**EN6501 MUNICIPAL SOLID WASTE MANAGEMENT COURSE FILE**

**1. PREFACE**

**2. SYLLABUS**

**3. LESSON PLAN**

**4. TIMETABLE**

**5. COURSE DESCRIPTION**

**PREFACE**

We believe everyone has the right to live and work in a clean environment. We’re working with some of the poorest communities to safely and securely improve their waste management and collection methods. Introducing home composting bins to poor families in order to turn generated waste into useful rich compost for vegetable gardens. Some of the world’s poorest people are those who live in slums, Practical Action is working to install effective sanitation in these areas Waste plastics are washed in specially designed machines before being sold on for commercial recycling and pelletizing. Waste collectors recycle and sell material thrown away by others, thus contributing to the improved health of slum dwelling families.

The municipal solid waste industry has four Components: [recycling](http://en.wikipedia.org/wiki/Recycling), [composting](http://en.wikipedia.org/wiki/Compost), [landfilling](http://en.wikipedia.org/wiki/Landfill),and [waste-to-energy](http://en.wikipedia.org/wiki/Waste-to-energy) via incineration. The primary steps are generation, collection, sorting and separation, transfer, and disposal. Activities in which materials are identified as no longer being of value and are either thrown out or gathered together for disposal.

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**SYLLABUS**

**EN6501 MUNICIPAL SOLID WASTE MANAGEMENT L T P C**

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 **OBJECTIVES:**

 To make the students conversant with different aspects of the types, sources, generation, storage, collection, transport, processing and disposal of municipal solid waste.

**UNIT I SOURCES AND TYPES (8)**

 Sources and types of municipal solid wastes-waste generation rates-factors affecting generation, characteristics-methods of sampling and characterization; Effects of improper disposal of solid wastes-Public health and environmental effects. Elements of solid waste management –Social and Financial aspects – Municipal solid waste (M&H) rules – integrated management-Public awareness; Role of NGO‟s.

 **UNIT II        ON-SITE STORAGE AND PROCESSING (8)**

 On-site storage methods – Effect of storage, materials used for containers – segregation of solid wastes – Public health and economic aspects of open storage – waste segregation and storage – case studies under Indian conditions – source reduction of waste – Reduction, Reuse and Recycling.

 **UNIT III COLLECTION AND TRANSFER (8)**

Methods of Residential and commercial waste collection – Collection vehicles – Manpower– Collection routes – Analysis of collection systems; Transfer stations – Selection of location, operation & maintenance; options under Indian conditions – Field problems- solving.

**UNIT IV OFF-SITE PROCESSING (12)**

Objectives of waste processing – Physical Processing techniques and Equipments; Resource recovery from solid waste composting and biomethanation; Thermal processing options – case studies under Indian conditions.

**UNIT V DISPOSAL (9)**

Land disposal of solid waste; Sanitary landfills – site selection, design and operation of sanitary landfills – Landfill liners – Management of leachate and landfill gas- Landfill bioreactor– Dumpsite Rehabilitation

**TOTAL: 45 PERIODS**

 **OUTCOMES:**

The students completing the course will have

* an understanding of the nature and characteristics of municipal solid wastes and the regulatory requirements regarding municipal solid waste management
* ability to plan waste minimisation and design storage, collection, transport, processing and disposal of municipal solid waste

 **TEXTBOOKS:**

1. Tchobanoglous, G., Theisen, H. M., and Eliassen, R. “Solid. Wastes: Engineering Principles and Management Issues”. McGraw Hill, New York, 1993.

2. Vesilind, P.A. and Rimer, A.E., “Unit Operations in Resource Recovery Engineering”, Prentice Hall, Inc., 1981

3. Paul T Willams, “Waste Treatment and Disposal”, John Wiley and Sons, 2000

 **REFERENCES:**

1. Government of India, “Manual on Municipal Solid Waste Management”, CPHEEO, Ministry of Urban Development, New Delhi, 2000.

