Ref No:

### SRI KRISHNA INSTITUTE OF TECHNOLOGY



COURSE PLAN

### Academic Year 2019-2020

Program:	B E – Civil Engineering
Semester :	6
Course Code:	17CV651
Course Title:	Solid Waste Management
Credit / L-T-P:	3 / 3-0-0
Total Contact Hours:	40
Course Plan Author:	RENUKA H R

Academic Evaluation and Monitoring Cell

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Note : Remove "Table of Content" before including in CP Book Each Course Plan shall be printed and made into a book with cover page Blooms Level in all sections match with A.2, only if you plan to teach / learn at higher levels

### A. COURSE INFORMATION

#### 1. Course Overview

Degree:	BE	Program:	CV
Semester:	6th	Academic Year:	2019-20
Course Title:	Solid Waste Management	Course Code:	17CV651
Credit / L-T-P:	3/3-0-0	SEE Duration:	180 Minutes
Total Contact Hours:	40 Hours	SEE Marks:	60 Marks
CIA Marks:	40 Marks	Assignment	1 / Module
Course Plan Author:	RENUKA H R	Sign	Dt:
Checked By:		Sign	Dt:
CO Targets	CIA Target : 78%	SEE Target:	75%

Note: Define CIA and SEE % targets based on previous performance.

#### 2. Course Content

Content / Syllabus of the course as prescribed by University or designed by institute. Identify 2 concepts per module as in G.

Mod	Module Content	Teachi	Module	Blooms
ule		ng Hours	Concepts	Level
	Sources: Sources of Solid waste, Types of solid waste, Physical and Chemical composition of municipal solid waste. Generation rate, Numerical Problems. Collection: Collection of solid waste- services and systems, equipments Transportation: Need of transfer operation, transfer station, transport means and methods, route optimization. Solid waste management 2000 rules with, 2016 amendments.	08	Solid waste systems Onsite Processing	L1, L2,L3
2	<b>Processing techniques</b> : Purpose of processing, Chemical volume reduction (incineration) – Process description, 3T's, principal components in the design of municipal incinerators, Air pollution control ,Mechanical volume reduction (compaction), Mechanical size reduction (shredding), component separation (manual and mechanical methods).		Processing of solid wastes Compaction	L1, L2,L3
3	Composting Aerobic and anaerobic method-process description, process microbiology, design consideration, Mechanical composting, Vermicomposting, Numerical Problems. Sanitary landfilling: Definition, advantages and disadvantages, site selection, methods, reaction occurring in landfill- Gas and Leachate movement, Control of gas and leachate movement, Design of sanitary landfill. Numerical Problems		Composting Design of sanitary landfill	L1, L2,L3
4	<b>Sources, collection, treatment and disposal of :-</b> Biomedical waste ,E-waste ,Hazardous waste and construction waste	. 08	Solidwaste Management Disposal of bio medical wastes	L1, L2,L3
5	<b>Incineration</b> -3Ts factor affecting incineration,types of incinerations , Pyrolsis ,design criteria for incineration, Energy recovery technique from solid waste management	1	Chemical Volume Reduction Design criteria for incineration	L1, L2,L3

#### 3. Course Material

Books & other material as recommended by university (A, B) and additional resources used by course teacher (C).

1. Understanding: Concept simulation / video ; one per concept ; to understand the concepts ; 15 – 30 minutes

2. Design: Simulation and design tools used – software tools used ; Free / open source

3. Rese	arch: Recent developments on the concepts – publications in journals; co	nference	
Modul	Details	Chapters	
es		in book	
	Text books (Title, Authors, Edition, Publisher, Year.)	-	-
4, 5	George Tchobanoglous, Hilary Theisen , Samuel A Vigil, "Integrated Solid Waste Management : Engineering principles and management issues", M/c Graw hill Education . Indian edition		In Lib / In Dept
	Howard S Peavy, Donald R Rowe and George Tchobanoglous, "Environmental Engineering", Tata Mcgraw Hill Publishing Co ltd.	3, 4,5	In Lib⁄ In dept
	Reference books (Title, Authors, Edition, Publisher, Year.)	-	-
	Handbook of Solidwaste management, second edition, George Tchobanoglous, Frank Kreith, published by M/c Graw hill Education, 2002, ISBN-13 978-0071356237 ISBN -10 0071356231		In Lib
С	Concept Videos or Simulation for Understanding	-	-
	http://youtu.be/DpDzGPTkRlc (solid waste systems)		
	http://youtu.be/ZYTAs10Dn5l (onsite processing of solid wastes)		
-	http://youtu.be/ldqQAzzY2uw (processing of solid waste)		
	http://youtu.be/EHb3XR_EGh4 (compaction)		
-	http://youtu.be/URj3kloTDNs (composting of solid waste)		
-	http://youtu.be/s-ps_0UFmfl (design of sanitary landfills)		
C7	http://youtu.be/nL <u>354fxAfBk</u> (solid waste management)		
	http://youtu.be/MEslczJKxro (disposal of solid waste)		
	http://youtu.be/FFBbJJf_iK0 (chemical volume reduction)		
C10	http://youtu.be/xxDz5WCxz6A (design criteria of incineration)		
D	Software Tools for Design	-	-
E	Recent Developments for Research		
<b>-</b>	http://youtu.be/gcsuvyBbJJU		
	http://youtu.be/3RDGV5i82_Q		
F	Others (Web, Video, Simulation, Notes etc.)	-	-

#### 4. Course Prerequisites

Refer to GL01. If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.

Students must have learnt the following Courses / Topics with described Content ....

Mod	Course	Course Name	Topic / Description	Sem	Remarks	Blooms
ules	Code					Level
1	17CV651	Solid waste	Knowledge on solid waste	6th		L3
		management	management and different process	ò		
		_	of solid waste management.			

#### 5. Content for Placement, Profession, HE and GATE

The content is not included in this course, but required to meet industry & profession requirements and help students for Placement, GATE, Higher Education, Entrepreneurship, etc. Identifying Area / Content requires experts consultation in the area.

Topics included are like, a. Advanced Topics, b. Recent Developments, c. Certificate Courses, d. Course Projects, e. New Software Tools, f. GATE Topics, g. NPTEL Videos, h. Swayam videos etc.

ModTopic / DescriptionAreaRemarksBlooms

				Laval
ules				Level
	Solid Waste management/Knowledge		Seminar on solid waste	Understa
	of different solid waste systems	study	management	nding L2
2	Different process of solid waste and	Higher	Seminar on compaction and	Understa
	compaction	study	different process of solid waste	nding L2
3	Different methods of composting and	Higher	Seminar on composting of solid	Understa
	landfilling	study	waste	nding L2
4	Disposal of solid waste and different	Higher	Seminar on disposal of solid	Understa
	process	study	waste	nding L2
5	Design of incenaration	Higher	Seminar on design of incenaration	Understa
		study		nding L2

### B. OBE PARAMETERS

#### 1. Course Outcomes

Expected learning outcomes of the course, which will be mapped to POs. Identify a max of 2 Concepts per Module. Write 1 CO per Concept.

·		1 CO per Concept.		1			
Mod	Course	Course Outcome	Teach.	Concept		Assessme	
ules	Code.#	At the end of the course, student	Hours		Method	nt	Level
		should be able to				Method	
1	17CV651.1	Students are able to understand	04	Solid waste	Lecture	C.I.A	Understand
		the solid waste systems		systems			L2
1	17CV651.2	Students are able to estimate solid	04		Lecture	C.I.A	L3
		waste generation rate		Onsite			Apply
		5		Processing			,
2	17CV651.3	Students are able to apply the	04	Processing	Lecture	C.I.A	L3
		processing techniques in solid	-	of solid			Apply
		waste management		wastes			1. 1 7
2		Students are able to apply the		Compactio	Lecture	C.I.A	Understand
	, , ,	compaction techniques in solid		n '			L2
		waste management					
3		Students are able to understand	04	Compostin	Lecture	C.I.A	Apply
		the composting process and applly		a '			L3
		in SWM		<u> </u>			
3	17CV651.6	Students are able to design	04	Design of	Lecture	C.I.A	Apply
	, ,	sanitary landfill.		sanitary			L3
		,		landfill			0
4	17CV651.7	Students are able to design	04	Solidwaste	Lecture	C.I.A	Apply
		suitable solid waste processing		Manageme			L3
		system and disposal methods		nt			0
4	17CV651.8		04	Disposal of	Lecture	C.I.A	Apply
		suitable Hazardous waste	-	bio			L3
		Management systems		medical			Ŭ
		, a a		wastes			
5	17CV651.9	Students are to estimate the		Chemical	Lecture	C.I.A	Apply
		technique for energy recovery from		Volume			L3
		solid waste		Reduction			Ŭ
5	17CV651.10	Students are able to design	04	Design	Lecture	C.I.A	Apply
		suitable incineration technique		criteria for			L3
				incineratio			Ŭ
				n			
-	-	Total	40	-	-	-	L2-L3

### 2. Course Applications

Write 1 or 2 applications per CO.

