

# **Techno India NJR Institute of Technology**



## **Course File**

### **Solid and Hazardous Waste Management (6CE5-12)**

**Session 22-2023**

Nishit Jain

(Assistant Professor)

**Department of CE**



# RAJASTHAN TECHNICAL UNIVERSITY, KOTA

## Syllabus<sup>3rd</sup> Year - VI Semester: B.Tech. (Civil Engineering) 6CE5-12: SOLID AND HAZARDOUS WASTE MANAGEMENT

Credit: 2  
2L+0T+0P

Max. Marks: 100(IA:30, ETE:70)  
End Term Exam: 3 Hours

SN	CONTENTS	Hours
1	<b>Introduction:</b> Objective, scope and outcome of the course.	1
2	<b>Introduction to SWM:</b> Definition of waste and solid waste, classification solid waste, sources of solid waste, its composition, factors affecting waste generation, traditional methods of waste collection and disposal	4
3	<b>Waste Collection:</b> Components of waste collection, waste collection containers, their characteristics, types, waste collection vehicles, collection frequency, collection route, transfer stations	4
4	<b>Solid Waste Characterization:</b> Physical characteristics, chemical characteristics and biological characteristics of solid wastes <b>Waste Processing:</b> Size reduction, factors affecting size reduction, size reducing equipment, volume reduction, equipment for volume reduction, waste minimization, waste hierarchy, 3 R principle	5
5	<b>Hazardous Waste:</b> Definition, sources, classification, collection, segregation, treatment and disposal methods <b>Radioactive Waste, E-Waste, Biomedical Waste:</b> Definition, sources, classification, segregation, management and disposal methods	6
6	<b>Treatment and Disposal of Solid Waste:</b> Composting, vermicomposting, biogas production, thermal treatment, incineration, pyrolysis, gasification, biological treatment, Sanitary land filling, land fill leachate and gas management <b>Latest Advances and Rules</b> related to SWM, Hazardous Waste, Plastic Waste and E-Waste Management	5 3
	<b>TOTAL</b>	<b>28</b>

Office of Dean Academic Affairs  
Rajasthan Technical University, Kota

## Course Overview:

Student will learn basics of SWM from this 30 hours course. They will be able to reducing and Eliminating adverse impacts of waste materials on human health and the environment to support Economic development and superior quality of life. Municipal solid waste generation in large Quantities on daily basis constitutes serious environmental problems. The need to encourage the Increasing recycling of municipal solid waste to facilitate a global sustainable environment as well as boosting the circular economy and green cities is recommended.

This is to be done in the most efficient manner possible, to keep costs low and prevent waste build-up. Proper solid-waste collection is important for the protection of public health, safety, and environmental quality. It is a labor-intensive activity, accounting for approximately three-quarters of the total cost of solid-waste management

## Course Outcomes:

CO. NO.	Cognitive Level	Course Outcome
1	Application	To list the solid waste management and disposal techniques.
2	Synthesis	To define the waste management rules to generators of solid waste And its generation rate.
3	Application	To state what biomedical waste management and hazardous solid Waste management are.
4	Synthesis	To understand the environment and health impacts of solid waste Mismanagement.
5	Application	Understand the engineering, financial and technical options for waste Management.

## Prerequisites:

1. To know about the solid waste management and disposal techniques.
2. To know the waste management rules to generators of solid waste and its generation rate.
3. To know about the biomedical waste management and hazardous solid waste.
4. Outline the design, operation, and maintenance of different methods of treat.
5. Explain the operation, and maintenance of sanitary landfill

## Course Outcome Mapping with Program Outcome:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO366.1	3	1	2	1	1	2	2	1	1	1	1	1	1	2	3
CO366.2	3	2	2	1	1	1	1	1	1	1	1	2	1	2	2
CO366.3	3	1	2	1	1	2	2	1	1	1	1	1	1	2	3
CO366.4	1	2	2	1	1	2	2	1	2	2	2	2	2	2	1
CO366.5	1	1	2	2	1	2	1	1	2	2	2	2	2	2	1
CO366 (AVG)	2.2	1.4	2	1.2	1	1.8	1.6	1	1.4	1.4	1.4	1.6	1.4	2	2