2. Bhide A.D. and Sundaresan, B.B. “Solid Waste Management Collection”, Processing and Disposal, 2001

3. Manser A.G.R. and Keeling A.A.,” Practical Handbook of Processing and Recycling of Municipal solid Wastes”, Lewis Publishers, CRC Press, 1996

4. George Tchobanoglous and Frank Kreith”Handbook of Solidwaste Management”, McGraw Hill, New York, 2002

**E.G.S. PILLAY ENGINEERING COLLEGE, NAGAPATTINAM**

**DEPARTMENT OF CIVIL ENGINEERING**

 **COURSE CODE : EN6501**

**COURSE TITLE : MUNICIPAL SOLID WASTE MANAGEMENT**

**COURSE PLAN**

**Semester: 07 Course Duration: July - October 2016**

**Year/ Class: IV Year Civil Location: PG Block**

**Faculty Details**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sl. No** | **Name** | **Designation** | **Dept** | **Mail ID** | **Mobile No.** |
| 1 | T.ADHAVANATHAN | Asst.Professor | Civil | adhavanathan@gmail.com | +91 8148266586 |

**Required Text Book**

1. Tchobanoglous, G., Theisen, H. M., and Eliassen, R. “Solid. Wastes: Engineering Principles and Management Issues”. McGraw Hill, New York, 1993.

2. Vesilind, P.A. and Rimer, A.E., “Unit Operations in Resource Recovery Engineering”, Prentice Hall, Inc., 1981

3. Paul T Willams, “Waste Treatment and Disposal”, John Wiley and Sons, 2000

 **Reference Books**

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2. Bhide A.D. and Sundaresan, B.B. “Solid Waste Management Collection”, Processing and Disposal, 2001

3. Manser A.G.R. and Keeling A.A.,” Practical Handbook of Processing and Recycling of Municipal solid Wastes”, Lewis Publishers, CRC Press, 1996

4. George Tchobanoglous and Frank Kreith”Handbook of Solidwaste Management”, McGraw Hill, New York, 2002

**Resources**

1. [www.wikipedia.com](http://www.wikipedia.com)
2. www. NPTEL.com

**LESSON PLAN**

B.E Civil Engineering – (2016-17)

**Semester** : Seven **Course Duration**: June-October 2016

**Year/ Class**: IV Year Civil **Location** : PG Block

|  |  |
| --- | --- |
| Subject Code | EN6501 |
| Subject Name | Municipal Solid Waste Management |
| Prerequisites | Nil |
| Category | Environmental Engineering |

**Instructional objectives and Student outcomes**

|  |  |
| --- | --- |
| Instructional objectives | Student outcomes |
| 1. To study the Sources and types of municipal solid wastes
2. To impart the knowledge of On-site Processing, collection and transfer of solid waste.
3. To acquire the knowledge of Off –site Processing and waste disposal management.
 | Students will be able to  1.Discuss the Sources and types of municipal solid wastes  2. Interpret the various methods Waste handling and separation, storage and processing at the source.3.Identify the methods of collection and transfer of solid wastes.4. List the Off –site Processing techniques.5..Evaluate the various options for disposal of wastes and their selection criteria. |

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| --- |
| EN6501 - MUNICIPAL SOLID WASTE MANAGEMENT |
| Course Designed By | Anna University –Chennai |
| Student out comes | a | b | c | d | e | f | g | h | i | j | k |
|  | \* |  |  |  |  |  | \* |  | \* |  |
| Category | Science | Core | Elective |
|  | x |  |
| Course Coordinator | T.ADHAVANATHAN |

(a) an ability to apply knowledge of mathematics, science, and engineering

* (b) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(c) an ability to design and conduct experiments, as well as to analyze and interpret

data

(d) an understanding of professional and ethical responsibility

(e) an ability to identify, formulate, and solve engineering problems

(f) an ability to function on multidisciplinary teams

(g) an ability to communicate effectively

* (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

(i) a knowledge of contemporary issues

* (j) a recognition of the need for, and an ability to engage in life-long learning

(k) an ability to use the techniques, skills, and modern engineering tools necessary

for engineering practice.

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| --- | --- | --- |
| LECTURE | TUTORIAL | PRACTICAL |
| 45 Hrs. | 0Hrs. | 0 Hrs. |

**UNIT I SOURCES AND TYPES                                                           (8)**

Sources and types of municipal solid wastes-waste generation rates-factors affecting generation, characteristics-methods of sampling and characterization; Effects of improper disposal of solid wastes-Public health and environmental effects. Elements of solid waste management –Social and Financial aspects – Municipal solid waste (M&H) rules – integrated management-Public awareness; Role of NGO‟s..

