

Course Type	Course Code	Name of the Course	L	T	P	Credits
DE	NESD509	Advanced Water and Wastewater Treatment	3	0	0	3

#### Course Objectives

- To describe methods of advanced effluent treatment for higher discharge standards and effluent re-use.

#### Learning Outcomes

Upon successful completion of this course, students will be able to:

- Understand the role of each unit process within typical treatment process trains, their interaction and the context of when they are applied.
- Appreciate the advantages, disadvantages and limitations of the technologies and new developments.

Unit No.	Topics to be covered	Lecture Hours	Learning outcomes
1.	Biological nutrient removal: Nitrogen removal- nitrification, denitrification, processes for biological nitrogen removal, Anammox process; Phosphorous removal- Enhanced Biological Phosphorus Removal, application of phostrip, Bardenpho and phoredox process; Combined N and P removal by A2/O, bardenpho, UCT and VIP process; Gas stripping: Design of stripping towers.	10	Students will have a theoretical understanding of various biological nutrient removal processes.
2.	Membrane Filtration: Membrane process terminology & classification, Materials, membrane configurations, membrane operation, Reverse osmosis, ultrafiltration, microfiltration, nanofiltration, Electrodialysis.	9	Students will understand the basics of membrane filtration techniques.
3.	Adsorption: Types of adsorbents, fundamentals of adsorption, sorption isotherm models and rate considerations, Design of granular and powdered activated carbon contactor;	5	Students will have an understanding of the advanced treatment processes such as Adsorption for water and wastewater treatment.
4.	Ion Exchange: Fundamentals of ion exchange, types of ion exchange resins, application of ion exchange, operational considerations;	5	Students will have an understanding of ion exchange process for water and wastewater treatment.
5.	Advanced Oxidation Process: Theory of advanced oxidation, technologies used to produce hydroxyl radicals, applications.	4	Students will have an understanding of the advanced oxidation process for water and wastewater treatment.
6.	Sludge handling and disposal: Thickening, stabilization, conditioning, dewatering, heat drying and thermal reduction, Design of aerobic and anaerobic sludge digesters, land application of sludge and design consideration.	9	Students will get the knowledge of advanced sludge handling and disposal techniques.
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#### Text Books:

- Wastewater Engineering: Treatment and Reuse - Metcalf & Eddy, McGraw Hill Education; 4th edition (2017).

#### Reference books:

- Wastewater Treatment for Pollution Control and reuse- SJ Arceivala, McGraw Hill Education; 3rd edition (2017)