BITS PILANI, DUBAI CAMPUS
SECOND SEMESTER 2012-2013
COMPREHENSIVE EXAM

Course NO: BIOT C338/F245 **Maximum Marks: 40**
CourseTitle: INTRO TO ENVIRON BIOTECHNOL **Weightage: 40%**
Time: 3 hours **Date: 10th June 2013**

Answer all the questions in the given sequence. Draw diagrams where ever necessary.

1a. Define the following: [4]
i. Bioremediation ii.Bioaccumulation iii. Eutrophication iv. Phytotransformation
b. How do bacteria degrade n-paraffin in the environment? Give examples of the bacteria involved in degradation of n-paraffin. [3]
c. What are the problems associated with microbial degradation of polychlorinated biphenyls? [3]

2a. Describe the Deep shaft process and mention its advantages. [2+1]
b. Why is it important to do a microbial characterization of the soil before developing the bioremediation process? [3]
c. What are emulsifiers? Mention the role of emulsifiers in hydrocarbon degradation? [2]
d. Describe the degradation of TNT by aerobic microorganisms. [2]

3a. What is the importance of protozoa in the environment? [3]
b. Why is microbial mobility important with respect to bioremediation? How is it influenced by soil properties? [1+2]
c. Explain the biological process of nitrogen removal from the domestic waste. Mention the names of the organisms involved and the reactions catalyzed by them. [4]

4a. Differentiate between Intensive and Extensive Technologies. [2]
b. What are the advantages of immobilization of enzymes for development of biosensors? [2]
c. How can biosurfactants help in remediating the soil from inorganic contaminants? [2]
d. As a student of biotechnology support the use of GMO in remediation of petroleum contaminated soil. [2]
e. What are IPR? Which type of IPR would you file for if you have created a new piece of art? [2]

**********ALL THE BEST **********

BITS PILANI, DUBAI CAMPUS
SECOND SEMESTER 2012-2013
COMPREHENSIVE EXAM ANSWERKEY

Course NO: BIOT C338/F245 | **Maximum Marks: 40**
CourseTitle: INTRO TO ENVIRON BIOTECHNOL | **Weightage: 40%**
Time: 3 hours | **Date: 10th June 2013**

1a. Define the following: [1x4]

i. **Bioremediation**: activities of aerobic and anaerobic heterotropic microbes to reduce the concentration/ remove or detoxify the pollutant from the environment.

ii.**Bioaccumulation**: Compounds with low solubility in water generally have greater solubility in cellular lipids and thus are accumulated in fatty tissues of the organism. This is called Bioaccumulation.

iii. **Eutrophication**: Excessive growth of algae in lakes contaminated with metals and organic matter.

iv. ***Phytotransformation*** — chemical modification of environmental substances as a direct result of plant metabolism, often resulting in their inactivation, degradation (phytodegradation), or immobilization (phytostabilization).

1b. How do bacteria degrade n-paraffin in the environment? Give examples of the bacteria involved in degradation of n-paraffin. [3]

Oxidation of *n*-paraffins proceeds, via terminal oxidation to the corresponding alcohol, aldehyde and fatty acid. Fatty acids formed can be further oxidized to acetate and propionate by inducible β-oxidation. Subterminal alkane oxidation occurs in some bacterial species. It results in long chain secondary alcohols and ketones.

Pseudomonas putida grows on alkanes of 6-10 carbon in length.

Acinetobacter sp is capable of growth on long chain alkanes.

1c. What are the problems associated with microbial degradation of polychlorinated biphenyls? [3]

The microbial degradation of PCB starts with the dehalogenation of polychlorinated biphenyls. There are significant problems with this microbial dehalogenation.

I. These microbes tend to be highly selective in their dechlorination, with lower chlorinated biphenyls being readily transformed, and with preference to dechlorination in the *para* and *meta*-positions.
II. Microbial dechlorination tends to be rather slow-acting on PCB as a soil contaminant in comparison to other methods.
III. While microbes work well in laboratory conditions, there is often a problem in transferring a successful laboratory strain to a natural system. This is because the microbes can access other sources of carbon, which they decompose in preference to PCBs.

