GUJARAT TECHNOLOGICAL UNIVERSITY

ENVIRONMENTAL SCIENCE AND TECHNOLOGY (35)
SOLID & HAZARDOUS WASTES - CHARACTERIZATION & TREATMENT
SUBJECT CODE: 2163505
B.E. 6th SEMESTER

Type of course: Environmental Science & Technology

Prerequisite: An introductory knowledge of solid and hazardous waste along with some basic understanding of solid waste management at industries

Rationale: This subject is intended to make students aware about various kind of solid wastes and their general characteristics along with different technologies for treatment of these wastes. Existing legislation for municipal waste, e-waste & hazardous waste and design criteria for hazardous waste and municipal waste landfill is also an integral part of this course.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	3	7	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs.	% Weightage
1	**Introduction and characterization of solid waste and hazardous waste:** Municipal waste, Plastic waste, Biomedical waste, e waste, dairy wastes, agricultural wastes, slaughter house wastes, industrial waste and hazardous waste.	10	25
2	**Legislation for management of solid waste:** Municipal Solid Waste Management Rules, 2000. e-waste management and handling rules, 2011. Major sections of Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008.	10	25
3	**Solid waste management/treatment:** Sustainable waste management practices, 4R principle for waste management. Physico-chemical and Biological methods (aerobic composting and anaerobic digestion) of treating solid wastes. Thermo-chemical methods (Pyrolysis, gasification and incineration) of treating solid wastes. Energy recovery through Refuse derived fuel. Solid waste management in industries. E-waste processing and disposal.	12	25
4	**Solid and hazardous waste disposal:** Guidelines and Landfill procedure for disposing hazardous waste. Location and Site selection criteria for hazardous waste landfill. Site investigation, planning and design of hazardous waste landfill. Waste acceptance criteria at hazardous waste landfill. Liner and cover criteria for hazardous waste landfill. Sanitary landfills for municipal waste. Other methods of disposing solid waste.	12	25

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
27	**26**	**21**	**13**	**13**	**00**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Industrial Water Pollution Control, Eckenfelder W.W.; McGraw Hill Book Company 3rd Ed, 2000.
2. Environmental Engineering, Kiely G.McGraw Hill Book Company, 1998.
3. Environmental Pollution Control and Engineering, Rao C.S.,New Age International (P) Limited, 1991.
4. Treatment of Industrial Wastes, Besselviere, E and Schwartz. McGraw Hill. 1975.
5. Handbook of Solid Waste Management and Waste Minimization Technologies, N P Cheremisinoff, Butterworth-Heinemann, 2003.
6. Integrated Solid waste Management, F Dougal and P White, John Wiley and Sons, 2001.
7. Solid waste Engineering, Worrell and Vesilind, Cengage Learning, 2nd Ed., 2001.

Course Outcome:

After learning this course the students would have:

1. Proper understanding about various kind of solid wastes and their general characteristics.
2. Awareness about existing legislation for municipal waste, e-waste and hazardous waste in India.
3. Sound knowledge of different technologies available for treatment of various solid wastes.
4. Awareness about design criteria for hazardous waste landfill

List of Experiments:

1. To determine the pH of a given sample of hazardous waste by universal indicator method and pH meter method.
2. To carry out Paint Filter Liquid Test (PFLT) for a given sample of hazardous waste to check the availability free moisture.
3. To determine the Calorific value of a given solid waste using Bomb Calorimeter.
4. To determine the total chloride in given sample of solid waste using Bomb Calorimeter.
5. To determine the total sulfur content in given sample of solid waste using Bomb Calorimeter.
6. To determine the moisture content in given solid waste sample.
7. To Determine Loss on ignition (% organic matter) of given sample of solid waste.
8. To determine heavy metals (Ni, Pb and Cu) in given sample of hazardous waste through TCLP.

Design based Problems (DP)/Open Ended Problem:

1. Understanding of comprehensive and fingerprint analysis.
2. Understanding of various treatment methods for solid waste.
3. Design of hazardous waste landfill.

Major Equipment:

- pH meter.
- Hot Air Oven.
- Muffle Furnace.
- Bomb calorimeter

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.