Students should be able to employ / apply the course learnings to ...

Mod	Application Area	CO	Level
ules	Compiled from Module Applications.		
1	understand solid waste systems	CO1	L2
	Used to estimate solid waste generation rate	CO2	L2
2	Adopt processing techniques in solid waste management	CO3	L2
2	Used in compaction process	CO4	L2
3	Used in composting process	CO5	L2
3	Used to design sanitary landfill.	CO6	L2
4	Used to design suitable solid waste processing system.	CO7	L2
4	Used to design disposal methods	CO8	L2
5	Used to estimate the technique for energy recovery from solid waste	CO9	L2
5	Used to estimate the technique for energy chemical volume reduction	CO10	L2

### 3. Mapping And Justification

CO – PO Mapping with mapping Level along with justification for each CO-PO pair. To attain competency required (as defined in POs) in a specified area and the knowledge & ability required to accomplish it.

· · ·			mpusini.		
Mod ules			Mapping	Justification for each CO-PO pair	Lev el
-	со	PO	Level	'A real's 'Compataness' and 'Knowladne' for an asifad 'A complichment'	et
-			-	'Area': 'Competency' and 'Knowledge' for specified 'Accomplishment'	-
1	CO1	PO1	3	understand solidwaste systems.	L3
1	CO1	PO2	2	Identify the sources of solid waste generation using natural sciences, and Engineering sciences	L2
1	CO2	PO1	1	Apply the knowledge of science, Engineering fundamentals, to understand solidwaste generation rate	L3
1	CO2	PO2	2	Identify the point of solid waste generation using natural sciences, and Engineering sciences	L2
1	CO2	PO3	2	Design solutions for waste generation problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and environmental considerations.	
1	CO2	PO4	1	Analysis and interpretation of data, and synthesis of the information to provide valid conclusions for solid waste generation rate.	L1
1	CO2	PO6	3	Apply reasoning informed by the knowledge waste generation to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional Engineering practice	
1	CO2	PO7	1	Understand the impact of the solidwaste generation in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable developments.	
1	CO2	PO10	1	Communicate effectively on complex waste management activities with the Engineering Community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	
2	CO3	PO1	2	Apply the knowledge of science, Engineering fundamentals, a to understand processing techniques involved in solid waste management.	L3
2	CO3	PO2	2	Identify, formulate and analyze volume and size reduction problems of solid waste reaching substantiated conclusions using Engineering sciences	
2	CO3	PO3	1	Design solutions for complex processing techniques problems in solid waste and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety,	
2	CO3	PO6	2	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal issues and the consequent responsibilities relevant to the solidwaste processing practice	
2	CO3	PO7	2	Understand the impact of the processing techniques in solid waste management in societal and environmental contexts, and the need for	

				sustainable developments.	
2	CO3	PO10	2	Communicate effectively on complex processing activities of solid waste with the Engineering Community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	
2	CO4	PO1	3	Apply the knowledge of science, Engineering fundamentals, for composting of solid waste.	L3
2	CO4	PO2	2	Identify, formulate and analyze methods of composting using Engineering sciences	L2
2	CO4	PO3	2	Design solutions for aerobic and anaerobic composting and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	
2	CO4	PO6	3	Apply reasoning informed by the knowledge of composting techniques to assess societal, health, safety, and the consequent responsibilities relevant to the Solidwaste management practices	
2	CO4	PO7	2	Understand the impact of the composting in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable developments.	
2		PO10	2	Composting techniques communicate effectively on solid waste management activities with the Engineering Community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	
3	CO5	PO1	3	Apply the knowledge of mathematics, science, Engineering fundamentals to the solution of disposal of solid waste.	L3
3	CO5	PO2	2	Identify the site for the sanitary land filling for the solid waste disposal.	L2
3	CO5	PO3	2	Design solutions for complex solid waste disposal problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	
3	CO5	P06	2	Apply reasoning informed by the sanitary landfilling knowledge to assess societal, health, safety, legal issues and the consequent responsibilities relevant to the professional Engineering practice	
3	CO5	PO7	2	Understand the impact of the sanitary landfilling in ground water, societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable developments.	
3	CO6	PO1	3	Apply the knowledge of science, Engineering fundamentals, for hazardous waste management.	L3
3	CO6	PO2	2	Identify point, sources and collection of hazardous waste using natural sciences, and Engineering sciences	
3	CO6	PO3	2	Design solutions for complex biomedical, e-waste and construction waste and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, societal, and environmental considerations.	
3	CO6	PO4	2	Analysis and interpretation of data, and synthesis of the information to provide valid conclusions for hazardous waste management.	L2
3	CO6	PO6	2	Apply reasoning informed by the knowledge of e-waste and biomedical waste management to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the Hazardous waste management practices.	
3	CO6	PO7	3	Understand the impact of the sanitary landfilling in ground water, societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable developments.	
3	CO6	PO10	2	Identify point, sources and collection of hazardous waste using natural sciences, and Engineering sciences	L2
3	CO6	PO11	2	Design solutions for complex biomedical, e-waste and construction waste and design system components or processes that meet the	

				specified needs with appropriate consideration for the public health and	
				safety, societal, and environmental considerations.	
4	CO7	PO1	3	Apply the knowledge of mathematics, science, Engineering L; fundamentals to the solution of disposal of solid waste.	-3
4	CO7	PO2	2	analysis and interpretation of data, and synthesis of the information to La provide valid conclusions for hazardous waste management.	.2
4	CO8	PO1	3	Understand the impact of the hazardous waste in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable developments.	
4	CO8	PO2	2	Hazardous waste management communicate effectively on solid waste management activities with the Engineering Community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	
4	CO8	PO3	1	Demonstrate knowledge of and understanding of the hazardous waste management principles and apply these to one"s own work, as a member and leader in a team, to manage projects and in multi disciplinary environments.	
5	CO9	PO1	3	Apply the knowledge of science, Engineering fundamentals to understand Incineration and pyrolysis	
5	CO9	PO2	2	Identify, formulate, review research literature, and analyze Incineration and pyrolysis reaching substantiated conclusions using natural sciences and Engineering sciences	
5	CO9	PO3	1	Design of municipal incinerator for solid waste management and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	
5	CO10	PO1	3	Apply reasoning informed by the knowledge of incineration and energy recovery from the solid waste to assess societal, health, safety, legal issues and the consequent responsibilities relevant to the professional Engineering practice	
5	CO10		2	Understand the impact of the incineration and pyrolysis in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable developments.	
5	CO10	PO3	1	Incinerators communicate effectively on solid waste management activities with the Engineering Community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	

#### 4. Articulation Matrix

CO – PO Mapping with mapping level for each CO-PO pair, with course average attainment.

			-		· ·	-					<u> </u>							
-	-	Course Outcomes					P	rogi	ram	ιΟι	utco	me	s					-
Mod	CO.#	At the end of the course	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PS	PS	PS	Lev
ules		student should be able to	1	2	3	4	5	6	7	8	9	10	11	12	O1	02	03	el
1		Students are able to understand the solid waste systems	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	L2
1		Students are able to estimate solid waste generation rate		2	1	1	-	3	1	-	-	1	-	-	-	-	-	L2
2		Students are able to apply the processing techniques in solid waste management		2	1	-	-	2	1	-	-	1	-	-	-	-	-	L2
2		Students are able to apply the compaction techniques in solid waste management		2	2	-	-	2	1	-	-	1	-	-	-	-	-	L3
3		Students are able to understand the composting process and applly in SWM		2	2	-	-	2	1	-	-		-	-	-	-	-	L3
3	17CV651.6	Students are able to design	3	2	2	2	-	1	2	-	-	2	1	-	-	-	-	L3

																		1
		sanitary landfill.																
4	17CV651.7	Students are able to design	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	L3
		suitable solid waste processing																
		system and disposal methods																
4	17CV651.8	Students are able to design	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	L3
		suitable Hazardous waste																
		Management systems																
5	17CV651.9	Students are to estimate the	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	L3
		technique for energy recovery																
		from solid waste																
5	17CV651.10	Students are able to design	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	L3
		suitable incineration technique																
-	17CV651	Average attainment (1, 2, or 3)																
-	PO, PSO	1.Engineering Knowledge; 2.Probl	lem	Ar	naly	sis;	<u>3.</u> L	Desi	ign	/	De	velo	pm	ent	of	Sc	oluti	ions;
		4.Conduct Investigations of Compl																
		Society; 7.Environment and Sustainability; 8.Ethics; 9.Individual and Teamwork;																
		0.Communication; 11.Project Management and Finance; 12.Life-long Learning; 1.Software Engineering; S2.Data Base Management; S3.Web Design																
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#### 5. Curricular Gap and Content

Topics & contents not covered (from A.4), but essential for the course to address POs and PSOs.