2a. Describe the Deep shaft process and mention its advantages. [2+1]

The air lift design of bioreactor operates by introducing air at the bottom of the vessel. The introduced air reduces the overall density of the liquid and the air bubbles rise. These factors cause the flow of water upwards. If this upwards flow is separated from the rest of the vessel by a partition (draft tube), a circulating flow can be generated so that both mixing and aeration can be achieved by sparging air. [1]

The airlift bioreactor is normally a tall narrow vessel, with a height of 100m or more so that a pressure of about 10atm will be found at the base. The high pressure will force more oxygen into solution, improving aeration considerable. In practice the deep-shaft bioreactor is sunk into the ground either as concentric pipes or divided vertically. [1]

Advantages : [1]

- It requires only a small space compared with conventional systems
- Due to the high aeration rate, high BOD_5 wastes can be treated with 90% removal
- Produces less sludge

2b. Why is it important to do a microbial characterization of the soil before developing the bioremediation process? [1x3]

The main objective of the microbiological degradation test is to determine the ability of **the indigenous flora** to degrade the contaminant at optimal conditions.
If not, nonindigenous microorganisms will be required for bioremediation.
It is important to determine the degradation rate of the pollutant.

2c. What are emulsifiers? Mention the role of emulsifiers in hydrocarbon degradation? [2]

Emulsifiers are Microbiologically derived surfactants. The natural role of emulsans is to enhance the growth of bacteria on petroleum by two mechanisms: a. Increasing the hydrocarbon surface area and b. Desorbing the bacteria from used oil droplets.

2d. Describe the degradation of TNT by aerobic microorganisms. [2]

Reduction of aromatic nitro groups to amino groups is the primary activity observed when anaerobes metabolize nitoaromatics. Desulfovibrio was able to use TNT as the sole nitrogen source and could completely reduce it to triaminotoluene (TAT) and then further degrade it to unknown intermediates. 2,4-diamino-6-nitotoluene (2,4-DANT) was the intermediate formed.

3a. What is the importance of protozoa in the environment? [1x3]

- Pathogenic to men and animals.... Ecto or endo parasites
- Grow in waste water treatment facilities
- Clean water by ingesting harmful bacteria
- Indicators for assessing toxicity levels of water, Eg: *Tetrahymena, Paramoecium.*

3b. Why is microbial mobility important with respect to bioremediation? How is it influenced by soil properties? [1+2]

For efficient in situ bioremediation, transport of the microorganism from site of introduction to the location of the contaminant within the soil is important, ie vertical transport with in the soil layers/ profile is important. [1]
The transport of bacteria depends on their sorption to the soil components and physical filtering in which cell size is the deciding factor. Cells larger in size are inhibited from passing through small soil pores. Soils with larger sand sized particles result in greater bacterial transport, than soils with clay.[1]
Inorganic and organic colloids in the soil have a net negative charge, as do most bacterial cells. Microorganisms can overcome electrostatic repulsion with solid surfaces in soil by anion exchange, H-bonding, cation bridging, ligand exchange and hydrophobic interactions. The more hydrophobic the cell membrane, greater is the sorption on solid soil surfaces. Thus greater cell hydrophobicites decrease vertical transport. [1]

3c. Explain the biological process of nitrogen removal from the domestic waste. Mention the names of the organisms involved and the reactions catalyzed by them. [4]

