

Course no.: ENR 141
 Course title: **Waste utilization**
 Core or Elective: Elective
 Number of credits: 3
 Number of lectures-tutorials-practicals: 24-18-0
 Course coordinator: Dr. A K Saxena

Course outline:

This elective course introduces the various concepts of waste minimization in domestic, municipal, industrial and agricultural sectors. Characterization and classification of different types of wastes will be discussed along with existing norms for waste disposal. Different technologies available for waste-to-energy and waste utilization will be discussed along with economics of different methods. Several case studies for waste minimization and waste utilization will be presented.

Evaluation procedure:

- Assignments: 30%
- Minor project: 40%
- Major test: 30%

Details of course content and allotted time

S. No.	Topic	Allotted time (hrs)		
		L	T	P
1	Introduction to waste production in different sectors such as domestic, industrial and agriculture sectors. Three general methods of attaining zero pollution. Economics of zero pollution.	4		
2	Waste minimization by reuse and recovery. Waste minimization by recovery and external sale of products	4	6	
3	Different types of waste (organic, inorganic, hazardous, etc.). Characterization of different wastes. Introduction to concept of waste as resources. Classification of waste as fuel – agrobased, forest residues, industrial organic waste, municipal solid waste. Existing government norms for waste disposal.	4		
4	Technologies for utilization of organic wastes and waste-to-energy options: anaerobic digestion, composting, vermin-culture, briquetting/pelletization, pyrolysis, combustion, gasification, bio-refineries. Landfills: gas generation and collection in landfills; devices for conversion of fuels to useful energy applications- engine, compressors, burners, lamps etc.	4	6	
5	Case studies of waste utilization in different industrial sectors: Manufacturing process, pollution sources, waste characterization, waste reduction/recovery/reuse and final treatment methods for- pulp and paper, sugar, distillery, tannery, dairy, textile.	8	6	
	Total	24	18	

Suggested readings

1. Nelson L. Nemerow, 1995. Zero Pollution for Industry: Waste minimization through industrial complexes. John Wiley & Sons, New York
 2. CPCB publications (COINDS series for case studies)
 3. WW Eckenfelder (1990), Industrial pollution control: Mc Graw Hill Int. Ed.
 4. Other suitable reference papers and books will be suggested in class.
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Reviewers

1. Dr. A K Nema, IIT, Delhi
2. Dr. A K Mittal, IIT, Delhi