		10, 10, 10 I I I I I I I I I I I I I I I I I I			
Mod	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
ules					
1					
2					
3					
4					
5					
·					

#### 6. Content Beyond Syllabus

Topics & contents required (from A.5) not addressed, but help students for Placement, GATE, Higher Education, Entrepreneurship, etc.

	alleri, Entropronodior					
Mod ules	Gap Topic	Area	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1						
1						
2						
2						
3						
3						
4						
4						
5						
5						

### C. COURSE ASSESSMENT

#### 1. Course Coverage

Assessment of learning outcomes for Internal and end semester evaluation. Distinct assignment for each student. 1 Assignment per chapter per student. 1 seminar per test per student.

Mod	Title	Teachi	No. of question in Exam						CO	Levels
ule		ng	CIA-1	CIA-2	CIA-3	Asg	Extra	SEE		
#		Hours					Asg			
1	Sources Collection	08	2	-	-	1	1	2	CO1, CO2	L2, L3

	Transportation									
2	Processing techniques	08	2	-	-	1	1	2	CO3	L2, L2
	Composting Aerobic and anaerobic method Sanitary landfilling	08	-	2	-	1	1	2	CO4, CO5	L2, L3
4	Sources, collection, treatment and disposal	08	-	2	-	1	1	2	CO6	L3
5	Incineration	08	-	-	4	1	1	2	CO7	L3
-	Total	40	4	4	4	5	5	10	-	-

### 2. Continuous Internal Assessment (CIA)

Assessment of learning outcomes for Internal exams. Blooms Level in last column shall match with A.2.

Mod	Evaluation	Weightage in	СО	Levels
ules		Marks		
-	CIA Exam – 1	15	CO1, CO2, CO3,Co4	L2,L4,L3,L2
3, 4	CIA Exam – 2	15	CO5, CO6, CO7, C08	L2,L3,L3,L4
5	CIA Exam – 3	15	CO9, CO10	L2,L2
	Assignment - 1	05	CO1, CO2, CO3,Co4	L2,L4,L3,L2
	Assignment - 2	05	CO5, CO6, CO7, C08	L2,L3,L3,L4
5	Assignment - 3	05	CO9, CO10	L2,L2
1, 2	Seminar - 1		-	-
	Seminar - 2		_	-
5	Seminar - 3			-
	Quiz - 1			-
3, 4	Quiz - 2		_	-
5	Quiz - 3		-	-
1 - 5	Other Activities – Mini Project	-	CO9, CO10	L2,L2
	Final CIA Marks	40	-	L3

## D1. TEACHING PLAN - 1

#### Module - 1

Title:	Solid Waste Management	Appr	08 Hrs
Thue.	Solid Waste Management	Time:	001115
	Cauraa Outaamaa		Diagrams
a	Course Outcomes	-	Blooms
-		-	Level
1	Students are able to understand the solid waste systems	CO1	L2
2	Students are able to estimate solid waste generation rate	CO2	L3
b	Course Schedule	-	-
Class N	o Module Content Covered	СО	Level
1	Sources of Solid waste, Types of solid waste	CO1	L2
2	Physical and Chemical composition of municipal solid waste	CO1	L2
3	Generation rate, Numerical Problems	CO2	L3
4	Collection of solid waste- services and systems, equipments	CO1	L2
5	Transportation: Need of transfer operation, transfer station	CO1	L2
6	transport means and methods	CO1	L2
7	route optimization	CO1	L2
8	Solid waste management 2000 rules with, 2016 amendments.	CO1	L2
С	Application Areas	CO	Level
1	understand solid waste systems	CO1	L2
2	Used to estimate solid waste generation rate	CO2	L3

d	Review Questions	-	-
1	List out different sources of Municipal Solid Waste. Explain briefly.	CO1	L2
2	Explain with the aid of neat sketches, Hauled container system and stationary container system of collection of Municipal wastes.	CO1	L2
3	Describe Route Optimization process.	CO1	L2
4	With the aid of schematic of HCS and SCS, explain the terms : pick up hond, at site and off route	CO1	L2
5	What is a transfer station'? Explain factors to be considered in the design of transfer station.	CO1	L2
6	Explain the factors to be considered in container on site process technique.	CO1	L2
7	Briefly explain physical and chemical characteristics of solid waste.	CO1	L2
8	With a neat sketch, explain hauled container system.	CO1	L2
9	Discuss the factors influencing the solid waste generation rates.	CO1	L2
10	Briefly discuss on the various methods used to estimate waste quantities.	CO1	L2
11	Explain the classification of functional elements of a solid waste management system with the help of flow diagram	CO1	L2
е	Experiences	-	-
1			
2			
3			
4			
5			

### Module – 2

Title:	Solid Waste Management	Appr	08 Hrs
		Time:	
a	Course Outcomes	-	Blooms
_	The student should be able to:	-	Level
1	Students are able to apply the processing techniques in solid waste management	CO3	L3
b	Course Schedule	_	-
Class No	D Module Content Covered	СО	Level
1	Processing techniques: Purpose of processing	CO3	L2
2	Chemical volume reduction (incineration) – Process description	CO3	L2
3	3T's	CO3	L2
4	principal components in the design of municipal incinerators	CO3	L2
5	Air pollution control	CO3	L3
6	Mechanical volume reduction (compaction)	CO3	L3
7	Mechanical size reduction (shredding)	CO3	L3
8	component separation (manual and mechanical methods)	CO3	L3
с	Application Areas	со	Level
1	adopt processing techniques in solid waste management	CO3	L3
d	Review Questions		
1	Brief out what do you mean by Mechanical volume reduction and Chemical volume reduction.	CO3	L3
2	Give list of component separation techniques. Explain them	CO3	L3
3	Define Incineration. Sketch and explain a typical Municipal Incinerator.	CO3	L2
4	What are 3T's of Incineration process? Explain.	CO3	L2
5	Explain briefly the following component separation techniques : i) Magnetic separation ii) Air separation.	CO3	L3
6	Write a short note on following; i) Garbage chutes ii)Bailing and Campaction.	CO3	L2

7	What is meant by 'size reduction'? Enumerate the various equipments used and with a neat sketch, explain any one.	CO3	L3
	Discuss on the factors that must be considered in the design of transfer station.	CO3	L3
е	Experiences	-	-
1			
2			
3			
4			
5			

### E1. CIA EXAM – 1

### a. Model Question Paper - 1

Crs (	Code	17CV651 Se	m:	6	Ν	1arks	5: 30		Tin	ne: 7:	5 minute	S	
Coui	rse:	Solid Waste Ma											
-	-	Note: Answer a									Marks		Level
1	a	List out differer									08	CO1	L2
	b	Estimate the 1000kg sampl estimate energ Take ash conte	.e Of s gy conte	olid was ent on d	ste wi	th tł	ne follow	ing	compc	sition. Als	c	CO2	L3
		Component	Food waste	Paper	Card rd	boa	Plastic	W	ood				
		% by mass	45	5	15		15	20					
		Moisture %	70	06	05		02	20		_			
		Bulk density kg/m3	290	85	50		65	24	0				
		Energy content kJ/kg	4650	16750	1630	0	32600	18	600				
2	a	Define the tern	ns <sup>,</sup> i) so	lid waste	ii) sol	id wa	aste mana	aem	nent		05	CO1	L2
	b	Explain the omanagements	classifica	ation of	func	tiona	l elemer	nts (		solid wast		CO1	L2
	С	Estimate unit 1500 dwellinge week at a disp	solid w es with	aste ger 6 perso	neratic ns pe	n ra r hou	te for a r	resid				CO2	L3
		Vehicle	Nu	mber of	loads	Ave	rage volu	me	densi	ty, kg/m3			
		Truck	10			10			350				
		Tractor	08			1.5			150		_		
		Private vehicle	22			0.3			100				
3	a	Explain briefly the following processing techniques i) Mechanical volume reduction ii) Mechanical size reduction.									09	CO3	L3
	b	Explain briefly Magnetic sepa					ent sepa	ratio	n tech	iniques :	i) 06	CO3	L3
4	a	Write a short note on following; i) Garbage chutes ii)Bailing and Campaction.									08	CO3	L2
	b	With a neat ske									07	CO3	L2

### b. Assignment -1

Note: A distinct assignment to be assigned to each student.

