Course title: Water and Wastewater Treatment Processes and Design			
Course code: NRE 174	**No. of credits:** 4	**L-T-P:** 42-14-0	**Learning hours:** 56
Pre-requisite course code and title (if any): NRE 142 Water Quality management (with atleast `B' grade)			
Department: Energy and Environment			
Course coordinator:		**Course instructor:** Dr Akash Sondhi	
Contact details: akash.sondhi@terisas.ac.in			
Course type: Elective		**Course offered in:** Semester 3	

Course Description

The course is meant for M.Sc. opting for a specialized course in water treatment technologies. The course will elucidate the latest developments made in treatment technologies and their application in diverse pollution sources including industries. The course is broadly divided into three parts. In the first part, fundamentals of fluid mechanics are discussed which is vital for understanding the motion of water, calculation of head losses, hydraulic profile diagram and design of pumping systems. Design of treatment technology for criteria pollutants are explained in the second part. The current and suggested methods of industrial waste treatment are dealt in the third part. The course highlights negative effects of wastes disposed off into the environment, suitable methods for treating these wastes under Indian conditions and methods for waste reduction, recycling and reuse. Selected case studies are chosen to reinforce key concepts and issues. The course concludes with a brief discussion on pollution issues in small-scale industries and industrial estate planning.

Course objectives

1. Elucidate the latest developments in treatment technologies and their application in diverse pollution sources including industries
2. To provide fundamentals of fluid mechanics and understanding of motion of water
3. Design of treatment plants for various industries.

Course content

Module	Topic	L	T	P
1.	**Fluid mechanics and hydraulics** Water pressure; pressure-velocity-head relationships; energy and momentum equations; flow in pipes; equivalent pipe; open channel flow; flow measurement in pipes and open channel; centrifugal pump characteristics; system characteristics; head loss constants in open channels and pressure pipes; plant layout and hydraulic profile.	12	6	
2.	Design principles of physico-chemical treatment units *Aeration*-theory of gas transfer; design of cascade and spray aerators. *Coagulation and flocculation*-Design criteria and principles of hydraulic and mechanical flash mixers and flocculators; design of clari-flocculator; concept of tapered velocity gradient and sludge blanket clarifier. *Sedimentation*-Analysis of discrete and flocculent particle settling, concept and design of high rate sedimentation techniques; design of tube settlers. *Filtration*- Design of filter media for slow and rapid sand filters;	12	6	

	backwash and sand bed expansion; hydraulic of filtration. Specific treatment methods-Design of equalization and neutralization tank; removal of oil and grease.			
3.	Design principals of biological treatment ***Aerobic process***-kinetics of biological growth; Design of activated sludge process and its modifications; oxygen transfer and design of aerators. *Anaerobic treatment*-High rate anaerobic treatment processes; sludge stabilization and design of anaerobic digesters.	6	2	
4.	Industrial wastewater treatment processes ***Introduction***-magnitude of industrial pollution, their characteristics and impacts; selection procedure for physical, chemical and biological methods of industrial wastewater treatment **Case studies**-Manufacturing process description; pollution sources, waste reduction and treatment methods for industries-pulp and paper, sugar, distillery, tannery, dairy, textile. Planning-Small-scale industries and pollution issues, concept of CETPs, planning of industrial estate, concept of zero discharge	12		
	Total	**42**	**14**	

Evaluation criteria

- Test 1 & 2: 40%
- Assignment: 10%
- Test 3: 50%

Learning outcomes

- On completion of the course, students should be able to design treatment processes for various criteria pollutants, be able to decide suitable methods for treating these wastes under Indian conditions and methods for waste reduction, recycling and reuse of industrial wastewater.

Pedagogical approach

Materials

Required text

1. Birde G.S. and Birde J.S. (2004) *Water Supply and Sanitary Engineering*, 7th ed., New Delhi,DhanpatRai 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.

Suggested readings

1. CPCB Publications (COINDS series for case studies).
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.
4. McGhee T.J. and Steel E.W. (1991) *Water Supply and Sewerage,* New York, McGraw-Hill.
5. Metcalf and Eddy (2003) *Wastewater Engineering: Treatment and Reuse,* 4th ed. New

Delhi, Tata McGraw-Hill.
6. Nathanson J.A. (2009) *Basic Environmental Technology: Water Supply, Waste Management and Pollution Control,* 4th ed., New Delhi, PHI Learning.
7. Qasim S.R., Motley E.M. and Zhu G. (2000)*Water Works Engineering: Planning, Design and Operation,* New Jersey, Prentice Hall.

Journals

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

Additional information (if any)

Student responsibilities

Attendance, feedback, discipline, guest faculty etc