

**BIO F216: WATER, SANITATION & SOLID WASTE MANAGEMENT**

**Comprehensive Examination (Closed Book)**

Date: **28.12.2022**

Marks: **80**

Time: **3 Hrs**

**INSTRUCTIONS:**

1. There are **FOUR** questions. Start answering each question in a **FRESH PAGE**.
2. Precisely answer all questions in the **GIVEN ORDER** only.
3. Indicate the **COMPLETE QUESTION NUMBER** for all the answers, e.g., **1. A (i)**
4. **ALL PARTS** of a question should be answered **TOGETHER**.
5. Figures in the parentheses refer to **MARKS** allotted to respective questions

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**1. A.** Hyderabad city generates around 8000 tons of MSW daily.

(i) Which type of vehicle should be chosen for transporting the MSW, which is collected and stored at temporary collection points to the landfill? Justify the basis for vehicle selection. (2)

(ii) For MSW, the density value in trucks ( $\text{kg/m}^3$ ) is in the range of 250-500 and 100-170 for low- and high-income countries, respectively. Explain the basis of this difference. (2)

**1. B. (i)** What is the main cause of diarrhea in low and middle-income countries? (2)

(ii) Name any three pathogens that cause diarrhea. (3)

**1. C. (i)** What are the three cross-cutting tasks, and why are they imperative throughout the entire planning process of Community-Led Urban Environmental Sanitation? (3)

(ii) What is the importance of SFD? (2)

**1. D. (i)** Average life expectancy of a person in Hyderabad is 70 years. Suppose a person loses a leg at the age of 50 and lives with a disability (the weight of one leg lost due to amputation is 0.3), and by the age of 60, he dies prematurely due to an accident. With the data provided, calculate the Disability Adjusted Life Years (DALY). (3)

(ii) Explain how Guinea worms can be eliminated without taking vaccines. (2)

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**2. A. (i)** What kind of biological activity happens in the biosand filtration process of HWTS? (2)

(ii) List any three advantages and three challenges of the biosand filtration process. (3)

**2. B. (i)** Explain the two physical processes that happen during membrane filtration of drinking water. (2)

(ii) How do the WAPI and Chulli systems work? (1.5+1.5)

**2. C. (i)** List the six characteristics of a container used to store drinking water at home safely. (3)

(ii) What was identified as the critical cause of contamination at the Malawi refugee camp study on improved water storage containers? (2)

**2. D. (i)** Fill in the values in the table below of the WHO scheme for evaluating household water treatment options. Answer in a tabular form. (3)

Target	Log <sub>10</sub> reduction required: <b>Bacteria</b>	Log <sub>10</sub> reduction required: <b>Viruses</b>	Log <sub>10</sub> reduction required: <b>Protozoa</b>
Highly protective			
Protective			

**(ii)** Explain any two types of financial and economic analysis of HWTs. (2)

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**3. A. (i)** How could one differentiate excreta, faecal sludge, and wastewater? (3)

**(ii)** How will faecal sludge and municipal wastewater differ if their TSS/VSS (mg/L) are plotted against their COD (mg/L)? (2)

**3. B. (i)** What are the four treatment objectives which are to be followed in faecal sludge treatment? (2)

**(ii)** Give two methods each for physical, chemical, and biological treatment of faecal sludge. (3)

**3. C. (i)** Delhi generates 600m<sup>3</sup> of sludge yearly with a total solid content of 60 g/L. A planted drying bed system was constructed to treat the sludge produced. The loading rate of this system is 200 Kg TS/m<sup>2</sup>/year. Calculate the surface area required to set up the said treatment plant. (3)

**(ii)** List any two products with their applications that are obtained from the resource recovery of faecal sludge. (2)

**3. D. (i)** How is the UN sustainable development goals linked with faecal sludge management? (2)

**(ii)** Describe any three weak links of the faecal sludge management service chain in urban areas. (3)

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**4. A. (i)** What does MSW compost's maturity and stability mean? (2+2)

**(ii)** How do microorganisms in a UASB reactor not get flushed out of the system? (3)

**(iii)** What are the three unique features of a UASB reactor? (3)

**4. B. (i)** Calculate the LCV of the MSW generated in a city that has the following composition of waste: paper – 20%, textile – 5%, woods, and leaves – 15%, food waste – 23%, plastic and rubber – 5%, and water – 32%. (3)

**(ii)** Suggest the type of incineration that is suitable for the above waste. Justify. (2)

**4. C. (i)** A drinking water sample was tested for (i) total coliforms and (ii) *E.coli* to confirm faecal contamination. What is the rationale for performing both tests? (3)

**(ii)** Among the faecal sludge from (i) septic tanks and (ii) public toilets, the methane potential will be higher in which one? Justify your answer. (2)