4 Brief out what do you mean by Mechanical volume reduction 05 CO3 L2   5 Give list of component separation techniques. Explain them 05 CO3 L2   6 Define Incineration. Sketch and explain a typical Municipal Incinerator. 05 CO3 L2   7 What are 3Ts of Incineration process? Explain. 05 CO3 L2   8 Briefly explain physical and chemical characteristics of solid waste. 05 CO1 L2   9 From the following data estimate the waste generation rate per day for a residential area consisting of 1200 houses. The observation location is a local transfer station that receives all the waste collected for disposal. The observation period is for one week. Assume 5 persons in each house 05 CO2 L3   Vehicle type No. of loads Vol of vehicle Sp. Wt. of (m3) 05 CO1 L2   10 With a neat sketch, explain the operational sequence of Hauled Container System. 05 CO2 L3   11 Estimate the moisture content. bulk density and energy content of 1000kg sample Of solid waste with the following composition. Also estimate energy content on dry weight basis and on ash free dry basis. Take ash content as 7 percent. CO2 L3   11 Component Fod Paper	NOLC.	Aus		griment to be a			ment Que	stions					
Interpretation Marks CO Leve   1 List out different sources of Municipal Solid Waste. Explain of the briefty. OS CO1 Lz   2 Explain with the aid of neat sketches. Hauled container system of collection of Municipal wastes. OS CO1 Lz   3 Describe Route Optimization process. OS CO1 Lz   4 Brief out what do you mean by Mechanical volume reduction of Municipal and Chemical volume reduction. OS CO2 Lz   5 Give list of component separation techniques. Explain them os OS CO2 Lz   6 Define Incineration. Sketch and explain a typical Municipal os OS CO2 Lz   7 What are 3T's of Incineration process? Explain. OS CO2 Lz   8 Briefly explain physical and chemical characteristics of solid waste waste. OS CO2 L3   9 From the following data estimate the waste generation rate receives all the waste collected for disposal. The observation period is for one week. Assume 5 persons in each house OS CO2 L3   10 Usite bed load 08 153 133.40 OS CO1 L2   11 Estimate the	Crs C	ode:			5					ne: 7	5 minute	es	
No   Assignment Description   Marks   CO   Lev     1   List out different sources of Municipal Solid Waste. Explain or distionary container system of collection of Municipal wastes.   05   C01   L2     2   Explain with the aid of neat sketches, Hauled container system and stationary container system of collection of Municipal wastes.   05   C01   L2     3   Describe Route Optimization process.   05   C03   L2     4   Brief out what do you mean by Mechanical volume reduction and Chemical volume reduction.   05   C03   L2     5   Give list of component separation techniques. Explain them lincinerator.   05   C03   L2     7   What are 3Ts of Incineration process? waste.   05   C03   L2     8   Briefly explain physical and chemical characteristics of solid waste.   05   C01   L2     9   From the following date estimate the waste generation rate per day for a residential area consisting of 1200 houses. The observation location is a local transfer station that receives all the waste collected for disposal. The observation period is for one week. Assume 5 persons in each house   05   C01   L2     10   With a neat sketch, explain the operational sequence of truck				¥									
1   List out different sources of Municipal Solid Waste Explain briefty.   05   CO1   L2     2   Explain with the aid of neat sketches, Hauled container system and stationary container system of collection of Municipal wastes.   05   CO1   L2     3   Describe Route Optimization process.   05   CO1   L2     4   Brief out what do you mean by Mechanical volume reduction.   05   CO3   L2     5   Give list of component separation techniques. Explain them 05   05   CO3   L2     6   Define Incineration.   Sketch and explain a typical Municipal Incinerator.   05   CO3   L2     7   What are 3T's of Incineration process? Explain   05   CO1   L2     8   Briefly explain physical and chemical characteristics of solid waste.   05   CO1   L2     9   From the following data estimate the waste generation rate per day for a residential area consisting of 1200 houses. The observation location is a local transfer station that receives all the waste collected for disposal. The observation period is for one week. Assume 5 persons in each house   05   CO1   L2     10   White are neat sketch, explain the opearational sequence of trastruck   05		Each	student	to answer 2-3 a					rries (	equal mar			
Image: Second Stationary Container System of Collection of Municipal wastes: 05 CO1 L2   3 Describe Route Optimization process: 05 CO1 L2   4 Brief out what do you mean by Mechanical volume reduction of Municipal and Chemical volume reduction. 05 CO2 L2   5 Give list of component separation techniques. Explain them 05 CO2 L2   6 Define Incineration. Sketch and explain a typical Municipal 05 CO2 L2   7 What are 3Ts of Incineration process? Explain. 05 CO2 L2   8 Briefly explain physical and chemical characteristics of solid waste for a residential area consisting of 1200 houses. The observation location is a local transfer station that receives all the waste collected for disposal. The observation period is for one week. Assume 5 persons in each house 05 CO1 L2   9 Firat bed load 08 153 133.40 Private 05 CO2 L3   10 With a neat sketch, explain the operational sequence of truck 12 Sp mass 45 5 15 15 20 CO2 L3   11 Estimate the moisture content, bulk density and energy content of oloxing sample Of solid waste with the following composition. Also estimate				list sut sliffs					<u> </u>				
and stationary container system of collection of Municipal wastes. 05 C01 L2   3 Describe Route Optimization process. 05 C01 L2   4 Brief out what do you mean by Mechanical volume reduction. 05 C03 L2   5 Give list of component separation techniques. Explain them 05 C03 L2   6 Define Incineration. Sketch and explain a typical Municipal Incinerator. 05 C03 L2   7 What are 3Ts of Incineration process? Explain. 05 C03 L2   8 Briefly explain physical and chemical characteristics of solid waste. 05 C01 L2   9 From the following data estimate the waste generation rate per day for a residential area consisting of 1200 houses. The observation period is for one week. Assume 5 persons in each house 05 C02 L3   Vehicle type No. of loads Vol. of vehicle Sp. Wt. of solid waste (kg/m3) 05 C01 L2   10 With a neat sketch, explain the operational sequence of Hauted Container System. 11 C5 C02 L3   11 Estimate the moisture content. bulk density and energy content of 1000kg sample Of solid waste with the following content of 1000kg sample Of solid waste				briefly.									
4 Brief out what do you mean by Mechanical volume reduction 05 CO3 L2   5 Give list of component separation techniques. Explain them 05 CO3 L2   6 Define Incineration. Sketch and explain a typical Municipal Incinerator. 05 CO3 L2   7 What are 3Ts of Incineration process? Explain. 05 CO3 L2   8 Briefly explain physical and chemical characteristics of solid waste. 05 CO1 L2   9 From the following data estimate the waste generation rate per day for a residential area consisting of 1200 houses. The observation location is a local transfer station that receives all the waste collected for disposal. The observation period is for one week. Assume 5 persons in each house 05 CO2 L3   Vehicle type No. of loads Vol of vehicle Sp. Wt. of (m3) 05 CO1 L2   10 With a neat sketch, explain the operational sequence of Hauled Container System. 05 CO2 L3   11 Estimate the moisture content. bulk density and energy content of 1000kg sample Of solid waste with the following composition. Also estimate energy content on dry weight basis and on ash free dry basis. Take ash content as 7 percent. CO2 L3   11 Component Fod Paper	2			and stationary wastes.	contai	ner syst	em of co						L2
and Chemical volume reduction. -   5 Give list of component separation techniques. Explain them 05 CO3 L2   6 Define Incineration. Sketch and explain a typical Municipal 05 CO3 L2   7 What are 3T's of Incineration process? Explain. 05 CO3 L2   8 Briefly explain physical and chemical characteristics of solid waste. 05 CO1 L2   9 From the following data estimate the waste generation rate per day for a residential area consisting of 1200 houses. The observation location is a local transfer station that receives all the waste collected for disposal. The observation period is for one week. Assume 5 persons in each house 05 CO1 L2   Vehicle type No. of loads Vol. of vehicle (m3) 296.50 CO1 L2   10 With a neat sketch, explain the operational sequence of Hauled Container System. 05 CO1 L2   11 Estimate the moisture content, bulk density and energy content on dry weight basis and on ash free dry basis. Take ash content as 7 percent. Composition. Also estimate energy content on dry weight basis and on ash free dry basis. Take ash content as 7 percent. CO2 L3   11 Estimate the moisture content, bulk density and energy content on dry weight basis and on ash free dry basis. Take ash content as 7	3												L2
6   Define Incineration. Sketch and explain a typical Municipal Incinerator.   05   CO3   L2     7   What are 3T's of Incineration process? Explain.   05   CO3   L2     8   Briefly explain physical and chemical characteristics of solid waste.   05   CO1   L2     9   From the following data estimate the waste generation rate per day for a residential area consisting of 1200 houses. The observation location is a local transfer station that receives all the waste collected for disposal. The observation period is for one week. Assume 5 persons in each house   05   CO2   L3     Vehicle type   No. of loads   Vol. of vehicle (m3)   Sp. Wt. of solid waste (kg/m3)   05   CO1   L2     10   With a neat sketch, explain the operational sequence of truck   15.3   133.40   9   12   Compactor   10   15.30   296.50   CO1   L2     11   With a neat sketch, explain the operational sequence of Hauled Container System.   05   CO1   L2     11   Estimate the moisture content, bulk density and energy content of 1000kg sample Of solid waste with the following composition. Also estimate energy content on dry weight basis and on ash free dry basis. Take ash content as 7 percent.   CO2   L3	4			and Chemical v	volume	reductio	n.				05		L2
