GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering
Level: UG
Branch: Environmental Engineering
Subject Code: BE04013031
Subject Name: Municipal and Hazardous Solid Waste Management

w. e. f. Academic Year:	2024-25
Semester:	4
Category of the Course:	Professional Core Course

Prerequisite:	Basics of Environmental Science
Rationale:	To understand key issues and its technical solutions pertaining to municipal and industrial solid waste management is necessary for practicing environmental engineers

Course Outcomes:

Sr. No.	CO statement	Marks% weightage
CO-1	Recognize the need for integrated solid waste management and onsite processing of solid waste.	20
CO-2	Evaluate collection and transportation systems of municipal solid waste.	10
CO-3	Analyze processing techniques to recover resources, conversion products and energy from solid waste.	20
CO-4	Describe landfill operations and design for disposal of solid waste.	10
CO-5	Discuss treatment techniques and disposal methods of Hazardous, Biomedical, E-waste and Plastic Waste Management.	40

Teaching and Examination Scheme:

Teaching / Learning Scheme (in Hours per semester)					Total Credits	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	PBL*	Total no of hours per semester		ESE (E)	PA / CA (M)	PA/ CA (I)	PBL (I)	ESE (V)	
45	15	0	60	120	4	70	30	20	30	50	200

- ***Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.***

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, PA = Progressive Assessment, ESE = End-Semester Examination

Content:

Sr. No.	Content	Total Hrs
	[A] Municipal Solid Waste Management	
1	**Introduction to Municipal Solid Waste:** Solid waste terminology, Sources, Characteristics, Composition, Generation rate, Need for integrated solid waste management	**04**
2	**Onsite Handling, Storage and Processing of Solid Waste:** Handling methods, Factors considered for storage, Need for segregation, Onsite processing	**04**
3	**Collection and Transportation of Municipal Solid Waste:** Waste collection, Collection systems and equipment's, Layout of collection routes, means of transport, Need and design requirements of Transfer station	**06**
4	**Processing and Separation of Municipal Solid Waste:** Importance, Storage, Conveying, Compacting, Shredding, roll crushing, Material separation principle, Picking, Screens, Float/Sink separators, Magnetic separators, other devices for processing and material separation, Drying and dewatering. Material recovery & recycling, Recovery of chemical and biological products, Recovery of energy	**08**
5	**Disposal of Solid Waste:** Landfill site selection criteria, Landfilling methods, Landfill processes, Landfill design, Landfill operations, Landfill closure and post-closure care	**04**
	[B] Hazardous Waste Management	
1	**Introduction to Hazardous Solid Waste:** Definition, Classification of Hazardous Solid Waste, Characteristics of Hazardous Waste, Manifest system of Hazardous waste, Hazardous waste Storage and Transportation requirements	**05**
2	**Hazardous Waste Management:** Waste Minimization, Waste Exchange, Zero Waste, Recycling, Physico-Chemical Processes, Thermal Methods, Stabilization, Solidification, Site selection criteria, Landfill operation, Liner and Leachate collection system, Cover System, Water Controls, Closure & Post-closure	**06**
3	**Biomedical Waste Management:** Definition, Sources, Generation, Classification, Storage, Transportation, Treatment techniques, Disposal	**04**
4	**E-Waste & Plastic Waste Management:** Definition, Sources, Generation, Recovery & Recycling technologies, Extended Producer Responsibility (EPR)	**04**
	TOTAL	**45**

Suggested Specification table with Marks (Theory): (For B.E. only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	**20**	**20**	**10**	**00**	**00**

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. Integrated Solid Waste Management by George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, McGraw- Hill, New York, 1993
2. Manual on Municipal Solid waste management by Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000.
3. Hazardous Waste Management: By Michael D. LaGrega, Phillip L. Buckingham, Jefferey C. Evans, McGraw- Hill International Edition
4. Solid Waste Management, Van Nostrand Reinhold Co. 1975.
5. Solid Waste Management by C.L. ell, John Wiley, 1975.
6. Solid waste Management – A Vesilind
7. Hazardous Waste minimization By Harry M Freeman, McGraw Hill publications 8. Hazardous Waste Incineration By Brunners, Calvin R

List of Open-Source Software/learning website:

1. NPTEL - https://nptel.ac.in
2. COURSERA
3. CPHEEO: Manual on Municipal Solid Waste Management- cpheeo.gov.in

List of Tutorials:

1. Numericals based on waste generation.
2. Numericals based on Ultimate analysis of Solid and Hazardous waste.
3. Numericals based on Stationary container and Haul Container System.
4. Technologies for Processing of Solid Waste.
5. Municipal Solid Waste Collection Methods.
6. Municipal Solid Waste Processing and Separation Methods.
7. Municipal Solid Waste Disposal requirements and Environmental concerns.
8. Hazardous waste management Hierarchy.
9. Hazardous waste treatment and Disposal methods.
10. Biomedical Waste Management concept and requirements.
11. E – Waste Management.

List of suggested activities for Problem Based Learning:

Sr. No.	Name of the activity	No. of hours	Evaluation Criteria
1.	Technical Video based learning related to municipal and hazardous waste characterization and Processing of solid and hazardous waste / Landfill operations / Landfill post closure plan / Biomedical waste management / EPR concept	Duration of video: 10 hrs	Multiple choice questions-based Assessment
2.	Numerical related to • Proximate analysis of MSW • Transportation of Municipal solid waste • Storage capacity of MSW containers	Duration: 06 hrs	Based on submission of given tutorials
3.	Prepare a report on onsite waste handling practices in your locality	Duration: 5hrs	Based on submission of Report
4.	Summarize a case study of a Waste-to-Energy plant in India	Report preparation: Duration: 10hrs	Based on submission of report
5.	Google Earth Mapping of Secured Landfill Sites in Gujarat (Refer: GPCB Website)	Duration: 10hrs	Based on submission of map
6	Visit to Landfill site / Waste to energy plant	Visit: 8hrs Report preparation: 4hrs Total: 12hrs	Based on the report submission
7	Poster on Extended Producer Responsibility (EPR) concept / Biomedical waste segregation	Duration: 5hrs	Based on poster/chart preparation
8	Prepare a short summary on the "Various Campaign of Government and non-government organization for Waste Management"	Duration: 5 hrs	Based on Report preparation
9	Survey on MSW: Residential, commercial, and institutional area	Duration: 5hrs (Survey) Report preparation: 5hrs Total: 10 hrs	Based on data collection and its report submission
10	Prepare a layout diagram of a sanitary/secured landfill	Duration: 5hrs	Based on poster/chart preparation