

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
FIRST SEMESTER 2023-2024
MID-SEMESTER TEST (CLOSED BOOK)

COURSE NO.: SAN G511

MAX. MARKS: 25%

TIME: 90 Min.

COURSE TITLE: Sanitation Technology

DATE: 10/10/2023

Note: (i) Attempt all questions. (ii) Make necessary assumptions, if required.

- Q.1 What do you mean by user interface in sanitation technology? Also, write the salient points of pour flush toilet and urine diverting flush toilet (UDFT), especially in context to their appropriateness, acceptances, operation & maintenance, and design considerations. [3]
- Q.2 How would you distinguish a single pit onsite sanitation technology with that of the septic tank? In which of the above two technologies, polluting parameters such as TS, COD, BOD etc. would be higher in concentration? Why? Justify your answer. [3]
- Q.3 What are the key improvements and future challenges in achieving Sustainable Development Goal 6 (SDG 6) on Water and Sanitation? You should highlight salient points related to access to safely managed drinking water, sanitation, and basic hygiene services from 2015 to 2022. [3]
- Q.4 Design a septic tank for a hostel housing 100 persons with the peak discharge of 240 lpm. Also, design the soil absorption system for the disposal of the effluent of the septic tank, assuming the percolation rate as 20 minutes per cm and the sewage flow @150 lpcd. [5]
- Q.5 A conventional activated-sludge plant without primary clarification operates under the following conditions: [5]
- * Design flow = 30 MLD; Total influent COD concentration (COD_i) of 580 mg/l
 - * Effluent total COD concentration (COD_e) of 120 mg COD/l
 - * A minimum yearly wastewater temperature of 22 °C.
 - * Influent flow rate contains 30 mg/l of inorganic or fixed suspended solids.
 - * Sludge Retention Time is 9.0 days.
 - * Influent daily flux of biodegradable COD is 4500 kg COD/d
 - * Influent daily flux of particulate unbiodegradable COD is 1800 kg COD/d
 - * Mass of influent particulate inorganic matter in the bioreactor is 3000.0 kg.ISS
 - * Particulate matter of activated sludge is 2500 gTSS/m³

Consider stoichiometric parameters for design –

Biomass yield of the OHOs	Y_{OHOv}	0.45	gVSS/gCOD
Specific endogenous mass loss rate of the OHOs at 20 °C	$b_{OHO,20}$	0.24	gVSS/gVSS.d
Fraction of endogenous residue of the OHOs	$f_{XE,OHO}$	0.20	gVSS/gVSS
COD/VSS ratio of the sludge	f_{cv}	1.48	gCOD/gVSS

(P.T.O.)

Specific endogenous mass loss rate of the OHOs at temperature T,

$$b_{OHO,T} = b_{OHO,20} \theta_{b_{OHO}}^{(T-20)} \quad (\text{where, } \theta = 1.029)$$

Based on the previous information, determine:

- a. Active biomass present in the system (MX_{VSS})
- b. Total solids produced (MX_{TSS})
- c. Total volume of the reactor (V_R)
- d. Nominal Hydraulic Retention Time (HRT_n)
- e. Waste of activated sludge (Q_w)

Q.6 Explain the following:

[2x3 = 6]

- a. Disinfection by advanced oxidation process.
- b. Factors influencing denitrification and Nitrification versus denitrification.

-----WISH YOU ALL THE BEST-----