GUJARAT TECHNOLOGICAL UNIVERSITY

Minor Degree: Waste Technology
Subject Code: 114AB01
Semester-IV
Subject Name: Hazardous Waste Management Technology

Type of course: Minor Degree Course

Prerequisite: A good understanding regarding the hazardous waste, its sources and classification is required.

Rationale: The main objective of this subject is to study the technologies related to the management of hazardous waste. Also, Engineers and professionals working in waste management area could be benefited by 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)	
3	0	2	4	70	0	30	0	100

Content:

Sr. No.	Content	Total Hrs	%Weightage
1	**Sources of Hazardous Waste:** Hazardous waste, waste classification, sources, hazardous waste-toxicology and hazardous waste sources / generators. Need for hazardous waste management - elements of integrated hazardous waste management and roles of stakeholders and NGOs - salient features of Indian legislations on management.	**11**	**25**
2	**Characterization of Hazardous Waste:** Hazardous waste generation rates and variation - Composition, physical, chemical and biological properties of hazardous waste, waste sampling and characterization plan - Source reduction of waste - Recycling and reuse. Labelling and handling of hazardous waste. Transportation of Hazardous Waste- Modes and scope of hazardous waste transportation.	**12**	**27**
3	**Processing of Hazardous Waste:** Objectives of waste processing - material separation and processing technologies - evaluation of Hospital waste, Treatment, Healthcare waste generation, Segregation and collection, Industrial waste and its treatment.	**10**	**21**
4	**Disposal of Hazardous Waste:** Waste disposal options - Disposal in landfills - Landfill Classification- Construction and operation of secured landfills- Ocean dumping, Land disposal, Soil remediation. Hazardous waste management, Regulation and Disposal Methods, Waste Minimization.	**12**	**27**

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Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**20**	**20**	**10**	**10**	**0**

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

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference books:

1. John Pichtel, Waste Management Practices CRC Press, Taylor and Francis Group 2005.
2. LaGrega, M.D. Buckingham, P.L. and Evans, J.C. Hazardous Waste Management, McGraw Hill International Editions, New York, 1994.
3. Richard J. Watts, Hazardous Wastes - Sources, Pathways, Receptors John Wiley and Sons, New York, 1997.
4. Ramachandra T.V., Management of Municipal Solid Waste, Commonwealth Of Learning, Canada and Indian Institute of Science, Bangalore, 2006.
5. Shah K. L., Basics of Solid and Hazardous Waste Mgmt. Tech. by, Prentice Hall, 1999.
6. Bhatia S.C., Solid and Hazardous Waste Management, Atlantic Publishers & Dist. 2007.

Course Outcomes:

Sr. No.	CO Statement	Marks % Weightage
CO-1	Understanding the sources of hazardous waste, its management and related Indian legislations.	25
CO-2	Application of different methods for hazardous waste characterization and its transportation.	27
CO-3	Evaluation of proper method for transportation, handling and processing of hazardous waste.	21
CO-4	Understanding the appropriate method for the disposal of hazardous waste.	27

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List of Experiments: (Minimum 6 experiments need to be performed)

1. To carry out the characterization of hazardous waste.
2. To determine the color intensity of dye contaminated water by using spectrophotometer.
3. To study the adsorption of dye from aqueous solution on any adsorbent
4. To determine the electrical conductivity of hazardous waste water.
5. Determination of total solids, volatile solids and fixed solids of waste.
6. To study about the regulations, methods for the disposal of hazardous waste.
7. To study about legislations on management and handling of hazardous waste.
8. To prepare material safety data sheet for hazardous waste.

Major Equipments:

C.O.D. digester, Flame photometer, Kjeldal assembly, Autoclave, B.O.D. incubator, Double beam spectrophotometer, Micro balance, Conductivity meter, etc.

List of Open Source Software/learning website:

Reference to NPTEL lectures can be made for a better understanding regarding municipal solid waste management, solid and hazardous waste management and integrated waste management for smart city done in industries under different conditions.