Domestic waste has high levels of ammonia in it. Ammonia is oxidized rapidly to nitrate in the environment and in waste water by nitrification carried out by two groups of chemoautotrophic bacteria. These bacteria use the oxidation of ammonia as a source of energy.
The first stage of ammonia oxidation is carried out mainly by the genera *Nitrosomonas, Nitrosococcus, Nitrosospira, Nitrocystis, Nitrosogloea.*
The reaction is: $2NH_4^+ + 3O_2 \longrightarrow 2NO_2^- + 4H^+ \; 2H_2O$ + Energy
The energy released is used by the organism to synthesize cell components from inorganic sources. The hydrogen ions released cause a drop in pH.
The nitrite formed is converted to nitrate by the *genera Nitrobacter, Nitrocystis, Nitrosococcus, Nitrosocystis,* but *Nitrobacter* has been the most studied.
The reaction is: $2NO_2^- + O_2 \longrightarrow 2NO_3^-$ + energy
The energy released in this reaction is less as compared with the conversion of ammonia t o nitrites. Hence the growth of *Nitrobacter* is less than *Nitrosomonas*.

4a. Differentiate between Intensive and Extensive Technologies. [2]

Intensive Technologies	**Extensive Technologies**
sophisticated,	less sophisticated
fast acting techniques	slower acting
high intervention strategies	lower-level interventions
heavy demand for resources	small resource requirement
high initiation running and support costs.	low initiation, running and support costs.
excellent for heavy contamination conditions	Excellent for large scale treatment where speed is not of the essence.
Eg: Soil washing and thermal treatments	Eg: composting,

4b. What are the advantages of immobilization of enzymes for development of biosensors? [2]
Advantage:

1. enzyme is not free in the medium and therefore once the substrate is converted to the product the enzyme is not lost and can be reused.
2. It also allows continuous process to be used.
3. Cost effective
4. Immobilization increases the stability of the enzyme
5. Immobilization increases the half life of the enzyme, thus sensitive and expensive enzymes can be afforded for use.

4c. How can biosurfactants help in remediating the soil from inorganic contaminants? [2]
Biosurfactants are water soluble molecules whose monomers aggregate to form structures such as micells, vesicles and bilayers. Due to their small size, these molecules freely move through soil pores. Cadmium (56%) and lead (42%) have been removed from soil by Rhamnolipid biosurfactant produced by *Pseudomonas aeruginosa*. Thus the metal contaminated soils if flushed with a surfactant containing solution, can help in metal desorption and removal. This treatment can be done *in situ*.
Bioemulsifiers such as emulsan, produced by *Acinetobacter calcoaceticus*, are also used in removing metals from soils. Bacterial exopolymers have been efficient in removing Cd and Pb from sand (12-91%).

4d. As a student of biotechnology support the use of GMO in remediation of petroleum contaminated soil. [2]

Genetic modifications of microorganisms also occur naturally

- *Mutation*
- *Horizontal transfer*

Recombinant microorganisms are not well adapted to the environment

- *less chance of surviving*
- *Genetic instability*

Gene transfers are limited

- *Generally between closely related species*

4e. What are IPR? Which type of IPR would you file for if you have created a new piece of art? [2]

Intellectual property (**IP**) is a legal concept which refers to creations of the mind for which exclusive rights are recognized.

I would file the IPR for **Copyright : A** copyright gives the creator of an original work exclusive rights to it, usually for a limited time. Copyright may apply to a wide range of creative, intellectual, or artistic forms, or "works". Copyright does not cover ideas and information themselves, only the form or manner in which they are expressed.

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BITS PILANI DUBAI CAMPUS
DUBAI INTERNATIONAL ACADEMIC CITY
SECOND SEMESTER 2012-2013
Test 2 (OPEN BOOK)

Course NO: BIOT C338/F245 **Maximum Marks: 20**
CourseTitle: INTRO TO ENVIRON BIOTECHNOL **Weightage: 20%**
Date: 6.05.2013

Answer all the questions in the given sequence

1a. Describe a secondary treatment for sewage which is based on biofilm formation. [3]

b. Why is the physical interaction of microorganisms with hydrocarbons essential for their degradation? What are the strategies used by the microorganisms to survive on hydrocarbons as sole source of carbon and energy? [3]

c. A field has been contaminated with Phenanthrene. 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]

