

**BITS PILANI, DUBAI CAMPUS
SECOND SEMESTER 2011-2012
COMPRE EXAM (Closed BOOK)**

Course No.: BIOT C338

10.06.12

Max. Marks: 40

Course Title: Introduction to Environmental Biotechnology

Max. Time: 3Hrs

Note: Answer the questions in a sequence.

- Q1a. Define: i. Recalcitrant compound ii. Biosubstitutions [2]
- b. Desorption from the hydrocarbon is a critical part of the growth cycle of petroleum degrading bacteria. Justify. Explain the mechanism underlying desorption of bacteria from the hydrocarbons. [3]
- c. Explain the sequestration mechanism exhibited by microbes towards heavy metal resistance. [3]
- d. What is the injection recovery method of bioremediation? [2]
- Q2a. Give examples of any three natural disasters that gave rise to some form of pollution in past two years. [3]
- b. A highly complex hydrocarbon failed to be degraded aerobically and hence was transferred to an anaerobic digester. Suggest the probable steps and the organisms involved in the degradation of the hydrocarbon. [4]
- c. The efficiency of bioremediation at one location in the soil profile may differ radically from that at another point in the same profile. Justify. [3]
- Q3a. How are microbial biofilms important in environmental biotechnology? [3]
- b. Compare and contrast between Trickle filter and Fluidized bed reactors. [3]
- c. What are BTEX compounds? Why are they important? [2]
- d. What are IPR? List the different types of IPR. [2]
- Q4a. Give examples of two key bacteria capable of degrading chlorinated phenols. [2]
- b. Describe the degradation of TNT by aerobic microorganisms. [3]
- c. List the probable risks posed by GMOs in the environment. [2]
- d. Differentiate between in situ and ex situ remediation techniques. [3]
-

**BITS PILANI DUBAI CAMPUS
SECOND SEMESTER 2011-2012
TEST- 2 (OPEN BOOK)**

Course No.: BIOT C338

6.05.12

Max. Marks: 20

Course Title: Introduction to Environmental Biotechnology

Max. Time: 50 mins

- 1 a. What is bioaugmentation? Why is it generally not preferred to remediate a petroleum oil spill? [2]
- b. Explain the toxic mechanisms of dichloromethane on bacteria. [2]
- c. A field has been contaminated with Pentaphene. The population of *Aeromonas* being abundant, they immediately start degrading the contaminant. Discuss the degradation pathway of the compound along with the enzymes and cofactors involved in the degradation. [4]
- d. How do emulsans enhance growth of bacteria growing on oil droplets? [2]

- 2 a. Justify with examples the effect of microbes on metal speciation. [4]
- b. How can we use vitamins to dechlorinate hydrocarbons with one or more chlorine residues? [2]
- c. What was the causative agent of the Minamata disease? What is its mode of action? [2]
- d. Justify with examples, 'the genes involved in hydrocarbon degradation are chromosomal as well as plasmid born'. [2]

**BITS PILANI DUBAI CAMPUS
SECOND SEMESTER 2011-2012
TEST- I (CLOSED BOOK)**

**Course No.: BIOT C338 18.03.12 Max. Marks: 25
Course Title: Introduction to Environmental Biotechnology Max. Time: 50 mins**

1. A. What is the significance of site characterization? How is it achieved? [3]
B. What are the consequences of bioremediation on the environment? [2]
C. A new pollutant has been detected in the soil samples of a land fill. What are the different properties of the pollutant that need to be studied to decide the remediation technique? [4]
D. How do the soil constituents alter the bioavailability of the pollutant? [3]

2. A. The in situ treatment methods are useful for remediating some pollutants, whereas are not recommended for most cases. Justify. [4]
B. Describe the biopiling method for bioremediation. Draw a suitable diagram for the same. [3]
C. Differentiate between the intensive and extensive technologies [3]
D. What are the different methods used by microorganisms to remediate the contaminants? [3]

5. What is the Windrow system? [1]

6. Where is the captor process used? [1]

7. Mention the salient features of the Deep shaft reactor. [0.5]

8. Give the two reactions carried out by bacteria in the nitrification process. [1]

BITS PILANI DUBAI CAMPUS
SECOND SEMESTER 2011-2012

QUIZ-I (CLOSED BOOK) Answer key

Course No.: BIOT C338

17.04.12

Max. Marks: 07

Course Title: Introduction to Environmental Biotechnology

Max. Time: 20 mins

1. What are the secondary treatment processes used in the sewage treatment? [1]

Biological Oxidation, Ponda, lagoons, Trickling filters, activated sludge

2. How are aerobic ponds different from the high rate aerobic ponds? [1]

Aerobic ponds: are shallow up to 1m in depth and hence light reaches the bottom.

The shallow ponds mean that more oxygen can be supplied by the algae via photosynthesis, in addition to the diffusion from the surfaces.

High rate aerobic ponds: are similar, but much shallower (0.2-0.5m deep). Oxygen production by algae is enhanced by some form of mixing. Algae produced in these ponds can be used as animal or fish food.

3. What is the major disadvantage of the activated sludge treatment? [0.5]

Filamentous microbes if grown hinder settling and hence some microbes can escape in the effluent.

4. What are the disadvantages of using incinerators for disposal of sludge? [1]

Disadvantages:

- The process can be expensive to operate and construct
- It is not a complete disposal as the resulting ash will need to be disposed of in a landfill site
- The ash might contain high levels of metals
- Produced particulates and flue gases

5. What is the Windrow system? [1]

Windrow system is the simplest open system, where the waste to be composted is piled in long heaps, often covered with straw to conserve heat, and aeration is achieved by periodic turning of the heaps.

6. Where is the captor process used? [1]

In the activated sludge process, the activated sludge biomass is immobilized in reticulated plastic pads. To maintain an active biomass some of the pads are stripped of excess biomass by a system that removes the pads, squeezes out the sludge, and returns the empty pad to the tank. This system is called the captor process.

7. Mention the salient features of the Deep shaft reactor. [0.5]

a. The deep-shaft bioreactor is sunk into the ground. b. A pressure of about 10atm is found at the base. The high pressure will force more oxygen into solution, improving aeration considerable.

8. Give the two reactions carried out by bacteria in the nitrification process. [1]

The first stage of ammonia oxidation is carried out mainly by the genera *Nitrosomonas*, *Nitrosococcus*, *Nitrospira*, *Nitrocystis*, *Nitrosogloea*.

The reaction is: $2\text{NH}_4^+ + 3\text{O}_2 \longrightarrow 2\text{NO}_2^- + 4\text{H}^+ + 2\text{H}_2\text{O} + \text{Energy}$

The nitrite formed is converted to nitrate by the genera *Nitrobacter*, *Nitrocystis*, *Nitrosococcus*, *Nitrosocystis*, but *Nitrobacter* has been the most studied.

The reaction is: $2\text{NO}_2^- + \text{O}_2 \longrightarrow 2\text{NO}_3^- + \text{energy}$

5. Growth of protozoa in sewage sludge is considered as an excellent indication of efficient waste water treatment. Justify. [1Mark]
6. Justify why immobilization of the contaminant may be beneficial as well as may pose hazards. [1Mark]
7. What is the solid phase treatment for bioremediation? [1Mark]
8. What is the significance of the Henry's law constant in bioremediation? [1Mark]