7 What are 3T's of Incinerator. 05 CO3 L2   8 Briefly explain physical and chemical characteristics of solid waste. 05 CO1 L2   9 From the following data estimate the waste generation rate observation location is a local transfer station that receives all the waste collected for disposal. The observation period is for one week. Assume 5 persons in each house 05 CO2 L3   Vehicle type No. of loads Vol of vehicle Sp. Wt. of solid waste (kg/m3) Solid waste (kg/m3) Compactor 10 1530 296 50 CO1 L2   10 Private cars/trucks 25 0.23 88.90 CO2 L3   11 Estimate the moisture content, bulk density and energy content of 100-ckg sample Of solid waste with the following composition. Also estimate energy content on dry weight basis and on ash free dry basis. Take ash content as 7 percent. O5 CO2 L3   11 Estimate the Food Paper Cardboa Paper Cardboa Plastic Wood Wood   14 Moisture % 70 06 05 02 20 20 20   14 Energy content of 16750 16300 32600 18600 16 16 16   14 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>•</td> <td></td> <td></td> <td></td> <td>-</td> <td>L2</td>								•				-	L2
8 Briefly explain physical and chemical characteristics of solid waste. 05 C01 L2   9 From the following data estimate the waste generation rate per day for a residential area consisting of 1200 houses. The observation location is a local transfer station that receives all the waste collected for disposal. The observation period is for one week. Assume 5 persons in each house 05 C02 L3   Vehicle type No. of Loads Vol. of vehicle (kg/m3) Sp. Wt. of solid waste (kg/m3) C04 C04 C04 C04 C05 C01 L2   10 Compactor truck 10 15.3 133.40 Private 25 0.23 88.90 C05 C01 L2   10 With a neat sketch, explain the operational sequence of Hauled Container System. 05 C02 L3   11 Estimate the moisture content, bulk density and energy content of 100 ckg sample Of solid waste with the following composition. Also estimate energy content on try weight basis and on ash free dry basis. Take ash content as 7 percent. C02 C02 L3   11 Estimate the moisture content, bulk density and energy content on dry weight basis and on ash free dry basis. Take ash content as 7 percent. C05 C02 L3   11 Estimate the moisture % 70 06 05 02 20<	6			Incinerator.			•		pical	Municipa	05		L2
9 From the following data estimate the waste generation rate per day for a residential area consisting of 1200 houses. The observation location is a local transfer station that receives all the waste collected for disposal. The observation period is for one week. Assume 5 persons in each house 05 CO2 L3   Vehicle type No. of loads Vol. of vehicle Sp. Wt. of solid waste (kg/m3) 05 CO2 L3   Compactor 10 15.30 296.50 296.50 296.50 10 153 133.40   Private 25 0.23 88.90 65 CO1 L2   10 With a neat sketch, explain the operational sequence of Hauled Container System. 05 CO2 L3   11 Estimate the moisture content, bulk density and energy content on dry weight basis and on ash free dry basis. Take ash content as 7 percent. 05 CO2 L3   11 Component Food Paper Cardboa Plastic Wood   % by mass 45 5 15 15 20 05 CO2 L3   Moisture % 70 06 05 02 20 20 20 20 20 20 20 20 20													L2
10 With a neat sketch, explain the operational sequence of Hauled Container System. 0.2 296.50 CO1 L2   11 With a neat sketch, explain the operational sequence of content of 1000 kg sample Of solid waste with the following composition. Also estimate energy content of 1000 kg sample Of solid waste with the following composition. Also estimate energy content of 1000 kg sample Of solid waste with the following composition. Also estimate energy content of 1000 kg sample Of solid waste with the following composition. Also estimate energy content of 1000 kg sample Of solid waste with the following composition. Also estimate energy content on dry weight basis and on ash free dry basis. Take ash content as 7 percent. 0.5 CO2 L3   10 With a neat sketch, working of a 125 0.22 20 0.5 CO2 L3   11 Estimate the moisture content. bulk density and energy content of 1000 kg sample Of solid waste with the following composition. Also estimate energy content on dry weight basis and on ash free dry basis. Take ash content as 7 percent. Component Food Paper Cardboa Plastic Wood   % by mass 45 5 15 15 20 0.5 CO3 L2   12 Explain with a neat sketch, working of a municipal incinerator. 05 CO3 L2   13 Explain briefly the following processing techniques 05 CO3	8			waste.									L2
12 Explain with a neat sketch, working of a municipal incinerator. 16300 32600 18600 18600   12 Explain with a neat sketch, working of a municipal incinerator. 05 CO1 L2   13 Explain with a neat sketch, working of a municipal incinerator. 05 CO1 L2   14 Estimate the moisture content, bulk density and energy content on dry weight basis and on ash free dry basis. Take ash content as 7 percent. 05 CO2 L3   14 Estimate the free dry basis. Take ash content as 7 percent. Wood Plastic Wood   14 Free dry basis. 15 15 20 05 CO2 L3   15 15 15 20 06 05 02 20 05 CO2 L3   16 Energy content of 1000 kg sample Of solid waste with the following composition. Also estimate energy content on dry weight basis and on ash free dry basis. Take ash content as 7 percent. Component frod from the state and the plastic wood from the state and the p	9			per day for a re observation loc the waste colle	esidentia cation is ected fo	al area co s a local t r disposa	onsisting of ransfer sta al. The obs	f 1200 tion th ervatio	hous nat ree	es. The ceives all	05	CO2	L3
$ \begin{array}{ c c c c c c } \hline \begin{tabular}{ c c c c } \hline \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ $				Vehicle type	No. of	loads		hicle	solid	waste			
Private cars/trucks 25 0.23 88.90 05 C01 L2   10 With a neat sketch, explain the operational sequence of Hauled Container System. 05 C01 L2   11 Estimate the moisture content, bulk density and energy content of 1000kg sample Of solid waste with the following composition. Also estimate energy content on dry weight basis and on ash free dry basis. Take ash content as 7 percent. 05 C02 L3   Component Food Paper Cardboa Plastic Wood Wood Vood </td <td></td> <td></td> <td></td> <td></td> <td>10</td> <td></td> <td>15.30</td> <td></td> <td>296.5</td> <td>50</td> <td></td> <td></td> <td></td>					10		15.30		296.5	50			
10 With a neat sketch, explain the operational sequence of Hauled Container System. 05 CO1 L2   11 Estimate the moisture content, bulk density and energy content of 1000kg sample Of solid waste with the following composition. Also estimate energy content on dry weight basis and on ash free dry basis. Take ash content as 7 percent. 05 CO2 L3   20 Food Paper Cardboa Plastic Wood Wood Vood V													
Hauled Container System.Image: Content of 1000kg sample Of solid waste with the following composition. Also estimate energy content on dry weight basis and on ash free dry basis. Take ash content as 7 percent.O5CO2L3ComponentFood wastePaper wasteCardboa rdPlasticWoodVoodVood% by mass455151520VoodVoodVoodVood% by mass455151520VoodVoodVoodVoodVood% by mass4555065240Vood <td></td> <td></td> <td></td> <td></td> <td>25</td> <td></td> <td>0.23</td> <td></td> <td>88.90</td> <td>)</td> <td></td> <td></td> <td></td>					25		0.23		88.90	)			
Image: content of 1000kg sample Of solid waste with the following composition. Also estimate energy content on dry weight basis and on ash free dry basis. Take ash content as 7 percent.ComponentFoodPaperCardboaPlasticWood% by mass455151520Moisture %7006050220Bulk density290855065240kg/m3Lenergy46501675016300326001860012Explain with a neat sketch, working of a municipal incinerator.05CO3L213Explain briefly the following processing techniques05CO3L3	10						the oper	ationa	l sec	luence of	f 05	CO1	L2
% by mass455151520Moisture %7006050220Bulk density kg/m3290855065240Energy content kJ/kg46501675016300326001860012Explain with a neat sketch, working of a municipal incinerator.05CO3L213Explain briefly the following processing techniques i) Mechanical volume reduction ii) Mechanical size reduction.05CO3L3	11			content of 100 composition. <i>A</i> basis and on as	ookg sa Also es sh free o Food	mple Of timate e dry basis.	solid was energy cor Take ash Cardboa	te wit ntent conter	h the on d nt as 7	following ry weight percent.		CO2	L3
Moisture %7006050220Bulk density290855065240Bulk density290855065240Energy content kJ/kg46501675016300326001860012Explain with a neat sketch, working of a municipal incinerator.05CO3L213Explain briefly the following processing techniques i) Mechanical volume reduction ii) Mechanical size reduction.05CO3L3				% by mass				15		20	-		
12 Explain with a neat sketch, working of a municipal incinerator. 05 CO3 L2   13 Explain briefly the following processing techniques i) Mechanical volume reduction ii) Mechanical size reduction. 05 CO3 L3													
12 Explain with a neat sketch, working of a municipal incinerator. 05 CO3 L2   13 Explain briefly the following processing techniques i) Mechanical volume reduction ii) Mechanical size reduction. 05 CO3 L3				Bulk density	-		-						
13Explain briefly the following processing techniques05CO3L3i) Mechanical volume reduction ii) Mechanical size reduction.				Energy content	4650	16750	16300	3260	0	18600			
13Explain briefly the following processing techniques05CO3L3i) Mechanical volume reduction ii) Mechanical size reduction.	12			Explain with a r	noat skr	tch wor	king of a m	unicir	nal inc	cinerator	05	$CO_{2}$	12
				Explain briefly	the follo	owing pro	ocessing te	echniq	lues				L2 L3
	14										05	CO3	L3