2a. Why are fertilizers used in remediating oil pollution? Give an example of its in situ application. [3]

b. A highly complex plant cellulosic material 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 hydrocarbons. [4]

c. Justify, 'polycyclic aromatic hydrocarbons can enter the environment through biogenic sources'.[1.5]

d. List the genes present in the upper pathway for biphenyl degradation. [1.5]

**********ALL THE BEST**********

Answer key

BITS PILANI DUBAI CAMPUS
DUBAI INTERNATIONAL ACADEMIC CITY
SECOND SEMESTER 2012-2013
Test 2 (OPEN BOOK) ANSWERKEY

Course NO: BIOT C338/F245 **Maximum Marks: 20**
CourseTitle: INTRODUCTION TO ENVIRONMENTAL BIOTECHNOLOGY **Weightage: 20%**
Date: 6.05.2013

Answer all the questions in the given sequence

1a. Describe a secondary treatment for sewage which is based on biofilm formation. [1x3]

The trickling filter is based on randomly packed solid medium, which will act as a surface on which a mixed culture of microorganisms will attach and grow. The biofilm which develops on the filter packing, will give the filter a high biomass content as the solid packing has a high surface area, and so the high biomass content should be able to metabolize the sewage rapidly.

The gaps between the stones allow air to penetrate the bed and this is improved by having ventilation at the base. The waste water is applied by rotating distribution system, and the treated water is collected by a drain at the base.

Such a filter **does not** require inoculation but develops its own population, which is a complex mixture of bacteria, fungi, protozoa, algae, and large organisms like insects and worms. The biofilm is in a dynamic equilibrium, which alters as the contents of the waste water changes. It also varies with the season. After the biofilm reaches a certain thickness, layers get detached and these aggregates are collected in a settling tank.

1b. Why is the physical interaction of microorganisms with hydrocarbons essential for their degradation? What are the strategies used by the microorganisms to survive on hydrocarbons as sole source of carbon and energy? [1.5x2]

There are two essential reasons for the microorganisms to come in direct contact with the hydrocarbon [a] Low solubility of the hydrocarbon in water and [b]The first enzyme involved in hydrocarbon degradation is a membrane bound oxygenase

Thus two different strategies have been proposed for enhancing contact between bacteria and water insoluble hydrocarbon.

i. Specific adhesion/ desorption mechanism and ii. Emulsification of the hydrocarbon.

1c. A field has been contaminated with Phenanthrene. 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]

Pentaphene is an aromatic compound. *Aeromonas* are aerobic bacteria, capable of degrading pentaphene. Since the contaminant is being degraded by bacteria the pathway followed for degradation uses the enzyme dioxygenase. The enzyme consists of a flavoprotein, an iron-sulfur protein and a ferredoxin. [1]

Bacteria initially oxidize aromatic compounds by incorporating both atoms of molecular oxygen into the aromatic ring to form a *cis*-dihydrodiol, catalyzed by a dioxygenase, consisting of a flavoprotein, an iron-sulfur protein and a ferredoxin. [1]

Further oxidation of *cis*-dihydrodiol leads to formation of catechol which leads to enzymatic fission of the aromatic ring. [1]

Once catechol is formed, it can be oxidized via the ***ortho* pathway**, which involves cleavage of the bond between the two carbon atoms bearing the hydroxyl groups to form *cis,cis*-muconic acid or *via* the ***meta* pathway**, which involves cleavage between one of the carbons with a hydroxyl group and the adjacent carbon, to form 2-hydroxy muconic semiahdehyde. In either pathway, the end products formed are the intermediates of TCA cycle, thus, metabolizing the compound completely. [1]

2a. Why are fertilizers used in remediating oil pollution? Give an example of its in situ application. [2+1]

The extent of degradation also depends on the availability of utilizable sources of nitrogen and phosphorus. The ammonium salts of strong acids when used tend to **lower the pH** of the medium. This can be avoided by using fertilizers like urea as nitrogen source. These compounds are highly water soluble and hence readily get diluted in open systems. Nitrogen and phosphorus containing **fertilizers** having affinity for hydrocarbons and hence are developed for treating oil pollution.

