0.013	
A. volcanus			0.006	
A. araneoides	0.117	0.140		
Atta cephalotes		0.010		
Carabarella sp. 1	0.004			
Cardiocondyla sp. 1				0.011
Crematogaster sp. 2	0.021	0.024		
Erebomyrma nevermanni	0.004	0.021		
Pheidole sp. 1	0.021	0.035	0.019	
P. annectans	0.079	0.028		0.005
P. longiscapa	0.050	0.003		
P. punctatissima				0.005
P. nr. subarmata		0.003		
P. subarmata				0.043
P. fiorii	0.075			
Sericomyrmex sp. 1			0.006	
Solenopsis sp. 1	0.004		0.006	
S. geminata		0.031	0.101	0.830
Tetramorium bicarinatum				0.005
Trachymyrmex sp. 1		0.003	0.019	
Trachymyrmex sp. 3	0.004	0.007		
Wasmannia sp. 1				0.011
W. auropunctata	0.050	0.021	0.006	
Pseudomyrmex sp. 1				
Ectatomma gibbum	0.004			
E. ruidum	0.004	0.038	0.753	
Hypoponera sp. 1	0.004	0.010		
O. erythrocephalus	0.017		0.006	0.043
O. hastatus				
O. laticeps	0.008	0.010		
O. opaciventris				
Pachycondyla apicalis	0.017	0.007		
P. constricta			0.006	
P. harpax	0.0125	0.031	0.013	
P. obscuricornis		0.003	0.006	
P. villosa				
Paraponera clavata			0.019	
Paratrechina sp. 1	0.033	0.063		
Total # of species per site:	37	36	16	

(i) Calculate H and E_H for both the abandoned and productive cacao plantation sites. Are they more similar to one another or to the more or less disturbed habitats?

(ii) What do you notice about the species compositions of these four habitats (i.e., do most species occur in all four habitats, in only one habitat, etc.)?

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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) Chlorella, an algal species, is particularly useful for removal of
   (a) Hydrocarbons
   (b) All types of organic pollutants
   (c) Heavy metals especially cadmium
   (d) Organic dyes.

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

   (iii) In ethanol production by alcoholic fermentation conversion of dextrin to glucose is known as
   (a) Saccharification   (b) Liquefaction
   (c) Partial hydrolysis   (d) all off (a), (b) and (c).

   (iv) Monoxygenase is an enzyme that takes part in
   (a) Degradation of hydrocarbons by bacteria
   (b) Synthesis of hydrocarbons
   (c) Enzymatic detoxification of mercury
   (d) Synthesis of organic dyes.

   (v) The micro-organism NOT used in bioleaching of minerals is
   (a) Acidithiobacillus thiooxidans   (b) Desulfovibrio
   (c) Acidithiobacillus ferrooxidans   (d) Bacillus subtilis.

   (vi) The main component of biogas is
   (a) Hydrogen   (b) Nitrogen
   (c) Methane   (d) Hydrogen sulphide.

(vii) An anion exchanger can be regenerated with
(a) Brine
(b) Caustic soda
(c) Hydrochloric acid
(d) Carbonic acid.

(viii) Phosphate in waste water reacts with lime to form
(a) Calcium carbonate
(b) Calcium bicarbonate
(c) Calcium hydroxyapatite
(d) Calcium hydroxide.

(ix) Which of the following is not a composting technique?
(a) Bangalore process
(b) Indore process
(c) Kolkata process
(d) Buhler process.

(x) 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 off (a), (b) and (c).

Group – B

2. Discuss the mode of action of the following compounds.
(i) synthetic pyrethroids, (ii) DDT, (iii) chromium (vi) salts.

$$(4 \times 3) = 12$$

3. (a) Write different chemical species of mercury and arrange them in order of increasing toxicity. Mention the major sources of mercury in environment.

(b) Study the following case and answer the questions.
In 1950s many people of Minamata city, Japan, complained of joint pain, difficulty in limb movement, difficulty in speech and some other neurological problems. Eventually many of them died. On investigation, it was found that they took fish contaminated with mercury, especially methyl mercury. Later it was found that a factory used to release mercury in ocean water as mercuric chloride ($HgCl_2$).
(i) Correlate the patients' syndrome with mercury consumption.
(ii) The factory used to release mercuric chloride. But the fishes had methyl mercury. How would you like to explain the anomaly?

$$4 + (4 + 4) = 12$$

Group – C

4. A cellulose acetate membrane with an area of $4.0 \times 10^{-3} m^2$ is used at 25°C to determine the permeability constants for reverse osmosis of a feed salt solution containing $12 kg/m^3 (\rho = 1005.5 kg/m^3)$. The product solution has a concentration of $0.468 kg$ $NaCl/m^3 (\rho = 997.3 kg/m^3)$. The measured product flow rate is

$3.84 \times 10^{-8} m^3/s$ and the pressure difference used is 56 atm. Calculate the permeability constants and the solute rejection R when $\pi = 9 atm$.

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5. Compare all the four different solid waste disposal methods and conclude which method in your opinion is the best. Justify your choice.

$$(8 + 1 + 3) = 12$$

Group – D

6. (a) Define bioaugmentation and biostimulation. In vitro bioremediation is faster than in vivo bioremediation, but in vivo bioremediation process is more practiced for site remediation. Justify the practice.

(b) Plants that produce large amount of metallothionein can be used for removal of cadmium and lead. Explain.

$$(4 + 4) + 4 = 12$$

7. (a) You got a bacterial species that is tolerant to phenol and can degrade phenol. It is observed that it degrades phenol to a faster rate in a reactor when oxygen is pumped through it. Suggest a possible explanation for your experimental observation.

(b) A bacterial consortium is always preferred to a single culture for degradation of organic pollutants. Explain.

(c) Discuss the role of metahnogens for degradation of alkanes.

$$5 + 4 + 3 = 12$$

Group – E

8. (a) Enumerate different sources of biomass used to produce energy.

(b) Justify the usage of biomass as a source of energy.

(c) What are energy crops? Give examples.

$$5 + 4 + (2 + 1) = 12$$

9. The following table contains data from a study of Costa Rican plant diversity (Roth *et al*. 1994). The authors measured diversity in four different habitats ranging very low levels of human disturbance (primary rain forest) to very high levels of human disturbance (banana plantations) to assess the impacts of different levels of disturbance on biological diversity. For each habitat studied use data collected from one site within that habitat. The numbers below represent relative proportions of each species (from Roth *et al*. 1994).