	techniques : i) Magnetic separation ii) Air separation.			
15	Write a short note on following;	05	CO3	L2
	i) Garbage chutes ii)Bailing and Campaction.			
16	With a neat sketch, explain municipal incinerators.	05	CO3	L2
18	Explain the effect of 3T's in incineration process of solid waste.	05	CO3	L2
19	Discuss on the factors that must be considered in the design of transfer station.	05	CO2	L2
		~-	<u> </u>	
20	List the principal components in the design of large municipal incinerators.	05	CO3	L2

## D2. TEACHING PLAN - 2

### Module – 3

Title:	Solid Waste Management	Appr Time:	08 Hrs
a	Course Outcomes	-	Bloom
-	The student should be able to:	-	Level
1	Students are able to understand the composting process and apply in SWM	CO4	L3
2	Students are able to design sanitary landfill.	CO5	L3
b	Course Schedule		
Class No	Module Content Covered	CO	Level
1	Composting Aerobic and anaerobic method - process description	CO4	L2
2	Process microbiology, design consideration	CO4	L2
3	Mechanical composting, Vermicomposting	CO4	L2
4	Numericals	CO4	L3
5	Sanitary landfilling: Definition, advantages and disadvantages, site selection, methods	CO5	L2
6	Reaction occurring in landfill- Gas and Leachate movement	CO5	L2
7	Control of gas and leachate movement	CO5	L2
8	Design of sanitary landfill	CO5	L3
с	Application Areas	со	Level
1	Used in composting process	CO4	L3
2	Used to design sanitary landfill.	CO5	L3
d	Review Questions	_	-
1	Describe different design components which are to be considered for Aerobic composting process	CO4	L2
2	With the aid of neat sketch, explain the bangalore Process of composting	CO4	L2
3	Explain the various ways of control of gas movement in landfills.	CO4	L2
4	Define leachate and list out the factors that affect the composition of leachate.	CO4	L2
5	Briefly discuss on the difference between Indore and Bangalore process of compositing of municipal solid waste.	CO4	L2
6	Explain the factors that govern the selection of site for Sanitary Land filling	CO5	L2
7	What are the sanitary land filling methods? Explain briefly.	CO5	L2
8	Explain the various ways of control of gas movement in landfills.	CO5	L2
9	With neat sketches, briefly explain the various vent systems used to control the lateral movement of gases in landfill.	CO5	L2
10	With neat sketches, briefly explain the various vent systems used to control the lateral movement of gases in landfill.	CO5	L2
е	Experiences	-	-
1		CO1	L2
2			
3			
4		CO3	L3
5			

#### Module – 4

Title:	Solid Waste Management	Appr Time:	08 Hrs
a	Course Outcomes	-	Bloom
-	The student should be able to:	-	Level
1	Students are able to design suitable solid waste processing system and disposal methods	CO6	L3
b	Course Schedule		
Class No	Module Content Covered	со	Level
1	Sources, collection of Biomedical waste	CO6	L2
2	Treatment and disposal of Biomedical waste	CO6	L3
3	Sources, collection of E-waste	CO6	L2
4	Treatment and disposal of E-waste	CO6	L3
5	Sources, collection of Hazardous waste	CO6	L2
6	Treatment and disposal of Hazardous waste	CO6	L3
7	Sources, collection of construction waste	CO6	L2
8	Treatment and disposal of construction waste	CO6	L3
C	Application Areas	CO	Level
1	Used to design suitable solid waste processing system and disposal methods	CO6	L3
d	Review Questions	_	_
1	Explain briefly the Biomedical waste classification and disposal.	CO6	L2
2	Write a short note on Plastic waste, its environmental significance and reuse.	C06	 L2
3	Highlight the Open dumping method of disposing Municipal Solid waste with its advantages and disadvantages.	CO6	L2
4	Explain environmental significance of plastic waste.	CO6	L2
5	Define Hazardous waste. Explain briefly about collection and disposal of hazardous waste	CO6	L2
6	Explain the characteristics of Bio - medical waste and its disposal method.	CO6	L2
7	Briefly explain about E - Waste and its environmental significance.	CO6	L2
8	Briefly explain about reuse of construction and demolition waste in Construction Industry.		L2
9	Outline the importance of recycle and reuse of plastic materials with examples.		L2
10	List the advantages and disadvantages of open dumping and ocean disposal of solid waste.	CO6	L2
11	Briefly discuss the salient features of "The bio-medical waste (management and handling)Rules, 2000.	CO6	L2
е	Experiences	-	-
1			
2			
3			
4			
5			

## E2. CIA EXAM – 2

### a. Model Question Paper - 2

Crs Code:	17CV651	Sem:	6	in iai no.	30	Time:	75 minutes
	Solid Waste	Manageme	ent				

-	-	Note: Answer any 2 questions, each carry equal marks.	Marks	СО	Level
1	а	Describe different design components which are to be considered for Aerobic composting process	08	CO4	L2
	b	Determine the amount of air required to oxidize one tone of waste having the chemical equation C <sub>50</sub> H 100 O <sub>40</sub> N $C_{a}H_{b}O_{c}Nd + \left[\frac{4a + b - 2c - 3d}{4}\right]O_{2} \rightarrow aco_{2} + \left[\frac{b - 3d}{2}\right] + H_{2}O + dNH_{3}$	07	CO4	L3
2	а	Explain the factors that govern the selection of site for Sanitary Land filling	08	CO5	L2
	b	What are the sanitary land filling methods? Explain briefly.	07	CO5	L2
3	а	Define Hazardous waste. Explain briefly about collection and disposal of hazardous waste	07	CO6	L2
	b	Explain the characteristics of Bio - medical waste and its disposal method.	08	CO6	L2
4	а	Briefly explain about E - Waste and its environmental significance.	07	CO6	L2
	b	Briefly explain about reuse of construction and demolition waste in Construction Industry.	08	CO6	L2

### b. Assignment – 2

Note: A distinct assignment to be assigned to each student.