Eg: the oleophilic fertilizer **Inipol EPA 22**, composed of *oleic acid, lauryl phosphate, 2-butoxy-1-ethanol, urea and water.* This was used in large quantities to treat oil contaminated shorelinne after the 1989 oil spill in Prince William Sound, Alaska.

2b. A highly complex plant cellulosic material 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 hydrocarbons. [4]

It is a complex process involving a number of reactions, three main groups of organisms and four main stages.

The first stage is the hydrolysis of complex cellulosic material to form organic acids, alcohol and ketones by hydrolytic microorganisms like *Clostridium, Eubacterium and Bacteroids.*

In the second stage (acidogenesis) organic acids are converted to acetate, carbon dioxide, hydrogen. Other amino acids and sugars are converted to acetate, carbon dioxide and hydrogen. The reactions are carried out by *Peptococcus and Propionibacterium*.

In the third stage (acetogenesis) organic acids are converted to acetate and carbon dioxide by *Syntrophobacter, Desulfovibrio* and *Syntrophomonas*

The fourth stage (methanogenesis) is the formation of methane by methanogenic bacteria like *Methanobacterium, Methanobacillus, Methanococcus* and *Methanosarcina*.

The methanogenic bacteria convert acetate, carbon dioxide and hydrogen to methane.

2c. Justify, 'polycyclic aromatic hydrocarbons can enter the environment through biogenic sources'. [1.5]

Biogenic sources are the natural sources of PAH. These are diverse structures widely distributed in the biosphere as components of surface waxes of leaves, plant oils, cuticles of insects and the lipids of microorganisms. Many alkanes and alkenes are of biogenic origin, produced from terrestrial plants and aquatic algae. Petroleum and coal provide the largest source of mononuclear and polynuclear aromatic compounds. Aromatic carotenoids, terpenes, lignins, alkaloids and flavinoids enter the environment through biosynthesis by plants.

2d. List the genes present in the upper pathway for biphenyl degradation. [1.5]

The cluster encoded first four enzymes in the biphenyl pathway:
bphA (encoding biphenyl dioxygenase),
bphB (encoding dihydrodiol dehydrogenase),
bphC (encoding 2,3-dihydroxybiphenyl dioxygenase) and
bphD (encoding the last enzyme in the upper pathway, the hydrolase).

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BITS PILANI DUBAI CAMPUS
DUBAI INTERNATIONAL ACADEMIC CITY
SECOND SEMESTER 2012-2013
Test 1 (CLOSED BOOK)

Course NO: BIOT C338/ F244 **Maximum Marks: 25**
CourseTitle: INTRODUCTION TO ENVIRONMENTAL BIOTECHNOLOGY **Weightage: 25%**
Date: 18.03.2013

Attempt all the questions in the given sequence

1a. Define pollution. What are the different parameters that help us classify pollutants? [2]

b. Explain the Biosparging method of remediation. [3]

c. Draw a neat diagram depicting land farming. [2]

d. Describe the inorganic phase in the soil. [3]

e. List any four sources of soil pollution. [2]

Q2a. How do the physical characteristics of the soil influence the pollutant remediation? [3]

b. Define : cometabolism, Extensive technologies, recalcitrant, Henry's law constant [4]

c. An agricultural farm has been accidentally contaminated with naphthalene. Suggest some methods for this pollution control. [3]

d. Describe the advantages and disadvantages of chemical remediation technologies. [3]

