GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM

COURSE TITLE: SOLID WASTE MANAGEMENT

(COURSE CODE: 3360611)

Diploma Programme in which this course is offered	Semester in which offered
Civil Engineering	Sixth

1. RATIONALE:

Solid waste management is a pressing issue, and lack of know how in solid waste management is a great concern for all the Local Self Govt. units & community. Additionally, there is still little awareness on the importance of sound environmental management within the majority of the population. The course on Solid Waste Management gives the student an overview of municipal solid waste management including collection, transfer, transport, and disposal. Methods of processing, basic disposal facilities, disposal options, and the environmental issues of solid waste management will be covered in this course. In addition, this course provides the student with relevant information about municipal solid waste reduction and on hazardous waste management. This course is therefore an essential course for diploma programme in Environmental/Civil Engineering.

2. LIST OF COMPETENCY:

The course content should be taught and implemented with the aim to develop required skills in the students so that they are able to acquire following competency:

Plan segregation, collection, transportation, recycling and disposal of municipal solid waste in such a way that its impact is minimal on environment, economy and community.

3. COURSE OUTCOMES:

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

I. Explain municipal solid waste management systems with respect to its physical properties, and associated critical considerations in view of emerging technologies
II. Outline sources, types and composition of solid waste with methods of handling, sampling and storage of solid waste.
III. Select the appropriate method for solid waste collection, transportation, redistribution and disposal.
IV. Describe methods of disposal of hazardous solid waste.

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4. TEACHING AND EXAMINATIONS SCHEME:

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
3	0	2	5	70	30	20	30	150

Legends: L- Lecture**-** Tutorial/Teacher Guided Student Activity; **P -** Practical; **C –**Credit;
ESE-End Semester Examination ;**PA**-Progressive Assessment.

5. COURSE DETAILS

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit-I **Sources and Composition of Municipal Solid Waste**	1a. State Municipal solid waste sources 1b. Describe the advantages of determining the composition of Municipal solid waste 1c. Explain types of solid waste. 1d. State types of materials recovered from MSW	1.1 Introduction 1.2 Sources of solid waste 1.3 Types of solid waste. 1.4 Composition of solid waste and its determination. 1.5 Types of materials recovered from MSW.
Unit-II **Properties of Municipal Solid Waste**	2a. State the Physical , Chemical and Biological properties 2b. Describe associated considerations of Municipal Solid Waste (Msw)	2.1 Physical properties of Municipal Solid Waste 2.2 Chemical properties of Municipal Solid Waste 2.3 Biological properties of Municipal Solid Waste 2.4 Transformation of Municipal Solid Waste.

Unit-III **Solid Waste Generation and Collection**	3a.Describe the functional Elements of solid waste management program 3b.Discuss in detail the methods of MSW collection and its generation 3c.State the assumptions for quantities of solid Waste generated and factors affecting solid waste generation rate. 3d.State the quantities of materials recovered from MSW	3.1 Quantities of Solid Waste. 3.2 Measurements and methods to measure solid waste quantities. 3.3 Solid waste generation and collection. 3.4 Factors affecting solid waste generation rate. 3.5 Quantities of materials recovered from MSW.
Unit- IV Handling, Separation and Storage of Solid Waste	4a.Discuss the importance of onsite handling of solid waste 4b.Explain onsite solid waste handling and separation at commercial and industrial facilities. 4c.State the storage of solid waste at the sources .	4.1 Handling and separation of solid waste At site. Material separation by pick in, screens, float and separator magnets and electromechanical separator and other latest devices for material separation. 4.2 Waste handling and separation at Commercial and industrial facilities. 4.3 Storage of solid waste at the sources.
Unit-V Processing of Solid Waste	5a.Explain solid waste processing methods 5b.Describe processing steps of residential, commercial and industrial site MSW from various sources with clean flow Chart**.**	5.1Processing of solid waste at residence e.g. Storage, conveying, compacting, Shredding, pulping, granulating etc. 5.2 Processing of solid waste at Commercial and industrial site.

Unit-VI Disposal of Municipal Solid Waste	6a.Describe different methods & safety precautions used in disposal of MSW. 6b.Compare disposal methods of MSW applying specific Criteria. 6c.compare sanitary land fill and incineration as final disposal system for solid waste 6d.State the effects of combustion desirable ,undesirable and energy recovery of municipal solid waste 6e.Classify the landfill 6f.Describe the landfill - planning, sitting, permitting , processes , design , operation, 6g.Describe the Biochemical processes - Methane generation by anaerobic digestion, composting.	6.1 Combustion and energy recovery of municipal solid waste, effects of combustion, undesirable effects of Combustion. 6.2 Landfill: Classification, planning, sitting, permitting, landfill processes, landfill design, landfill operation, use Of old landfill. 6.3 Differentiate sanitary land fill and incineration as final disposal system for solid waste 6.4 Biochemical processes: Methane generation by anaerobic digestion, composting and other biochemical Processes.
Unit-VII Hazardous Solid Waste	7a.Define the hazardous solid waste 7b.Classify hazardous solid waste with their identification 7c.Describe types of hazardous solid waste, their characteristics,& their harmful effects on community. 7d.Discuss safe methods of disposal of hazardous waste & their management principles. 7e.State the sources, generation, and storage of Bio-medical waste 7f .Describe transportation and disposal of Bio-medical waste with necessary precautions to Followed.	7.1 Definition, identification and classification of hazardous solid waste. **Characteristics** Hazardous waste toxicity, reactivity, infectiousness, flammability, radioactivity, corrosiveness, irritation, bio-concentration, genetic activity, explosiveness. 7.2 Bio-medical waste, its sources, generation, storage, transportation and Disposal.

