MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

VII SEMESTER B.TECH. END SEMESTER EXAMINATIONS

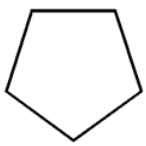
NOVEMBER 2019

SUBJECT: BIOREMEDIATION [BIO 4001]

Date of Exam: **26/11/2019** Time of Exam: **2.00 pm to 5.00 pm** Max. Marks: **50**

Instructions to Candidates:

- Answer ALL the questions & missing data may be suitable assumed

1A.	With respect to bioremediation, which parameter is monitored during the acclimation period?	**4A-2**
1B.	How does the bioavailability quotient of contaminants to microbes, affect a bioremediation process?	**2-4**
1C	What is the most distinguishing feature of slurry phase bioremediation? Using a schematic diagram, give a short note on this type of bioremediation.	**9-4**
2A.	A soil core, collected from the field, has a bulk volume of 100 mL, an air volume of 30 cm3, a wet mass of 145 g, and a dry mass of 125 g. Calculate the total porosity and the bulk density.	**3-3**
2B.	What is free energy of formation? Show how is this calculated for a general chemical reaction?	**4B-3**
2C.	 What is the name of the compound shown on the left? What is the mechanism of biodegradation of this compound? Explain with the structures of the intermediary compounds formed.	**5-4**
3A.	Enlist the methods used to increase and decrease the pH of soils. State examples.	**4A-2**
3B.	How does pumping rate affect the design of a pump, treat and reinjection system? Explain with a graphical plot.	**7-4**
3C.	How are contaminant plumes monitored? How does it help to monitor them? Provide a schematic diagram.	**2-4**
4A.	What is the significance of the electron tower concept for designing a bioremediation strategy?	**4B-2**
4B.	What are the salient features of the drainage system of a land treatment unit (LTU)?	**8-2**
4C.	A batch experiment was conducted to follow the biodegradation of the polynuclear aromatic hydrocarbon phenanthrene in a liquid culture. An inoculum of exponentially growing bacteria was introduced, and the following results were obtained.	**4A-6**

	<table><tr><td>Time (days)</td><td>0</td><td>2</td><td>5</td><td>7</td><td>10</td><td>15</td></tr><tr><td>C (mg/L)</td><td>500</td><td>450</td><td>375</td><td>350</td><td>298</td><td>215</td></tr></table> (i) Assuming first-order rate kinetics apply, find the biodegradation rate constant k. (ii) Based on the results of this experiment, what is the half-life of phenanthrene?	
5A.	What are the significant design and operational parameters for a soil vapour extraction unit?	**7-2**
5B.	Write a short note on rhizodegradation and comment on its progress rate when compared against phytodegradation.	**12-3**
5C.	Using chemical structural formulae, explain the mechanism of biodegradation of (i) Chlorobenzene (ii) Pentachlorophenol	**5-5**