Course title: Water Quality Management			
Course code: NRE 142	**No. of credits:** 3	**L-T-P:** 34-8-0	**Learning hours:** 42
Pre-requisite course code and title (if any): NRE 131 Environmental Chemistry and Microbiology, NRE 137 Environmental Monitoring laboratory			
Department: Energy and Environment			
Course coordinator:		**Course instructor:** Dr Akash Sondhi	
Contact details: akash.sondhi@terisas.ac.in			
Course type: Core		**Course offered in:** Semester 2	

Course Description

The purpose of the course is to develop understanding of water quality criteria, standards, impacts of water pollutants and treatment methods. It focuses on cause and effects of water pollution and water quality degradation from range of sources. Further, it illustrates each unit processes, functions of the processes in water or wastewater treatment and basic equipment that each process uses. The course is formatted in four parts: Part I covers the basics of water pollutants, their impacts, quality criteria and standards; Part II covers the basics of water treatment for public water supply; Part III covers the basics of wastewater treatment for municipal sewage; and Part IV covers the contemporary issues in water resource management and pollution control strategies.

Course objectives

1. To understand water quality criteria, and standards
2. To comprehend knowledge about sources, cause and impacts of water pollutants
3. To be abreast with physical, chemical and biological methods water treatment

Course content

Module	Topic	L	T	P
1.	**Introduction** The purpose of this module is to present an overview on: water quality and health linkage; impurities (pollutants and contaminants) in water, their significance and estimation techniques; water borne diseases; standards of potable water. Impact of water pollutants on environment; self-purification of waste in streams; zones of purification; eutrophication; disposal standards and philosophy of MINAS**.** Lakes systems: thermal stratification, dissolved oxygen. The module addresses 1. Water Quality as a core thread 2. Water quality and health 3. Potable water quality criteria: desirable vs rejection 4. Wastewater discharge standards. Impairment of natural water bodies.	4		
2.	**Water treatment** The objective of this module is to introduce Aeration and types of aerators; purpose and mechanism of flocculation; coagulants used in water treatment; factors influencing coagulation; estimation of coagulant dose; types of flash mixers and flocculators; sedimentation; analysis of discrete and flocculent settling; sedimentation tanks; Filtration: types and design of filters, factors effecting efficiency of filtration; operational issues in filtration; Disinfection: chemical and non-chemical methods;; chick's law; Tertiary treatment methods for removal of colour, salinity, hardness, fluorides, Arsenic, iron and manganese, Treatment process including Adsorption, Reverse Osmosis; Electro-dialysis; Ion-exchange; Chemical; and Distillation techniques will be discussed. The central idea of this module is be up-to-date with 1. Unit process and unit operation in a typical water treatment system 2. Conventional and advanced treatment methods	14	4	

	3. Discuss key methods to forecast population growth, estimate per capita water demand, variation in water demand			
3.	**Wastewater treatment** The scope of this module is to get acquainted with wastewater treatment: Physical treatment methods-screen chamber; grit separators; primary and secondary settling tanks. Biological treatment: Biology of sewage treatment; BOD growth curve and analysis; estimation of BOD rate constant; types of biological treatment processes; process description and design principals; removal of nitrogen and phosphorus. Sludge stabilization and dewatering systems; Low cost sewage treatment technologies-septic tanks; reed bed; oxidation ponds and lagoons. This central theme of this module is 1. To discuss key concepts to estimate quality and quantity of wastewater generation 2. Gather insights in the complexity of wastewater treatment 3. Importance of wastewater treatment from the point of view of receiving water quality.	12	4	
4.	**Water resources and quality management in India** This module connects various issues and themes discussed and leads to Water availability; water stress index; status and trend of surface and groundwater; issues and policy interventions; pollution of rivers, lakes and ground water; GAP and National River Action Programme; role of national and international agencies in water health and sanitation.	4		
	Total	**34**	**8**	

Evaluation criteria

- Test 1 20%
  Written test with conceptual, applied, graphical and scenario-based questions. Syllabus Module 1 and Part of Module 2
- Test 2 20%
  Written test with conceptual, applied and scenario-based questions. Syllabus Part of Module 2 and Module 3
- Test 3 50%
  Written test with conceptual, applied and scenario-based questions. Syllabus Part of Module 2, Module 3 and Module 4
- Assignments: 10%
  Think pair assignment on contemporary topics in the scope of the course.

Learning outcomes

By the end of the course, students will:

1. Gain insight into key concepts of water quality, water quality and health, impairment of natural water bodies. (Test 1)
2. Comprehend components of water treatment and schemes based on source of water, select suitable unit process and unit operation at conceptual, theoretical, methodical level. [Test 2]
3. Comprehend components of wastewater treatment and schemes based on input water quality and desired water quality. [Test 3]
4. Develop an integrated perspective on water resource and water quality management [Test 3]

Pedagogical approach

Materials

Required text

1. Gilbert M. Masters and Wendell P. Ela (2017) Introduction to Environment Engineering and Science.

3rd ed. Pearson,
2. Garg S.K. (2007) *Sewage Disposal and Air Pollution Engineering*, 20th ed, Vol. II, New Delhi, Khanna Publisher.
3. Garg S.K. (2007) *Water Supply Engineering*, 18th ed, Vol.I, New Delhi, Khanna Publisher.

Suggested readings

1. Birde G.S. and Birde J.S. (2004) *Water Supply and Sanitary Engineering*, 7th ed., New Delhi, Dhanpat Rai Publishing.
2. Chatterjee A.K. (2010) *Water Supply, Waste Disposal and Environmental Engineering*, 8th ed., New Delhi, Khanna Publisher.
3. Eckenfelder W.Jr. (1999) *Industrial Water Pollution Control*, 3rd ed., New York, McGraw-Hill.
4. Metcalf and Eddy (2003) *Wastewater Engineering: Treatment and Reuse*, 4th ed., New Delhi, Tata McGraw-Hill.
5. Nathanson J.A. (2009) *Basic Environmental Technology: Water Supply, Waste Management and Pollution Control*, 4th ed., New Delhi, PHI Learning.

Journals

1. American Society of Civil Engineering, Environmental Engineering.
2. Indian Water Works Association
3. Water Research
4. Water Science and Technology
5. Environment Pollution
6. Chemosphere

Advanced Reading Material (Must Read/Watch)

1. Joan Rose: Water is Life but Water Quality is Helath http://www.iwa-network.org/news/water-is-life-but-water-quality-is-health/
2. Video Presentation: Sedlak David, Healthy Tasty or Toxic: A Chemists view of Drinking Water
3. Animation Movie : Rango 2011
4. Documentary: Parched NAT GEO
5. Iran Water Crisis: https://www.aljazeera.com/programmes/peopleandpower/2016/11/iran-water-crisis-161109114752047.html
6. Victor Mallet (2018) River of Life and River of Death

Additional information (if any)

Student responsibilities

The students are expected to attend all classes, participate in discussion and submit assignments in time and come prepared with readings.

Course reviewers