Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) EXAMINATION – SUMMER 2023

Subject Code:3161306 Date:06-07-2023

Subject Name:Design of water Treatment Units

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Explain following terms as a selection criteria of water treatment schemes: (i) Existing Conditions, (ii) Environmental Compatibility and (iii) Utility capabilities	**03**
	(b)	Explain following terms in context of sedimentation tank design: (i) Detention Time, (ii) Surface Overflow Rate and (iii) Weir Loading Rate	**04**
	(c)	Design a Rapid Mixer with impeller for 5.56 m^3/d flow of water.	**07**
Q.2	**(a)**	Calculate the volume of sludge hopper of a clarifier using following data: Inlet Suspended Solids = 150 mg/L, Suspended solids removal efficiency = 70%, Flow = 20 MLD, Density of water = 1000 kg/m^3, Specific gravity of sludge = 1.02, Percentage solids present = 5% and sludge is removed every 4 hours interval.	**03**
	(b)	Write down typical design criteria for rectangular sedimentation tank.	**04**
	(c)	Prepare and explain an informative checklist for plant layout and preparation of hydraulic profile.	**07**
		OR	
	(c)	The result of chemical analysis of a sample of raw water is given below: Ca^{+2} =80 mg/L as $CaCO_3$, Na^+ =2.5 m.eq/L, HCO_3^- =80 mg/L as $CaCO_3$, Total hardness =120 mg/L as $CaCO_3$, Cl^- =140 mg/L as $CaCO_3$, SO_4^{--} =20 mg/L as $CaCO_3$ and NO_3^- =5 mg/L as $CaCO_3$ (i) Prepare a bar diagram for the raw water and (ii) Estimate the quantity in kg/day of CaO (90% pure) and Soda ash (95% pure) required to soften 5 million litres per day of this water.	**07**
Q.3	**(a)**	The maximum daily demand at a water purification plant has been estimated 3.33 m^3/d. Design the dimensions of a rectangular suitable sedimentation tank. Assuming detention time 6 hours and velocity of flow as 20 cm/minute.	**03**
	(b)	Explain Cascade aeration with the help of neat sketch.	**04**
	(c)	Write down detailed note on water treatment residuals with neat diagram showing various sources.	**07**
		OR	
Q.3	**(a)**	Determine the theoretical power requirement and the paddle area required to achieve a G value of 50 per second in a tank with a volume 3000 m^3. The coefficient of drag C_D for rectangular paddle is 1.8, the paddle tip velocity v is 0.6 m/s and v_p = 0.75 v. At temperature 15˚C, μ value is 1.139 x 10^{-3} NM/m^2.	**03**
	(b)	Write down the design criteria and performance factor equation for the tube settler.	**04**
	(c)	Enlist and explain types of rapid mixers. Write down the design criteria for Rapid Mixer.	**07**

Q.4	**(a)**	Write the sources and composition of sludge generation from drinking water treatment plant.	**03**
	(b)	Draw the neat diagram of rapid sand filter and explain why it is important to provide for "filter-to-waste" in the filter design.	**04**
	(c)	Design Bar screen for average flow of 40 MLD. Flow conditions in incoming trunk sewer is given by: (i) Diameter of trunk sewer =1.53 m (ii) Depth of flow at peak design flow = 1.0 m (iii) Velocity at peak design flow = 0.8 m/s (iv) Drop of screen chamber flow with respect to sewer invert = 0.08 m (v) Peaking factor = 2	**07**

OR

Q.4	**(a)**	Write down the design criteria for manual and mechanically cleaned bar screen.	**03**
	(b)	The flow through stainless fine screen chamber is 1.45 m3/s, & the depth and width of the screen channel are 1.35 m and 1.2 m, respectively. The manufacturer's recommended efficiency factor is 0.56, and coefficient of discharge is 0.6. Calculate (a) headloss and velocity through the clean screen and (b) headloss and velocity through the screen at 20% clogging.	**04**
	(c)	Design a Clarifier for 5.56 m^3/d flow for water treatment plant.	**07**
Q.5	**(a)**	Define effective size and uniformity coefficient and explain their use in design of Rapid Sand Filter.	**03**
	(b)	Explain iron and manganese removal from a ground water source.	**04**
	(c)	Design a chlorine contact tank for peak water flow of 10 MLD.	**07**

OR

Q.5	**(a)**	Draw the neat sketch of a treatment train for a ground water source when cations concentration is high.	**03**
	(b)	Write a short note on Nalgonda Technique.	**04**
	(c)	Design a Rapid Sand Filter for a city water treatment plant for average flow of 0.231 m^3/sec.	**07**

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