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| --- | --- | --- |
| **LECTURE :** 8 Hrs. | **TUTORIAL:** 0 Hrs. | **TOTAL :** 08 Hrs. |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Session no | Topics to covered | Text Book | Chap No and Page No | Instruction Delivery | Testing Method | Instructional Objective | Program outcome |
| Method | Level |
| 1 | Sources and types of municipal solid wastes | Municipal solid waste Management material | Ch No:1Page No : 1-20 | Chalk and black board Teaching ,PPT | Understanding | Weekly test and short answer Test, Assignment | To study the Sources and types of municipal solid wastes | Students will be able to discuss the Sources and types of municipal solid wastes |
| 2 | waste generation rates-factors affecting generation | Understanding |
| 3 | characteristics – methods of sampling and characterization | Understanding |
| 4 | Effects of improper disposal of solid wastes  |
| 5 | Public health and environmental effects | Understanding |
| 6 | Elements of solid waste management | Understanding |
| 7 | Social and Financial aspects, Municipal solid waste (M&H) rules | Understanding |
| 8 | Integrated management-public awareness; role of NGO’s. | Understanding |

**CUMULATIVE HOUR** = LECTURE -08

 **UNIT II        ON-SITE STORAGE AND PROCESSING                                       (8)**

On-site storage methods – Effect of storage, materials used for containers – segregation of solid wastes – Public health and economic aspects of open storage – waste segregation and storage – case studies under Indian conditions – source reduction of waste – Reduction, Reuse and Recycling.

|  |  |  |
| --- | --- | --- |
| **LECTURE :** 8 Hrs. | **TUTORIAL:** 0Hrs. | **TOTAL :** 08 Hrs. |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Session no | Topics to covered | Text Book | Chap No and Page No | Instruction Delivery | Testing Method | Instructional Objective | Program outcome |
| Method | Level |
| 1 | On-site storage methods | Municipal solid waste Management material | Ch No:2Page No : 21-30 | Chalk and black board Teaching | Understanding | Weekly test and short answer Test, Assignment | To impart the knowledge of On-site Processing of solid waste. | Students will be able to Interpret the various methods of handling, separation, storage and processing of wastes at the source. |
| 2 | Effect of storage, materials used for containers | Understanding |
| 3 | Segregation Of Solid Wastes  | Understanding |
| 4 | Public health and economic aspects of open storage | Understanding |
| 5,6 | Waste segregation and storage, case studies under Indian conditions | Understanding |
| 7,8  | Source reduction of waste, Reduction, Reuse and Recycling  | Understanding |

**CUMULATIVE HOUR** = LECTURE -16

**UNIT III COLLECTION AND TRANSFER                                                       (8)**

Methods of Residential and commercial waste collection – Collection vehicles – Manpower– Collection routes – Analysis of collection systems; Transfer stations – Selection of location, operation & maintenance; options under Indian conditions – Field problems- solving.

|  |  |  |
| --- | --- | --- |
| **LECTURE :** 8 Hrs. | **TUTORIAL:** 0Hrs. | **TOTAL :** 08 Hrs. |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Session no | Topics to covered | Text Book | Chap No and Page No | Instruction Delivery | Testing Method | Instructional Objective | Program outcome |
| Method | Level |
| 1 ,2 | Methods of Residential and commercial waste collection  | Municipal solid waste Management material | Ch No:3Page No : 31-61 | Chalk and black board Teaching | Understanding | Weekly test and short answer Test, Assignment | To impart the knowledge of Collection and transfer of solid waste. | Students will be able to identify the methods of collection and transfer of solid wastes. |
| 3 | Collection vehicles  | Understanding |
| 4 | Manpower  | Understanding |
| 5 | Analysis of collection systems; Transfer stations  | Understanding |
| 6 | Selection of location, | Understanding |
| 7 | Operation & maintenance | Understanding |
| 8 |  Options under Indian conditions – Field problems- solving  | Understanding |