6. SUGGESTED SPECIFICATION TABLE WITH HOURS&MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Sources and Composition of Municipal Solid Waste	06	05	03	02	10
II	Properties of Municipal Solid Waste	06	05	03	02	10
III	Solid Waste Generation and Collection	06	04	04	04	12
IV	Handling, Separation and Storage of Solid Waste	06	03	04	05	12
V	Processing of Solid Waste	05	02	02	03	07
VI	Disposal of Municipal Solid Waste	08	03	05	02	10
VII	Hazardous Solid Waste	05	02	05	02	09
Total		**42**	**24**	**26**	**20**	**70**

Legends: R = Remember, U = Understand, A= Apply and above Level (Bloom's revised taxonomy)
Note: This specification table shall be treated as only general guideline for students and teachers. The actual
Distribution of marks in the question paper may vary slightly from above table

7. SUGGESTED LIST OF EXERCISES/PRACTICAL

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills **(outcomes in psychomotor and affective domain)** so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

Note: Here only outcomes mainly in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes (**as given in a common list at the beginning of curriculum document for this programme) would be assured.

Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.

Sr.No.	Unit No.	Practical/Exercise	Appx. Hrs. Required
1.	I	Survey the MSW of your locality and Identify its sources and write composition of MSW.	4
2.	II	Carryout sample survey of different localities in groups listing properties of municipal solid waste.	4
3.	III	Survey your locality and based on it suggest methods of solid waste collection.	2
4.	IV	Survey your locality and based on it suggest suitable methods of handling, separation and storage of solid waste.	6
5.	V	Identify& discuss the methods of processing different types of solid waste (search internet for latest methods).	2
6.	VI	Compare different methods of disposal of MSW. (search internet for latest methods).	8
7.	VII	Identify methods of hazardous waste disposal during a site visit. and follow safety precautions.	2
Total			28

8. SUGGESTED LISTOFSTUDENT ACTIVITIES

A. Explore internet for studying latest methods of handling, collecting, segregating, recycling and disposing MSW and prepare reports.
B. Prepare charts/models of different method.

9. SPECIAL INSTRUCTIONAL STRATEGIES (if any):

- Arrange expert lectures on different aspects of MSW management.
- Discuss success stories of MSW management in cities across the globe.
- Arrange site visits to show different activities related with management of MSW
- Show video films/photographs etc. related to different aspects of management of MSW.

10. SUGGESTED LEARNING RESOURCES

A. BOOKS:

No.	TITLE	AUTHOR	PUBLISHER
1	Integrated solid waste management	George Tchobanoglous and Hillary theisen, Samuel Vigil	McGraw Hill
2	Disposal and recovery of municipal solid waste	Michael E Henstock Butterworths, Ann Arbor Science	
3	solid waste management	P Aarne Vesilig	
4	Environmental Engineering	Mackenzie L Davis, David A Cornwell	

B. List of Software/Learning Websites:

i. http://www.moef.nic.in/legis/hsm/mswmhr.html
ii. en.wikipedia.org/wiki/waste management
iii. http://www.cyen.org/innovaeditor/assets/Solid%20waste%20management.pdf
iv. http://www.ilo.org/oshenc/part-vii/environmental-pollution-control/item/514- solid-waste-management-and-recycling
v. www.houstontx.gov/solidwaste
vi. www.epa.gov/tribalmsw/
vii. www.unc.edu/courses/2009spring/.../SolidWasteIndiaReview2008.pdf

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

1. Prof .A N PAMNANI**,** Lecturer in Civil Department , B B I T , V V NAGAR
2. Prof. Bhavesh Modi , PRINCIPAL , B.V.P.I.T. (D.S.), Umrakh, Bardoli
2 Prof .M.C. Sanandiya, Lecturer in Environmental Engineering, K. J. Polytechnic, Bharuch

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- **Prof. V.H. Radhakrishnan**, Professor, Department of Civil and Environmental Engineering.
- **Prof. Shashi Kant Gupta.** Professor and Coordinator for State of Gujarat.