		· · · · · · · · · · · · · · · · · · ·		Mode	el Assignmen	t Questions	6			
Crs C	ode:	17CV651	Sem:	6	Marks:	5 / 10	Time:	75 minut	es	
Cours	se:	Solid Wa	aste Manage	ment						
-	Each	student	to answer 2-3	-		-	arries equal m			
SNo					ignment Des			Marks	СО	Level
1					esign compo composting		ich are to l	be 05	CO4	L2
2			composting		·	0	alore Process	_	CO4	L2
3	Explain the factors that govern the selection of site for Sanita Land filling					ry 05	CO5	L2		
4					and filling m			05	CO5	L2
5	Determine the land fill area required for a municipal solid waste management system with a population 50000, given that : i) Solid waste generation = 350gm/person/day. ii)Compacted density of landfill = 504 kg/m3 iii)Average depth of compacted solid wastes = 3m						CO5	L3		
6		Explain the factors that governs the selection of site fo sanitary land filling.					_	CO5	L2	
7			waste having	g the chem	nical equation	n C <sub>50</sub> H 100 O <sub>4</sub>	lize one tone ₀N -]+H₂O+dNH		CO4	L3
8					etch, Indore of municipal		and Bangalo e.	re 05	CO4	L2
9			population 5 i) Solid waste ii) Compacte	0,000. give generation d density of		gm/persor )4 kg/m3.	iunicipality wi 1/day.	th 05	CO5	L3

Explain the various ways of control of gas movement in landfills.	05	CO5	L2
Define leachate and list out the factors that affect the composition of leachate.	05	CO5	L2
Explain the area method and trench method of landfilling techniques stating merits and demerits	05	CO5	L2
Determine the landfill area required for municipality with a population of 50,000 given that : Solid waste generation = 360 gm/person/day Compacted density of land fill = 504 kg/m3	05	CO5	L3
What are the important factors for the design considerations in anaerobic compositing?	05	CO4	L2
Briefly discuss on the difference between Indore and Bangalore process of compositing of municipal solid waste.	05	CO4	L2
Determine the amounts of oxygen required to oxidize 1 tonne of waste and also to stabilize Ammonia in having the chemical equation : $C_{50}H_{100}O_{40}N$ , use equation $C_aH_bO_cN_d + \frac{4a+b+2c+3d}{4}H_2O \rightarrow \frac{4a+b+2c-3d}{B}CH_4 + \frac{4a+b+2c+3d}{B}CO_2 + dNH_3$	05	CO4	L3
Enumerate and briefly discuss the factors governing aerobic composting.	05	CO4	L2
What is a sanitary landfill? List and explain principal methods used for land-filling and explain in brief	05	CO5	L2
With neat sketches, briefly explain the various vent systems used to control the lateral movement of gases in landfill.	05	CO5	L2
Explain briefly the Biomedical waste classification and disposal.	05	CO6	L2
	Landfills.Define leachate and list out the factors that affect the composition of leachate.Explain the area method and trench method of landfilling techniques stating merits and demeritsDetermine the landfill area required for municipality with a population of 50,000 given that :Solid waste generation = 360 gm/person/day Compacted density of land fill = 504 kg/m3 Average depth of compacted solid waste = 3m.What are the important factors for the design considerations in anaerobic compositing?Briefly discuss on the difference between Indore and Bangalore process of compositing of municipal solid waste.Determine the amounts of oxygen required to oxidize 1 tonne of waste and also to stabilize Ammonia in having the chemical equation : $C_{50}H_{100}O_{40}N$ , use equation $C_{a}H_bO_cN_d + \frac{4a+b+2c+3d}{4}M_2O \rightarrow \frac{4a+b-2c-3d}{B}CH_4 + \frac{4a+b+2c+3d}{B}CO_2 + dNH_3$ Enumerate and briefly discuss the factors governing aerobic composting.What is a sanitary landfill? List and explain principal methods used for land-filling and explain in briefWith neat sketches, briefly explain the various vent systems used to control the lateral movement of gases in landfill.Explain briefly the Biomedical waste classification and	Landfills.Define leachate and list out the factors that affect the composition of leachate.O5Explain the area method and trench method of landfilling techniques stating merits and demeritsO5Determine the landfill area required for municipality with a population of 50,000 given that :O5Solid waste generation = 360 gm/person/day Compacted density of land fill = 504 kg/m3 Average depth of compacted solid waste = 3m.O5What are the important factors for the design considerations in anaerobic compositing?O5Briefly discuss on the difference between Indore and Bangalore process of compositing of municipal solid waste.O5Determine the amounts of oxygen required to oxidize 1 tonne of waste and also to stabilize Ammonia in having the chemical equation : $C_{50}H_{100}O_{40}N$ , use equationO5CaH <sub>b</sub> O <sub>c</sub> N <sub>d</sub> + $\frac{4a + b + 2c + 3d}{4}$ CO2 + dNH3O5Enumerate and briefly discuss the factors governing aerobic composting.O5What is a sanitary landfill? List and explain principal methods used for land-filling and explain in briefO5With neat sketches, briefly explain the various vent systems used to control the lateral movement of gases in landfill.O5	Landfills.CODefine leachate and list out the factors that affect the composition of leachate.05CO5Explain the area method and trench method of landfilling techniques stating merits and demerits05CO5Determine the landfill area required for municipality with a population of 50,000 given that :05CO5Solid waste generation = 360 gm/person/day Compacted density of land fill = 504 kg/m3 Average depth of compacted solid waste = 3m,05CO4What are the important factors for the design considerations in anaerobic compositing?05CO4Briefly discuss on the difference between Indore and Bangalore process of compositing of municipal solid waste.05CO4Determine the amounts of oxygen required to oxidize 1 tonne of waste and also to stabilize Ammonia in having the chemical equation : C <sub>s0</sub> H <sub>100</sub> O <sub>4</sub> N, use equation05CO4Enumerate and briefly discuss the factors governing aerobic composting.05CO4What is a sanitary landfill? List and explain principal methods used for land-filling and explain in brief05CO4With neat sketches, briefly explain the various vent systems used to control the lateral movement of gases in landfill05CO5

## D3. TEACHING PLAN - 3

### Module – 5

Solid Waste Management	Appr	08 Hrs
	Time:	
Course Outcomes	-	Blooms
The student should be able to:	-	Level
Students are to estimate the technique for energy recovery from solid waste	C07	L3
Course Schedule		
o Module Content Covered	СО	Level
Incineration -3Ts	CO7	L2
Factor affecting incineration	C07	L2
Types of incinerations	CO7	L2
Types of incinerations	CO7	L2
Pyrolsis	C07	L2
Design criteria for incineration	C07	L3
Design criteria for incineration	C07	L3
Energy recovery technique from solid waste management	C07	L3
Application Areas	СО	Level
Used to estimate the technique for energy recovery from solid waste	CO7	L3
Review Questions		-
What is incineration? With help of sketch, incneration processes.	CO7	L2
	Course Outcomes   The student should be able to:   Students are to estimate the technique for energy recovery from solid waste   Course Schedule   Module Content Covered   Incineration -3Ts   Factor affecting incineration   Types of incinerations   Types of incinerations   Pyrolsis   Design criteria for incineration   Energy recovery technique from solid waste management   Application Areas   Used to estimate the technique for energy recovery from solid waste	Course Outcomes -   The student should be able to: -   Students are to estimate the technique for energy recovery from solid waste CO7   Course Schedule -   D Module Content Covered CO   Incineration -3Ts CO7   Factor affecting incineration CO7   Types of incinerations CO7   Types of incinerations CO7   Pyrolsis CO7   Design criteria for incineration CO7   Design criteria for incineration CO7   Design criteria for incineration CO7   Question Areas CO   Used to estimate the technique for energy recovery from solid waste CO7   Review Questions -

CO7 CO7	L2 L2
,	2
anted COT	
opted CO7	L3
C07	L2
ating CO7	L2
-	-

## E3. CIA EXAM – 3

### a. Model Question Paper - 3

Crs C	Code:	17CV651 Sem:	6	Marks:	30	Tim	e: 7	5 minute	S	
Cour	rse:	Solid Waste Manager	nent							
-	-	Note: Answer any 2 q	uestions, ead	ch carry e	qual marl	KS.		Marks	со	Level
1		List the principal o incinerators.	components	in the	design c	of large	municipa	al 05	C07	L2
		Differentiate between pyrolysis.	10	CO7	L2					
2	а	What is incineration? With help of sketch, explain incneration processes.							C07	L2
	b	What are 3Ts of incine	eration proces	s? Explair	n briefly.			06	C07	L2
3		Explain briefly about a incineration process.	air pollution c	ontrol me	thods adc	pted in ar	า	08	CO7	L2
	b	List out different type	s of incineara	tors. Expla	ain any on	e in detail		07	CO7	L2
4		Briefly discuss the vai incinerating system.	rious factors t	o be cons	idered is a	design of	an	10	CO7	L2
	b	Write note on energy	recovery ope	rations of	solid was	tes		05	C07	L2

### b. Assignment – 3

Note: A distinct assignment to be assigned to each student.

