Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

VII SEMESTER B.TECH. (BIOTECHNOLOGY)

END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT: BIOREMEDIATION [BIO 445]

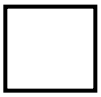
REVISED CREDIT SYSTEM
(30/11/2016)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** questions.
- Missing data may be suitable assumed.

1A.	You are taken to a site with soil contaminated with a chemical spill. The pH of the soil was observed to be 2.7. What is the initial step that you would take before degradation of the chemical?	**2m**
1B.	Analyze how the biodegradability of a compound is affected by the following factors: (i) Solubility (ii) Degree of branching (iii) Degree of saturation (iv) Nature & extent of substitution	**4m**
1C.	The following table lists the results of plate counts of anaerobic bacteria measured at different depths in an unpolluted and cultivated plot of land. Soil depth (cm) / CFU per g of soil 0 – 5 / 7.8×10^5 5 – 20 / 8.8×10^4 20 – 35 / 5.0×10^3 150 – 175 / 1.0×10^5 (i) In the top layers of the soil, the anaerobic microbial count is the highest, even though the topmost soil layers are well-aerated. Account for this discrepancy in observation. (ii) There is a decreasing trend in microbial count until about 35 cm. Explain the reason behind the sudden peaking of the count at 150-175 cm.	**4m**
2A.	How is lag phase otherwise known as, with regard to bioremediation? Which factor is most important when studying this specific phase of microbial growth?	**2m**
2B.	What do you understand by field capacity? How is the soil moisture content estimated?	**3m**

2C.	What is humus? What are its components? Which is the most important biological function that it plays? What are the chemical and structural features, responsible for this function?	**5m**
3A.	The Great Lakes of North America experienced high rates of eutrophication. Studies indicated that this was due to the widespread usage of biodegradable detergents. Though the detergents were fully biodegradable, how did this problem happen? How do you think, this problem was solved?	**3m**
3B.	An accidental burst of an underground chemical pipeline led to the release of toxic fumes of the chemicals released in the vadose zone, nearly 6 m below the soil surface. Luckily for the remediation team, the soil was not very porous in the region and the plume did not spread fast. Under the given circumstances, what would be the best method to sort out the problem? Present your answer with a figure and the values of operating parameters.	**3m**
3C.	Which form of sulphate and nitrate respiration is used for bioremediation of organic contaminants? Of the two, which is the better alternative? Present reasons for your choice.	**4m**
4A.	Identify the compound shown in the picture, below. It is one of the products from the petroleum industry. If it were to undergo microbial biodegradation, what is the pathway it would take? Outline the major steps. 	**4m**
4B.	A soil core 10 cm in diameter and 10 cm high is found to have a mass of 1690 g. After drying in an oven at 105ºC, the mass of solids is found to be 1465 g. Assuming the soil has a particle density of 2.66 g/cm^3, then: (i) What is the moisture content of the soil on a weight basis? (ii) What is the moisture content of the soil on a volume basis? (iii) What is the porosity of the soil?	**6m**
5A.	With a labelled diagram of a land treatment unit, elaborate on any of its two parts, stating their functions.	**4m**
5B.	Consider the metabolism of lactic acid by aerobic microbes, for the redox pairs CO_2/lactic acid and O_2/H_2O. Write the half reactions and the combined balanced reactions. Find the free energy for this reaction if the reduction potential values for O_2/H_2O is +0.82V and that for $CO_2/C_3H_6O_3$ is –0.22V.	**6m**
6A.	Enlist two advantages and disadvantages, each, of phytoremediation.	**2m**
6B.	During field-scale bioremediation, the disappearance of a polychlorinated biphenyl (PCB) is being monitored over time. The concentration of the contaminant is seen to drop from 950 to 500 ppm within 40 days. What would the concentration be at 70 days, if: (i) zero-order kinetics model is followed? (ii) first-order kinetics model is followed?	**8m**