**********ALL THE BEST**********

BITS PILANI DUBAI CAMPUS
DUBAI INTERNATIONAL ACADEMIC CITY
SECOND SEMESTER 2012-2013
Test 1 (CLOSED BOOK) ANSWERKEY

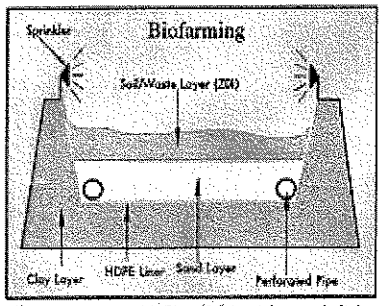
Course NO: BIOT C338/ F244 **Maximum Marks: 25**
CourseTitle: INTRODUCTION TO ENVIRONMENTAL BIOTECHNOLOGY **Weightage: 25%**
Date: 18.03.2013

Attempt all the questions in the given sequence

1a. Define pollution. What are the different parameters that help us classify pollutants? [2]
Pollution is the condition that disturbs the harmony between the biotic and abiotic components of the environment.
Toxicity of the pollutant, persistence of the pollutant in the environment, mobility of the pollutant, ease of controlling the pollutant, bioaccumulation of the pollutant and chemistry of the pollutant.

b. Explain the Biosparging method of remediation. [3]
It is a technique used to remediate contamination at or below the water table boundary. The process involves superaeration of the ground water, thereby stimulating accelerated contaminant biodegradation. Air is introduced via pipes sunk into the contaminated area and forms bubbles in the ground water. This extra oxygen dissolves into the water, and also the overlaying soil, thus stimulating the activity of the resident microbial flora. This leads to a speeding up of the natural ability to metabolize the polluting substance.

c. Draw a neat diagram depicting land farming. [2]



d. Describe the inorganic phase in the soil. [3]
Soil inorganic materials include both crystalline material in the form of layer silicates as well as more poorly crystalline oxides, hydroxides and oxyhydroxides (collectively termed hydrous oxides). Layer silicates or phyllosilicates play a key role in soil reactions because they exist typically in clay size fractions and participate as cation and anion exchangers. Aluminum, iron, manganese and titanium oxides, hydroxides or oxyhydroxides also exist in soils. A characteristic of aluminum and iron oxides relevant to bioremediation is the pH dependent charge resulting from the protonation/deprotonation of surface functional groups. At pH values below their zero point charge (ZPC), aluminum and iron oxides have a net positive charge and thus exhibit an anion exchange capacity. Manganese oxides likewise exhibit a pH dependent charge, but in most cases the ZPC is so far below typical soil pH values that they primarily participate only in cation exchange. Manganese and iron oxides may also participate in redox reactions

resulting from oxidation state changes, reactions which are enhanced by the fact that these oxides possess such large surface areas.

e. List any four sources of soil pollution. [2]
pesticides, accidental oil spillage, weedicides,

Q2a. How do the physical characteristics of the soil influence the pollutant remediation? [3]
The organization and orientation of soil particles results in the development of soil structure. Soil particles irrespective of their chemical composition are defined on the basis of their size as sand (2-0.05mm), silt (0.5 -0.002mm) and clay (<0.002mm). These primary particles are cemented together by organic and inorganic materials to form microscopic aggregates. At a larger scale, the microaggregates are organized into macroaggregates or peds. Formation of aggregates results in structures containing various size pores, which can be filled by gases or soil solutions. The diffusion of gases and liquid components into and out of the aggregate has important implications on bioremediation efficacy and degradation kinetics. In many instances the soil contaminant is distributed vertically within the soil to depths in which soil characteristics vary tremendously. The physical and chemical differences between the soil horizons at different depths alter the reactions between the soil and contaminant and soil and microbes. Thus the efficiency of bioremediation at one location in the soil profile may differ radically from that at another point in the same profile.