## Course Coverage Module Wise:

Lecture No.	Unit	Topic
	1	<b>INTRODUCTION:</b> Objective, scope and outcome of the course
2	2	<b>INTRODUCTION TO SWM:</b> Definition of waste and solid waste, classificationsolid waste.
3	2	Sources of solid waste, its composition.
4	2	Factors affecting waste generation
5	2	Traditional methods of waste collection and disposal
6	3	<b>WASTE COLLECTION:</b> Components of waste collection.
7	3	Waste collection containers, their characteristics, types.
8	3	Waste collection vehicles, collection frequency, collection route, transfer stations
9	3	Waste collection vehicles, collection frequency, collection route, transfer stations
10	4	<b>SOLID WASTE CHARACTERIZATION:</b> Physical characteristics.
11	4	Solid Waste Characterization: Chemical characteristics.
12	4	Solid Waste Characterization: Biological characteristics.
13	4	Waste Processing: Size reduction, factors affecting size reduction
14	4	Size reducing equipment, volume reduction, equipment for volume reduction, waste minimization, waste hierarchy, 3 R principle
15	5	<b>HAZARDOUS WASTE:</b> Definition, sources, classification, collection, segregation, treatment and disposal methods
16	5	Classification, collection, Segregation, treatment and disposal methods
17	5	Segregation, treatment and disposal methods
18	5	Radioactive Waste, E-Waste, Biomedical Waste: Definition, sources
19	5	Classification, segregation
20	5	Management and disposal Methods

21	6	<b>TREATMENT AND DISPOSAL OF SOLID WASTE:</b> Composting, vermicomposting.
22	6	Composting, vermicomposting.
23	6	Biogas production, thermal treatment, incineration, pyrolysis, gasification.
24	6	Biological treatment, Sanitary land filling
25	6	Land fill leachate and gas management
26	6	Latest Advances and Rules related to SWM, Hazardous Waste, Plastic Waste and E- Waste Management
27	6	(Contd.) Latest Advances and Rules related to SWM
28	6	(Contd.) Latest Advances and Rules related to SWM
29		Revision of course work
30		Revision of course work

### **TEXT/REFERENCE BOOKS**

1. Tchobanoglous G, Theisen H and Vigil SA 'Integrated Solid Waste Management, Engineering Principles and Management Issues' McGraw- Hill, 1993.
2. Vesilind PA, Worrell W and Reinhart D, 'Solid Waste Engineering' Brooks/Cole Thomson Learning Inc., 2002.
3. Peavy, H.S, Rowe, D.R., and G. Tchobanoglous, 'Environmental Engineering'.

### Course Level Problems (Test Items):

CO.NO.	Problem description
1	1) it's about Solid waste Management Write about Classification of Solid waste Write about Composition of Solid Waste 2) Write a short note on Factor Affecting of Solid waste Generation 3) Write about different types of Traditional method of Collection and Disposal of SolidWaste
2	1) Write a note on Components of Waste Collection Explain in detail about Waste Collection Centenary Write a note on Waste Collection Vehicle 2) Explain in detail Process of Waste collection Explain in detail about Collection Routs
3	1) Explain in detail about Physical Characteristics of solid waste 2) Write a note on Chemical and biological Characteristics of solid waste How can we Size Reduce of Solid waste 3) Explain in detail about Volume Reduction Equipment Write a note on Waste minimization
4	1) What is E waste and biomedical waste? Explain in Detail Sanitary land Filling Explain in detail about Vermi composting Write about Biogas production 2) Write a note on Radioactive Waste in detail

### Assessment Methodology

1. Assignments one from each unit.
2. Midterm subjective paper where they have to write on the subject (Twice during the semester)
3. Final paper at the end of the semester subjective.

