# GUJARAT TECHNOLOGICAL UNIVERSITY

**Master of Engineering Syllabus**

**Subject Code: 3726509**

**Subject: ADVANCED WASTE WATER TREATMENT TECHNOLOGIES**

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|---|---|
| WEF Academic Year: | 2023-24 |
| Semester: | II |
| Category of the Course: | Program Elective IV |

| | |
|---|---|
| **Prerequisite:** | Knowledge of physico-chemical and biological treatment of wastewater |
| **Rationale:** | Satisfying the stringent standards for disposal of treated effluents in various sinks and reusing/ recycling of treated effluents for different uses requires that the wastewater be given more exhaustive and advanced treatment. Hence this subject aims to give knowledge to the students regarding advanced wastewater treatment technologies. |

**Course Scheme:**

| Teaching Scheme | | | Total Credits | Assessment Pattern and Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | Practical | | |
| L | T | PR | C | ESE (E) | PA(M) | ESE (V) | PA (I) | |
| 3 | 0 | 2 | 4 | 70 | 30 | 30 | 20 | 150 |

**Course Content:**

| Sr. No. | Course Content | No. of Hours | % of Weightage |
|---|---|---|---|
| 1 | Need of Advanced Wastewater Treatment, Applications of Advanced Wastewater Treatment, Ion Exchange: Fundamentals of Ion Exchange, Types of Ion Exchange Resins for wastewater treatment, Theory of Ion Exchange Applications: Removal and recovery of heavy metals, Removal of nitrogen, Removal of phosphorus, Organic chemical removal | 7 | 15% |
| 2 | Nutrient Removal Nitrogen Removal: Nitrification, Denitrification Simultaneous nitrification and denitrification Phosphorus Removal: Introduction, Phosphorus removal by Chemical, biological methods, Adsorption Introduction, Fundamentals of adsorption, Type of adsorbents Development of adsorption isotherms: Freundlich, Langmuir, BET Activated carbon adsorption, Granular carbon adsorption | 7 | 20% |
| 3 | Membrane Filtration Membrane Process Classification and operation: Microfiltration, Ultra filtration, Nano filtration, Reverse Osmosis, Electro dialysis Membrane Configurations: Plate-and-frame module, Spiral-wound module, Tubular module, Hollow-fiber module Membrane | 7 | 19% |

| | | | |
|---|---|---|---|
| | Fouling: Modes of membrane fouling, Control of membrane fouling Application of membrane processes | | |
| 4 | Membrane Bio Reactor MBR Process Description, Types of Membrane Bioreactors, MBR System Features, Membrane Module Design Considerations, Process Applications: Industrial Waste water Treatment, Municipal Wastewater | 7 | 14% |
| 5 | Electrochemical Wastewater Treatment Processes: Introduction, Electro-coagulation: Factors affecting Electro coagulation, Electrode materials, Reactor configurations; Advanced Electro-floatation process: Electro-floatation: Factors affecting electro floatation Comparison with other technology, Reactor configurations; Electro-oxidation: Electro oxidation process, Reactor configurations | 7 | 19% |
| 6 | Advanced Oxidation Processes: Theory of advanced oxidation, Types of oxidizing agents, ozone based and non-ozone-based processes, Fenton and photo-Fenton Oxidation, Solar Photo Catalytic Treatment Systems | 7 | 14% |
| | **Total** | **42** | **100** |

**Reference Book:**

1. Waste water engineering: Treatment and Disposal by Metcalf & Eddy.
2. Environmental Engineering- Peavy, Rowe & Tclobaloglous.
3. Membrane Systems for Wastewater Treatment –Water Environment Federation.
4. Membrane Separation Processes by Kaushik Nath.

**Course Outcome:**

After Completion of the Course, Student will able to:

| No | Course Outcomes | RBT Level* |
|---|---|---|
| 01 | To undertake advanced-technical analysis for the selection of suitable water and wastewater treatment technologies. | AP |
| 02 | To create a requirement analysis, system design and detailed design for an advanced water and wastewater treatment system which addresses practical water treatment process problems. | AN |
| 03 | To select appropriate processes for target pollutants including emerging pollutants to meet specified water quality requirements based on the Indian standards. | AP |
| 04 | To apply principles of advanced treatment processes for water purification and wastewater treatment. | AP |

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

**Suggested Course Practical List:**

1. Numerical based on Adsorption isotherms
2. Assignment on membrane process
3. Assignment on Ion Exchange process.
4. Assignment on Advanced Oxidation Process.
5. Assignment on Advanced Wastewater Treatment for removal of Nitrogen & Phosphorus.
6. Assignment on Membrane Bioreactor.
7. Assignment of Electrochemical treatment of Wastewater

**Learning Resources Required:**

1. https://nptel.ac.in/

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