b. Define : [1x4]
cometabolism: the contaminant is taken up by microbe species, but not used as a food, metabolized alongside the organism's food into less hazardous chemical. Subsequently it may be mineralized by other microbial species.
Extensive technologies: Extensive methods are lower-level interventions, typically slower acting. They are based on simpler technology and less sophisticated engineering. They have a smaller resource requirement and lower initiation, running and support costs.
Recalcitrant: compounds that resist any degradation (chemical or biological)
Henry's law constant: it determines the ability to strip volatile organic compounds from water

c. **An agricultural farm has been accidentally contaminated with naphthalene. Suggest some methods for this pollution control. [3]**
Dilution and dispersal:
It involves the attenuation of pollutants by permitting them to become physically spread out, thereby reducing their effective point concentration. The dispersal and the consequent dilution of the pollutant depends on the nature and the characteristics of the pollutant. It may take place with varying degrees of effectiveness in air, soil and water.
Concentration and containment:
This approach is opposing the previous approach of dilution and dispersal. Here attempts are made to gather together the offending substance and prevent its escape into the surrounding environment.

d. Describe the advantages and disadvantages of chemical remediation technologies. [3]
Toxic compounds are destroyed, fixed or neutralized by chemical reaction.
The principle advantages are,

i. the destruction of biologically recalcitrant chemicals is possible
ii. toxic substances can be chemically converted to either more or less biologically available ones, whichever is required.

Disadvantage:

i. It is possible for contaminants to be incompletely treated,
ii. the reagents necessary may themselves cause damage to the soil and
iii. often there is a need for some form of additional secondary treatment.

**********ALL THE BEST**********

Q2a. How do the physical characteristics of the soil influence the pollutant remediation? [3]size of size particles, formation of aggregates, entrapment of gases,

4. Justify, "It is difficult to maintain the numbers of introduced bacterial strain or strains in soil and a decline in numbers have been reported with increased time". [3] biotic and abiotic

5. An agricultural farm has been accidentally contaminated with naphthalene. Suggest some methods for this pollution control. [3] dilution and dispersal, containment

6. Describe the advantages and disadvantages of chemical remediation technologies. [3]

7. Explain the Biosparging method of remediation. [3]

8.

9. Define : cometabolism, Extensive technologies, recalcitrant, Henry's law constant [4]

10. List any four sources of soil pollution. [2]

BITS PILANI DUBAI CAMPUS
SECOND SEMESTER 2012-2013
QUIZ– 2 (CLOSED BOOK)

Course No.: BIOT C338/F245 **18.04.13** **Max. Marks: 07**
Course Title: Introduction to Environmental Biotechnology **Max. Time: 20 mins**

Name: ID No.

1. What is the main aim behind the tertiary treatment of sewage? [1]

2. What are High rate aerobic ponds? [1]

3. What is the packing material used in the trickling filter? [1]

4. Mention the disadvantage of activated sludge process. [1]

5. What are the advantages of a landfill process? [1]

6. What is the Windrow system? [1]

7. Mention a method of sludge disposal where a major volume reduction id observed, but is ineffective in removing metal contaminants.

**********ALL THE BEST**********

BITS PILANI DUBAI CAMPUS
SECOND SEMESTER 2012-2013
QUIZ– 2 (CLOSED BOOK) ANSWERKEY

Course No.: BIOT C338/F245 **18.04.13** **Max. Marks: 07**
Course Title: Introduction to Environmental Biotechnology **Max. Time: 20 mins**

Name: ID No.

1. What is the main aim behind the tertiary treatment of sewage? [1]
The tertiary treatment of sewage is required to remove phosphate, nitrate and pathogenic microorganisms to produce potable water and to prevent eutrophication.

2. What are High rate aerobic ponds? [1]
These are aerobic ponds, 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 packing material used in the trickling filter? [1]
Gravel, shaft, stones, clinker, slag, lava, coke, polyurethane foam, sphagnum peat moss, ceramic, or plastic media.

4. Mention the disadvantage of activated sludge process. [1]
Filamentous microbes if grown hinder settling and hence some microbes can escape in the effluent.

5. What are the advantages of a landfill process? [1]
Gas recovery, efficient and economic waste disposal.

6. What is the Windrow system? [1]
It is the simplest open system for composting, where the waste is piled in long heaps, often covered with straw to conserve heat, and aeration is achieved by periodic turning of the heaps.