## **Teaching and Learning resources unit-wise:**

### **Unit-1**

#### **Introduction to SWM**

Video Tutorials: <https://www.youtube.com/watch?v=k0ktJRoRcOA>

Theory concepts: [http://www.uap-bd.edu/ce/nehreen/Lecture%201\\_431.pdf](http://www.uap-bd.edu/ce/nehreen/Lecture%201_431.pdf)

Sample Quiz: <https://quizizz.com/admin/quiz/5c4f0285accae2001aed8bbf/solid-waste>

### **Unit-2**

#### **Waste Collection**

Video Tutorials: <https://www.youtube.com/watch?v=CME8ym5WbcY>

Theory concepts: [http://homepages.hs-bremen.de/~office-ikrw/invent/e-learning\\_Dateien/Handbook\\_chapters/chapter\\_4.pdf](http://homepages.hs-bremen.de/~office-ikrw/invent/e-learning_Dateien/Handbook_chapters/chapter_4.pdf)

Sample Quiz: <https://quizizz.com/admin/quiz/5c9d1f18d9c4cc001b6cf1bc/waste-management>

## **Unit-3**

### **Solid Waste Characterization**

Video Tutorials: <https://www.youtube.com/watch?v=at5NuSbLiW8>

Theory concepts: [https://www.jica.go.jp/jica-ri/IFIC\\_and\\_JBICI-Studies/english/publications/reports/study/topical/waste/pdf/waste\\_02.pdf](https://www.jica.go.jp/jica-ri/IFIC_and_JBICI-Studies/english/publications/reports/study/topical/waste/pdf/waste_02.pdf)

Sample Quiz: <https://quizizz.com/admin/quiz/5c9d1f18d9c4cc001b6cf1bc/waste-management>

## **Unit4**

### **Hazardous waste**

Video Tutorials: <https://www.youtube.com/watch?v=e2NCMulhMN0>

Theory concepts:  
<https://www.bbau.ac.in/Docs/FoundationCourse/TM/Lecture%209%20Hazardous%20waste.pdf>

Sample Quiz: <https://study.com/academy/exam/topic/solid-and-hazardous-waste.html>

## **Unit-5**

### **Treatment and Disposal**

Video Tutorials: <https://www.youtube.com/watch?v=cNiy1kR-W74>

Theory concepts:  
[https://www.researchgate.net/publication/344519543\\_Solid\\_Waste\\_Treatment\\_Technologies\\_and\\_Environmental\\_Sustainability](https://www.researchgate.net/publication/344519543_Solid_Waste_Treatment_Technologies_and_Environmental_Sustainability)

Sample Quiz: <https://testbook.com/objective-questions/mcq-on-solid-waste-management--5eea6a0839140f30f369d6e9>



**TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY, UDAIPUR**  
**B. TECH III YEAR (VI SEM.)**  
**SOLID & HAZARDOUS WASTE MANAGEMENT (6CE5-12)**

**Assignment 1**

1. Write a note on classification of Solid waste
2. What are factors affecting the rate of Generation of solid waste
3. Write a note on physical properties of solid waste
4. How the sample is prepared for various types of test samples
5. Explain different types of dustbins used for solid waste
6. What are the different types of methods used in the High Rise apartments for reducing the solid waste
7. Describe "container locations"
8. What are different methods for onsite handling of solid waste
9. Write a note about the transfer station
10. Write important points you need to focus on for deciding the transfer routes

**TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY, UDAIPUR**  
**B. TECH III YEAR (VI SEM.)**  
**SOLID & HAZARDOUS WASTE MANAGEMENT (6CE5-12)**

**Assignment 2**

1. What is importance & factors affecting size reduction of solid waste?
2. Write a note on 3R principal.
3. Write a note on sanitary landfills. (Operation, challenges etc.)
4. Write about the construction & management of a sanitary landfill.
5. Write about the Vermicomposting.
6. What are different methods of composting?
7. Write a note on Hazardous waste. (Definition, collection, treatment, disposal etc.)
8. Write a note on e-Waste waste. (Definition, collection, treatment, disposal etc.)
9. What do you understand by energy generation from solid waste?
10. Discuss disposal of industrial solid waste.

