Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–VII EXAMINATION – WINTER 2025

Subject Code:3171309 Date:01-12-2025

Subject Name:Advanced Wastewater Treatment Technologies

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)**	What are the primary methods used for nitrogen removal in wastewater treatment plants in India? Explain briefly how each method works.	**03**
	(b)	How can the principles of biological precipitation be applied to enhance phosphorus removal in wastewater treatment plants in India? Provide specific examples of biological processes and their effectiveness in phosphorus removal.	**04**
	(c)	In the context of wastewater treatment in India, evaluate the effectiveness of simultaneous nitrification and denitrification (SND) compared to separate nitrification and denitrification processes for nitrogen removal. Discuss the environmental and economic implications of implementing SND technology in Indian wastewater treatment plants.	**07**
Q.2	**(a)**	What are the primary membrane filtration processes used in wastewater treatment plants in India? Briefly explain the operation of each process.	**03**
	(b)	How can membrane bioreactors (MBRs) be applied to improve the efficiency of wastewater treatment in urban areas of India? Provide specific examples of MBR applications and their impact on water quality and public health.	**04**
	(c)	Compare and analyze the effectiveness of membrane bioreactors (MBRs) and electrochemical wastewater treatment processes in addressing water pollution challenges in India. Consider factors such as treatment efficiency, energy consumption, operational costs, and applicability to different types of wastewater.	**07**
		OR	
	(c)	Analyze the potential environmental and economic benefits of implementing membrane filtration technology in wastewater treatment plants across India. Consider factors such as water reuse opportunities, energy consumption, operational costs, and the impact on water quality in receiving bodies.	**07**
Q.3	**(a)**	What is the working principle of electro-coagulation in wastewater treatment?	**03**
	(b)	How can membrane fouling be effectively controlled in membrane bioreactors (MBRs) to ensure optimal performance in wastewater treatment plants in India? Provide specific examples of membrane fouling control techniques and their applications.	**04**
	(c)	Analyze the potential applications of electrochemical wastewater treatment processes in addressing water pollution challenges in urban areas of India. Discuss the effectiveness of electro-coagulation, electro-floatation, and electro-oxidation processes, considering factors such as treatment efficiency, energy consumption, operational costs, and environmental impact.	**07**
		OR	
Q.3	**(a)**	What is the working principle of electro-oxidation in wastewater treatment?	**03**
	(b)	What are the primary types of membrane fouling in membrane bioreactors (MBRs), and how can they be controlled to ensure efficient operation of the MBR system? Provide a brief explanation of each type of fouling and its corresponding control measures.	**04**

	(c)	How can advanced oxidation processes (AOPs) be applied to address specific water pollution challenges in India, such as the removal of persistent organic pollutants (POPs) from industrial wastewater? Discuss the principles of AOPs, types of oxidizing agents used, and provide examples of AOP applications in India.	**07**
Q.4	**(a)**	Compare the efficiency of adsorption and ion exchange processes in removing heavy metals from industrial wastewater in India.	**03**
	(b)	How can electrochemical wastewater treatment processes, such as electro-coagulation and electro-oxidation, be applied to address water pollution challenges in industrial areas of India? Provide specific examples of industrial wastewater treatment applications and the effectiveness of electrochemical processes in removing pollutants.	**04**
	(c)	Compare and analyze the effectiveness of electrochemical wastewater treatment processes, such as electro-coagulation, electro-floatation, and electro-oxidation, with advanced oxidation processes (AOPs), including ozone-based and non-ozone-based processes, Fenton and photo-Fenton oxidation, and solar photo-catalytic treatment systems. Consider factors such as treatment efficiency, energy consumption, operational costs, and suitability for different types of wastewater.	**07**
		OR	
Q.4	**(a)**	Compare the efficiency of activated carbon adsorption and ion exchange processes in removing organic chemicals from industrial wastewater in India.	**03**
	(b)	What are the main types of electrochemical wastewater treatment processes, and how do they work? Provide a brief explanation of each process, including its working principle, electrode materials, reaction chemistry, and applications.	**04**
	(c)	Evaluate the potential applications of electrochemical wastewater treatment processes and advanced oxidation processes (AOPs) in specific industrial sectors in India, such as textiles, pharmaceuticals, and chemicals. Consider factors such as treatment efficiency, cost-effectiveness, environmental impact, and regulatory compliance.	**07**
Q.5	**(a)**	Explain the working principle of ion exchange processes in wastewater treatment.	**03**
	(b)	How can the principles of adsorption be applied to effectively remove organic chemicals from industrial wastewater in India? Provide examples of suitable adsorbents and discuss their application in wastewater treatment.	**04**
	(c)	Evaluate the applications of adsorption and ion exchange processes in the removal of heavy metals, nitrogen, phosphorus, and organic chemicals from wastewater in industrial settings in India. Discuss the suitability of different adsorbents and ion exchange resins, regeneration/reactivation methods, and the effectiveness of these processes in meeting regulatory standards.	**07**
		OR	
Q.5	**(a)**	What is the fundamental principle behind adsorption processes in wastewater treatment?	**03**
	(b)	Explain the concept of ion exchange in wastewater treatment. How does ion exchange resin selectively remove contaminants from wastewater?	**04**
	(c)	Evaluate the application of adsorption and ion exchange processes in addressing specific water pollution challenges in the textile industry in India. Discuss the suitability of different adsorbents and ion exchange resins, regeneration/reactivation methods, and the effectiveness of these processes in meeting regulatory standards and promoting environmental sustainability.	**07**

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