7. Mention a method of sludge disposal where a major volume reduction id observed, but is ineffective in removing metal contaminants.
Incineration.

BITS PILANI DUBAI CAMPUS
SECOND SEMESTER 2012-2013
QUIZ– I (CLOSED BOOK)

Course No.: BIOT C338/F 245 **27.02.13** **Max. Marks: 08**
Course Title: Introduction to Environmental Biotechnology **Max. Time: 20 mins**

Name: ID No.

1. Define the following and give an example of the same: [0.5x2]
   a. **Bioindicators**:

   b. **cytopathic effects**:

2. Describe the landfarming method of bioremediation. [1]

3. What is the significance of octanol/water coefficient? [1]

4. Give examples of any two natural disasters that have lead to environmental pollution in past two years. [1]

5. What is meant by Clean Technology? Give an example of the same. [1]

6. The microbial flora of air is influenced by the activity in the area. Justify with examples. [2]

7. Explain with an example, two different environmental importances of algae. [1]

BITS PILANI DUBAI CAMPUS
SECOND SEMESTER 2012-2013
QUIZ– I (CLOSED BOOK) ANSWERKEY

Course No.: BIOT C338/F 245 **27.02.13** **Max. Marks: 08**
Course Title: Introduction to Environmental Biotechnology **Max. Time: 20 mins**

Name: ID No.

1. **Define the following and give an example of the same:** **[0.5x2]**
   a. **Bioindicators**: are whole organisms that are representative of their environment and whose population changes are used to estimate the effects of pollutants. Eg: E.coli as an indicator of water pollution.
   b. **cytopathic effects**: degenerative changes in cells or tissue due to the multiplication of certain viruses. Plaques seen on a bacterial lawn.

2. **Describe the landfarming method of bioremediation.** **[1]**
   Contaminated soils, sludges or sediments are spread on fields and cultivated in much the same manner as a farmer might plow and fertilize agricultural land. Most inexpensive and effective treatment for petroleum contaminated soils. It is a technique used for easily biodegradable chemicals. There could arise a problem for leaching of chemicals to groundwaters.

3. **What is the significance of octanol/water coefficient?** **[1]**
   The octanol/water partition coefficient is defined as the ratio of a compound's concentration in the octanol phase to its concentration in the aqueous phase of a two-phase system. Compounds with low water solubilities and high octanol/water coefficients will be adsorbed more strongly to solids and are generally less biodegradable. Highly soluble compounds tend to have low adsorption coefficients for soils and tend to be more biodegradable. Thus it helps in understanding the pollutant and design the bioremediation process.

4. **Give examples of any two natural disasters that have lead to environmental pollution in past two years.** **[1]**
   Volcanic eruption in the Europe, hurricane Irene, Tsunami in Janpan

5. **What is meant by Clean Technology? Give an example of the same.** **[1]**
   Clean Technology is the drive towards cleaner processes, which are environmentally sustainable, and is a preferred option to the clean-up of the pollution once formed. Examples: using biofuels, microbial removal of sulphur from coal.

6. **The microbial flora of air is influenced by the activity in the area. Justify with examples.** **[2]**
   Bacteria can present in a particular area depending on the activity in that area. This is because depending on the activity the bacteria tend to rise in air along the dust particles and hence the source of bacteria depends on the activity in the area. Eg: hospitals may have potent pathogens in the air, while in an industrial area, there would be more of pollutants than bacteria. Animal sheds would possess bacteria which house animals than humans. Thus the bacterial flora of the atmosphere would vary with the activity.

7. **Explain with an example, two different environmental importances of algae.** **[1]**
   Anabena, Noctoc : nitrogen fixation.
   Chlorella and *Spirullina:* rich sources of protein
   Chlorella, Spirullina, Scenedesmus: used as scavengers of toxic minerals from water through biosorption.
   Some Chlorophycean genera are being tried for hydrogen generation as an alternative source of fuel.