## MCQ'S

1. How many major sources of solid waste are there based on their origin?
  - a) 10
  - b) 5
  - c) 9
  - d) 6
  
2. Which of the below is not an idea behind solid waste management?
  - a) Control of waste generation
  - b) Storage and collection
  - c) Disposal
  - d) Stop waste generation
  
3. The number of functional components of solid waste management is:
  - a) 5
  - b) 3
  - c) 6
  - d) 4
  
4. The term ISWM refers to:
  - a) International Solid Waste Management
  - b) Integrated Solid Waste Management
  - c) Integrated Solid Waste Machine
  - d) International Solid Waste Mechanism
  
5. Under which rule of Government, guidelines for solid waste management are followed today?
  - a) Municipal Solid Waste Rules, 2000
  - b) Municipal Solid Waste Rules, 2016
  - c) Solid Waste Rules, 2000
  - d) Solid Waste Rules, 2016
  
6. The average composition of Municipal solid waste is:
  - a) 41% organic, 40% inert & 19% recyclable
  - b) 20% organic, 60% inert & 20% recyclable
  - c) 30% organic, 20% inert & 50% recyclable
  - d) 19% organic, 41% inert & 40% recyclable
  
7. There are \_\_\_\_\_ ways to treat waste thermally.
  - a) 5

- b) 3
- c) 2
- d) 6

8. How many types of landfills are there?

- a) 3
- b) 2
- c) 5
- d) 4

9. Bio-medical waste can be effectively managed by the thermal process.

- a) True
- b) False

10. The WHO has classified the bio-medical waste into \_\_\_\_\_ categories.

- a) 5
- b) 4
- c) 3
- d) 2

11. Which gas produced in open dumps from the decomposition of biodegradable waste?

- a) Ethane
- b) Methane
- c) Propene
- d) Ethene

Solution: 1.c, 2.d, 3.c, 4.b, 5.d, 6.a, 7.b, 8.a, 9.a, 10.b, 11.b,

PREVIOUS YEAR RTU QUESTION PAPER

<b>5E5068</b>	Roll No. <u>15ECTC049</u>	[Total No. of Pages : <u>2</u> ]
	<b>5E5068</b> B.Tech. V Semester (Main/Back) Examination, Nov./Dec. - 2017 Civil Engineering 5CE6.3A Solid Waste Management	

Time : 3 Hours

Maximum Marks : 80

Min. Passing Marks : 26

Instructions to Candidates :

*Attempt any five questions, selecting one question from each unit. All Questions carry equal marks. (Schematic diagrams must be shown wherever necessary. Any data you feel missing suitable be assumed and stated clearly). Units of quantities used/calculated must be stated clearly.*

Unit - I

1. a) What are the main problems associated with solid waste disposal? (8)
- b) Explain the classification of solid waste. (8)

OR

1. a) What are the goals and objectives of solid waste management? (8)
- b) Describe the important characteristics of solid waste. Also discuss the factors influencing generation of solid waste. (8)

Unit - II

2. a) What do you mean by onsite handling of solid waste? How is the aspect of public health and aesthetics related to it? (8)
- b) What are the different types and materials used for storage containers? Explain with suitable sketches. (8)

OR

2. a) Explain the onsite processing methods used for solid waste. (8)
- b) How do we decide the location of containers? Write down the precautions and guidelines for this purpose. (8)

### Unit - III

3. a) What are the important steps in collection and transfer system design? (8)  
b) Explain the equipment and labour requirement in reference to solid waste management. (8)

