MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

VII SEMESTER B. Tech. BIOTECHNOLOGY
End Semester Exam
Program Elective 3: Bioremediation (BIO 4051)

Date: 30.11.2023 **Duration: 3 hrs** **Max. Marks: 50**

Answer ALL the questions.

Q. No.	Question	Marks	PO	CO	BLT
1	How are Sulphur bacteria used in bioremediation strategies? Represent the reactions mediated by them in the form of chemical equations.	**4**	1	1	**3**
2	Consider alkanes in the C5 to C40 range. Predict the degree of difficulty of the biodegradability of these alkanes by bacterial species.	**3**	1	1	**4**
3	A soil sample, upon being tested, was found to contaminated with the aromatic o-, m- and p-forms of xylene. An aerobic bacterium was used to bioremediate the soil. Present the complete mechanism of biodegration of this compound.	**3**	1	1	**3**
4	You are hired to design a retail petrol distrinbution bunk in the heart of a bustling city. As an environmental engineer, you are expected to put in place, the necessary measures to detect and contain any possible leakage from the USTs. Design a layout of the 2 acre site with all the necessary facilties in place. Mention any specific design parameters that need to be taken care of, as per international conventions.	**5**	4,12	2	**5**
5	In November 2023, it was reported that several devotees in Delhi had offered prayers to the rising sun standing in knee-deep toxic foam floating on the banks of the polluted Yamuna river, during Chhath Puja celebrations. According to officials, the toxic foam is due to the **high phosphate content** in the	**3**	4,12	2	**4**

	river, which can cause skin and respiratory problems. What measure(s) would you suggest in order to curb the problem?				
6	Upon the testing of a soil sample, an organic compound of very high molecular weight was derived having a variety of components like quinone, phenol, catechol and sugar moieties. Deduce what the compound is? What are its uses in bioremediation?	**2**	4,12	2	**3**
7	Determine the donor pair and the acceptor pair in the aerobic metabolism of sucrose by bacterial cultures.	**4**	4,12	2	**3**
8	Estimate the depth to which oxygen can diffuse in a dry soil with a porosity of 0.35 Assume a rate of oxygen consumption of 150 $g/m^3.h$ and an oxygen diffusion coefficient of $1.89x10^{-5}$ m^2/s. Assume an ambient temperature of 25 ºC	**3**	4,12	2	**3**
9	As a bioremediation systems installation engineer, you have helped in the design, construction and initiation of operations of a Land Treatment Unit. After a few months of operation, the resident manager of the unit informs you that the LTU is about to process contaminated soil that has excessive amounts of CaO, $Ca(OH)_2$, and $CaCO_3$. The oxygen concentration was also poor in the tested soil samples. What would be your advice to the manager in dealing with the above-said scenario?	**3**	4,12	2	**4**
10	How do you proceed to to develop an appropriate mix (or consortium) of microbial cultures to be used for treating contaminated soild using slurry-phase reactors?	**5**	1, 2, 3, 4, 5, 9	5	**3**
11	Determine the volume of trichloroethylene (TCE) required to exceed the drinking water MCL of 5 µg/L in 1 L of water and the volume of water that can be contaminated by 1 L of TCE. Density of pure TCE at 20ºC is 1.46 kg/L.	**3**	4, 5, 9, 10, 11, 12	3	**3**
12	A biotrickling filter system was malfunctioning after a few days of operation. The supervising engineer suggested the	**2**	4, 9, 10, 11	3	**4**

	provision of a stream of make-up solution. Do you agree with the suggestion? Why or why not?				
13	A metal-processsing industry decides to remediate its storage yards with phytoremediation approaches. Suggest any such two techniques with a brief outline of the same.	**4**	1, 2, 3, 4, 7, 9	4	**3**
14	Certain chemical compounds possess structural properties that may sterically hinder enzymatic attack. Enlist six such properties.	**3**	1, 2, 3, 4, 7, 9, 11, 12	4	**2**
15	How would you make use of the electron tower in making an informed choice of bioremediation strategy? Explain.	**3**	1, 2, 3, 4, 7, 9	4	**3**