Ref. No.: Ex/PG/EBT/T/112/2024

Name of the Examinations: **M. TECH. ENVIRONMENTAL BIOTECHNOLOGY FIRST YEAR FIRST SEMESTER -2024**

Subject: ENVIRONMENTAL POLLUTION (**Part-I** - 70 Marks)

Time: Three hours Full Marks : 100 Use separate answer script for each Part

No.	Questions	Marks
	Answer *any five questions*:	**14 × 5 = 70**
1.	a) How could you prepare 250 ml of 4 (N) of Na_2CO_3 solution? b) How could you prepare 500 ml of 2.5 (M) $CaCO_3$ from standard 10 (M) $CaCO_3$ solution? c) About 0.5 g of weighed soil sample was digested in acid medium and the volume was made up to 50 ml with double distilled water. During quantification of Cd concentration using Atomic Absorption Spectrometric method, the calibration went out of range. Then, the digested solution was diluted 10 folds with water and the concentration was found 25 ppb. What was the concentration of Zn in soil sample?	4 + 4 + 6
2.	a) Define Nalgonda technology used for defluoridation of water and its limitations. b) Define the role of dietary selenium (Se) and zinc (Zn) to fight against arsenic toxicity. c) Organic mercury (Hg) species are more toxic than its other available forms – explain.	5 + 4 + 5
3.	a) Explain the leaching mechanism of fluoride from its mineral source CaF_2 to aquifer. b) Describe all the steps involved during disinfection of water with addition of chlorine. c) How cadmium (Cd) exhibits its toxic effect on human health? d) Removal of arsenate is easier compared to arsenite during co-precipitation with iron?	4 + 4 + 2 + 4
4.	a) Define the technologies involved in chemo, electro and solar defluoridation of water. b) How nitrate can be removed from nitrate contaminated water? c) Several organic components may pollute the water body system – explain. d) What are the adverse impact of agricultural runoff on surface water bodies?	4 + 4 + 3 + 3
5.	a) Why arsenate is less toxic than arsenite? b) How quality control can be maintained during environmental sample analysis? c) What are the possible sources of nitrate in groundwater? d) Define pesticides with examples.	4 + 4 + 3 + 3
6.	a) What different kind of disinfectants are used for water purification? b) Define the different key factors involved in water sample analysis. c) Nitrate beyond its permissible limit in drinking water has adverse health effect – explain. d) What are the different sources of Hg in groundwater?	4 + 4 + 4 + 2

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M. TECH. ENVIRONMENTAL BIOTECHNOLOGY 1ST SEM. EXAM 2024

Subject: **ENVIRONMENTAL POLLUTION, Part II (Air Pollution)**

Full Marks: 30

1. Determine gravimetrically (in $\mu g/m^3$) the concentration of PM_{10} in the ambient air with the following information. Weight of 47 mm diameter blank Teflon filter is 0.12499 gm. Weight of the filter after 24 hour of continuous sampling is 0.13109 gm. Pumping efficiency of the sampler is 10 liters of air/minute. (3)

2. Find the AQI of a city from the following information (5)

Pollutants	concentration in $\mu g/m^3$ (24-hr avg)
PM_{10}	161.00
$PM_{2.5}$	110.00
SO_2	98.00
NO2	135.00

Table 3.11 Breakpoints for AQI Scale 0-500 (units: $\mu g/m^3$ unless mentioned otherwise)

AQI Category (Range)	PM_{10} 24-hr	$PM_{2.5}$ 24-hr	NO_2 24-hr	O_3 8-hr	CO 8-hr (mg/m³)	SO_2 24-hr	NH_3 24-hr	Pb 24-hr
Good (0-50)	0-50	0-30	0-40	0-50	0-1.0	0-40	0-200	0-0.5
Satisfactory (51-100)	51-100	31-60	41-80	51-100	1.1-2.0	41-80	201-400	0.6-1.0
Moderate (101-200)	101-250	61-90	81-180	101-168	2.1-10	81-380	401-800	1.1-2.0
Poor (201-300)	251-350	91-120	181-280	169-208	10.1-17	381-800	801-1200	2.1-3.0
Very Poor (301-400)								
Severe (401-500)	430+	250+	400+	748+*	34+	1600+	1800+	3.5+

*One hourly monitoring (for mathematical calculation only)

Image credit: National Air Quality Index Report by Central Pollution Control Board

Fill in the blanks: **5x1=5**

1. _____and _____ are colorless odorless gaseous indoor air pollutant
2. _____is a criteria air pollutant as well as a secondary air pollutant.
3. The pH of clean rainwater is _____and acid rain is approximately _____.
4. The largest reservoir of carbon on earth is in _____.
5. The largest source of NOx in the atmosphere is _____ and that of SOx is _____.

Short Answer Type Questions (answer any three): **4x3=12**

1. Why has an ozone hole appeared over Antarctic when ozone-depleting substances are present throughout the troposphere?
2. What are banded iron formation and red beds? What are their implications in the evolution of the atmosphere?
3. How is ground level or tropospheric ozone formed? During a 24 hour day when does tropospheric ozone levels peak and why? Mention two beneficial effects of aerosols.
4. What is Miller-Urey experiment and what is its significance?

Answer any one of the following: **5**

a. Determine using crustal enrichment factor which of the elements in PM_{10} have anthropogenic sources.

Al	Ca	Cu	Cr	Co	Fe	Ni	Pb	V	Zn
Aerosol composition in ng/m^3									
58.6	185	17	6.18	0.337	425	9.67	4.43	35.68	94
Crustal composition in ppm									
81497	25658	28	92	17.3	45349	47	17	97	67

OR

b. Calculate the percent sea salt contribution and marine enrichment factor of Mg^{2+}, Ca^{2+}, SO_4^{-2}, NO_3^- and Cl^- in the rainwater collected from North Bengal. Assume all Na^+ to be of marine origin.

	Cl^-/Na^+	Mg^{2+}/Na^+	Ca^{2+}/Na^+	SO_4^{2-}/Na^+	NO_3^-/Na^+	
Seawater	1.166	0.227	0.044	0.125	0.00002	
	Cl^-	Mg^{2+}	Ca^{2+}	SO_4^{-2}	NO_3^-	Na^+
North Bengal Rainwater	43.90	25.22	88.31	26.35	13	31.10