OR

3. a) Explain various methods of collection system with flow diagrams. (8)  
b) What are the different types of vehicles being used in for collection systems?(8)

### Unit - IV

4. What do you understand by sanitary land filling? How is it different from a normal land filling? How is it practiced? Explain the filling process with a neat sketch. (16)

OR

4. Describe in detail the different processing techniques and methods of solid waste disposal with neat sketches. (16)

### Unit - V

5. a) Explain the special techniques of treatment for industrial solid waste. (8)  
b) Describe the reuse and recycling of solid waste materials. (8)

OR

5. a) How is the nature, treatment and disposal of industrial solid waste different than the municipal solid waste? (8)  
b) Explain various methods of energy recovery from solid waste. (8)



**6E1547**

Roll No. \_\_\_\_\_

[Total No. of Pages : 2]

**6E1547****B.Tech. VI Sem. (Main/Back) Examination, June - 2022****Civil Engg.****6CE5- 12 Solid and Hazardous Waste Management****Time : 2 Hours****Maximum Marks : 80****Min. Passing Marks : 28****Instructions to Candidates:**

*Attempt All Five questions from Part A, Four questions out of Six questions from Part B and Two questions out of Three from Part C.*

*Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.*

*Use of following supporting material is permitted during examination. (Mentioned in form No.205)*

**PART - A**

(Answer should be given up to 25 words only)

All questions are **compulsory**.

(5×2=10)

1. Define Solid Waste.
2. Define 3R principal.
3. Explain Sanitary landfilling.
4. What is Bioremediation?
5. Define Industrial Waste.

**PART - B**

(Analytical/Problem solving questions)

Attempt any **Four** questions.

(4×10=40)

1. Describe the environmental concerns of solid waste disposal sites.
2. Describe various collection systems. What are the advantages and disadvantages of door - to - door collection system?
3. Sketch and describe the equipment for collection and transport of solid waste?
4. Discuss the treatment and disposal of industrial solid waste.
5. How do we decide the labour requirements for collection of solid waste?
6. What are the various points to be kept in mind while choosing the collection route of vehicle to pick up solid waste?

---

## PART - C

(Descriptive/Analytical/Problem Solving Design Questions)

Attempt any **Two** questions.

(2×15=30)

1. Suggest various methods for reducing the solid waste generation in the industries.
  2. What are the different types and materials used for storage containers? Explain with suitable sketches.
  3. What do you understand by sanitary land filling? How is it different from a normal land filling? How is it practiced? Explain the filling process with a neat sketch.
-





**UNIT - II**

- 2 (a) Explain onsite storage of solid waste. 8  
(b) Discuss briefly public health and aesthetics associated with solid waste. 8

OR

- 2 (a) Explain various types of dust bins that are used in collecting solid waste. 8  
(b) Describe various onsite processing methods in handling solid waste. 8

**UNIT - III**

- 3 (a) How will you decide the collection routes in the collection of solid waste? 8  
(b) Write short note on labour requirement and equipment for solid waste. 8

OR

- 3 (a) Explain various transport systems in transporting solid waste. 8  
(b) Write down the various options in the transfer of solid waste. 8

**UNIT - IV**

- 4 (a) Explain briefly sanitary land filling. 8  
(b) Write short note on bioremediation. 8

OR

- 4 (a) Describe various methods in the disposal of solid waste. 8
- (b) Explain various processing techniques in processing solid waste. 8

**UNIT - V**

5 Write short notes on any four :

- (a) Material recovery from solid waste
- (b) Energy generation from solid waste
- (c) Recovery operation from solid waste
- (d) Reuse in other industry of solid waste
- (e) Recycling of solid waste

4×4=16

OR

- 5 (a) Explain disposal methods adopted for industrial solid waste. 8
- (b) Describe various treatment methods for industrial solid waste. 8