	Model Assignment Questions									
Crs C	ode:	17CV651	Sem:	6	Marks:	5 / 10	Time:	90 – 120 minutes		
Cours	se:	Solid Wa	ste Manager	nent						
Note:	Each	student t	o answer 2-3	assignment	s. Each ass	signment c	arries equal ma	ark.		
SNo				Assig	nment Des	cription		Marks	СО	Level
1	1 Explain Pyrolysis process with applicable to incineration process for Municipal solid waste.					on 05	CO7	L2		
2	2 Differentiate between combustion, pyrolysis and solification. Explain pyrolysis.					05	CO7	L2		
3			What is incine processes.	eration? Wit	h help of sl	ketch, inch	eration	05	CO7	L2
4		1	Write note on	energy rec	overy oper	ations of s	olid wastes	05	C07	L2
5	5 What are 3Ts of incineration process? Explain briefly.					05	C07	L2		
6			Define Inciner	ration. Expla	ain briefly a	bout air po	ollution control	05	CO7	L2

	methods adopted in an incineration process.			
7	What is pyrolysis? With a flow diagram, explain the process of pyrolysis.	05	CO7	L2
8	Briefly discuss the various factors to be considered is design of an incinerating system.	05	CO7	L2
9	List out different types of incinearators. Explain any one in detail	05	CO7	L2
10	List the principal components in the design of large municipal incinerators.	05	CO7	L2
11	With a neat sketch, explain municipal incinerators.	05	C07	L2
12	Explain Pyrolysis process with applicable to incineration process for Municipal solid waste.	05	CO7	L2
13	Differentiate between combustion, pyrolysis and solification. Explain pyrolysis.	05	CO7	L2
14	What is incineration? With help of sketch, incneration processes.	05	CO7	L2
15	Write note on energy recovery operations of solid wastes	05	C07	L2
16	What are 3Ts of incineration process? Explain briefly.	05	C07	L2
17	Define Incineration. Explain briefly about air pollution control methods adopted in an incineration process.	05	CO7	L2
18	What is pyrolysis? With a flow diagram, explain the process of pyrolysis.	05	CO7	L2
19	Briefly discuss the various factors to be considered is design of an incinerating system.	05	CO7	L2
20	List out different types of incinearators. Explain any one in detail	05	CO7	L2

### F. EXAM PREPARATION

## 1. University Model Question Paper

Cours	se:	Month /	/ Year	May //	2018							
Crs C	ode:	17CV651	Sem:	VI		Marks:	80	Time:		180 m	inutes	
	Note	Answer all FIVI		Marks	со	Level						
ule												
1		List out differe					· · ·		08	CO1	L2	
		1000kg sampl estimate energ	stimate the moisture content, bulk density and energy content of bookg sample Of solid waste with the following composition. Also stimate energy content on dry weight basis and on ash free dry basis. ake ash content as 7 percent									
		Component	Food waste	Paper	Cardboa rd	Plastic	Wood					
		% by mass	45	5	15	15	20					
		Moisture %	70	06	05	02	20					
		Bulk density kg/m3	290	85	50	65	240					
		Energy content kJ/kg										
				·	OR							
-	а	Define the terms : i) solid waste ii) solid waste management 05									L2	
		Explain the or management s					ts of a soli	d waste	05	CO1	L2	

	С	Estimate unit soli	d waste generatio	on rate for a resid	lential area having	05	CO2	L3
			with 6 persons pe I facility is as follow		rvation taken for a			
		Vehicle	Number of loads	Average volume	density, kg/m3			
		Truck	10	10	350			
		Tractor	08	1.5	150			
		Private vehicle	22	0.3	100			
			•		1			
2	а	Explain briefly the i) Mechanical volu	following processi me reduction ii) Me		ction.	09	CO3	L3
	b		ne following com on ii) Air separation		n techniques : i)	06	CO3	L3
			C	)R				
-	а	Write a short note i) Garbage chutes	on following; ii)Bailing and Camp	paction.		08	CO3	L2
	b	Explain the effect	of 3T's in incineration	on process of solid	waste.	07	CO3	L2
2	2	Deceribe different	design compone	nte vyhich are te	be considered for	08	CO4	1.2
3	а	Describe different Aerobic composti	08	CO4	L2			
	b	Determine the am the chemical equa	07	CO4	L3			
		C <sub>a</sub> H <sub>b</sub> O <sub>c</sub> Nd +	$\begin{bmatrix} \frac{4a+b-2c-3d}{4} \end{bmatrix} O_{4}$	$a_2 \rightarrow aco_2 + \left\lfloor \frac{b-3d}{2} \right\rfloor + $	$-H_2O + dNH_3$			
4	a	Briefly explain abc				07	CO6	L2
	b	Briefly explain at Construction Indus		nstruction and de	emolition waste in	08	CO6	L2
				DR				
-	а	hazardous waste	•		on and disposal of	07	CO6	L2
	b	Explain the charac	teristics of Bio - m	edical waste and it	s disposal method.	08	CO6	L2
5	а	Explain briefly abc		ntrol methods adop	oted in an	08	CO7	L2
	b	List out different ty	07	C07	L2			
				DR				
	а	Briefly discuss th incinerating syster		to be considere	d is design of an	10	CO7	L2
	b	Write note on ene	rgy recovery opera	itions of solid wast	es	05	CO7	L2
L								

### 2. SEE Important Questions

Cours	rse: SOLID WASTE MANAGEMENT Month						/ Year	May /2018			
Crs C	Code: 17CV651 Sem: 6 Marks: 80 Time:							180 mi	inutes		
	Note	Answer all FIV	E full qu	estions. A	All questior	ns carry eq	ual marks.		-	-	
Mod	Qno.	Important Que	stion						Marks	СО	Year
ule											
1	1	List out differe	nt sourc	es of Mu	nicipal Soli	d Waste. E	xplain brie	fly.	08	CO1	2015
		List out different sources of Municipal Solid Waste. Explain briefly. Estimate the moisture content, bulk density and energy content of 1000kg sample Of solid waste with the following composition. Also estimate energy content on dry weight basis and on ash free dry basis. Take ash content as 7 percent Component Food Paper Cardboa Plastic Wood								CO2	2016
		omponent	waste		rd						

		% by mass	45	5	15	15	20				
		Moisture %	70	06	05	02	20				
		Bulk density kg/m3	290	85	50	65	240				
		Energy content kJ/kg	4650	16750	16300	32600	18600				
	4	Evolain briefly	the fell			abbiguas				<u> </u>	2017
2	1	Explain briefly i) Mechanical v							09	CO3	2017
	2	Explain briefly Magnetic sepa	, the <sup>-</sup>	following	compon			iniques : i)	06	CO3	2015
3	1	Determine the	amoun	t of air re	auired to	ovidize on	e tone of w	aste having	07	CO4	2012
5	-	the chemical e	quatior	n C <sub>50</sub> H 100	0 <sub>40</sub> N		$\left[\frac{Bd}{B}\right] + H_2O + O$	_	07	004	LOIL
	2	Explain the fa filling	ctors tł	nat gove	rn the se	lection of	site for Sa	nitary Land	08	CO5	2010
4	1	Briefly explain	about F	- Waste	and its en	vironment	al significar	ice	07	C06	2011
	2	Briefly explain Construction Ir		08	CO6	2011					
5	1	Briefly discuss the various factors to be considered is design of an incinerating system.								CO7	2008
	2	Write note on a		recovery	operation	s of solid w	vastes		05	CO7	2005

## Course Outcome Computation

Academic Year:																
Odd / Even semester																
INTERNAL TEST	· · · · · · · · · · · · · · · · · · ·									Тз						
Course	CO1		со		CO3		CO4		CO5		CO6		C07		CO8	
Outcome QUESTION NO	Q1	LV	2 Q2	LV	Q3	LV	Q1	LV	Q2	LV	Q3	LV	Q1	LV	Q2	LV
MAX MARKS																
USN-1																
USN-2 USN-3																
USN-4																
USN-5																
USN-6																
Average CO Attainment																
LV Threshold	LV Threshold : 3:>60%, 2:>=50% and <=60%, 1: <=49%															

CO1 Computation :(2+2+2+3)/4 = 10/4=2.5

## **PO Computation**

Program Outcome Weight of CO - PO	PO1	PO1 PO3 PO3 PO1		PO1	PO12	PO12	PO6	PO1	
Course Outcome	CO1	CO2	CO3	CO4	CO5	CO6	CO7	CO8	
Test/Quiz/Lab		T1			T2		Т	3	
QUESTION NO	Q1	L Q2 LV V	Q3 LV	Q1 LV	Q2 LV	Q3 LV	Q1 LV	Q2 LV	
MAX MARKS									
USN-1									
USN-2									
USN-3									
USN-4									
USN-5 USN-6									
Average CO Attainment									