**CUMULATIVE HOUR** = LECTURE -24

**UNIT IV OFF-SITE PROCESSING                                     (12)**

Objectives of waste processing – Physical Processing techniques and Equipments; Resource recovery from solid waste composting and biomethanation; Thermal processing options – case studies under Indian conditions

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| --- | --- | --- | --- | --- | --- | --- | --- |
| Session no | Topics to covered | Text Book | Chap No and Page No | Instruction Delivery | Testing Method | Instructional Objective | Program outcome |
| Method | Level |
| 1,2 | Objectives of waste processing | Municipal solid waste Management material | Ch No:4Page No : 62-101 | Chalk and black board Teaching ,PPT | Understanding | Weekly test and short answer Test, Assignment | To acquire the knowledge of Off –site Processing of solid wastes | Students will be able to list the Off –site Processing techniques. |
| 3,4,5 |  Physical Processing techniques and Equipments | Understanding |
| 6,7 | Resource recovery from solid waste composting  | Understanding |
| 8 | Biomethanation | Understanding |
| 9,10 | Thermal processing options  | Understanding |
| 11,12 | Case studies under Indian conditions | Understanding |

**CUMULATIVE HOUR** = LECTURE -36

**UNIT V DISPOSAL                                                              (9)**

Land disposal of solid waste; Sanitary landfills – site selection, design and operation of sanitary landfills – Landfill liners – Management of leachate and landfill gas- Landfill bioreactor– Dumpsite Rehabilitation

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Session no | Topics to covered | Text Book | Chap No and Page No | Instruction Delivery | Testing Method | Instructional Objective | Program outcome |
| Method | Level |
| 1,2 | Land disposal of solid waste; Sanitary landfills | Municipal solid waste Management material | Ch No:5Page No : 102-122 | Chalk and black board Teaching ,PPT | Understanding | Weekly test and short answer Test, Assignment | To acquire the knowledge of Off –site Processing and waste disposal management. | Students will be able to Evaluate the various options for disposal of wastes and their selection criteria. |
| 3,4 | selection, design and operation of sanitary landfills | Understanding |
| 5 | Landfill liners  | Understanding |
| 6 ,7 | Management of leachate and landfill gas | Understanding |
| 8 | Landfill bioreactor | Understanding |
| 9 | Dumpsite Rehabilitation |

CUMULATIVE HOUR = LECTURE -45

***Assignment details***

1. Solid waste management in the context of environmental sanitation.
2. Role of transfer station in solid waste Management.
3. Ready Reckoner on Implementation of MSWM for ULBs in TAMILNADU.

***Innovative assignment topics***

1. Smart recycling can save money and the Environment..

**FACULTY DETAILS**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sl. No** | **Name** | **Designation** | **Dept.** | **Mail ID** | **Mobile No.** |
| 1 | Mr.T.ADHAVANATHAN | Assistant professor | Civil | adhavanathan@gmail.com | +91 8148266586 |

Staff Signature HOD Signature

TIMETABLE

**Faculty Name**: T.Adhavanathan **Designation:**Assistant Professor **Department:** Civil

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Day. | S.No. | 9.00-9.50 | 9.50-10.40 |  | 10.55- 11.45 | 11.45-12.35 |  | 13.15-14.05 | 14. 05-15.05 |  | 15.05-15.55 | 15.55-16.45 |
| Mon | 1 |  |  |  |  |  |  |  |
| Tue | 2 |  |  |  | CE2039IV |  |  |  | CE2039IV |  |  |  |
| Wed | 3 |  |  |  | CE2039IV |  |  |  |  |  |  |  |
| Thu | 4 |  |  |  |  |  |  |  |  |  |  |  |
| Fri | 5 |  |  |  |  |  |  |  |  |  |  |  |

L -3 P- NIL TOTAL = 3

**COURSE DESCRIPTION**

**SOURCES AND TYPES**

The functional element of collection includes not only the gathering of solid waste and recyclable materials, but also the transport of these materials, after collection, to the location where the collection vehicle is emptied. This location may be a materials processing facility, a transfer station or a landfill disposal site.

**ON-SITE STORAGE & PROCESSING**

Waste handling and separation involves activities associated with waste management until the waste is placed in storage containers for collection. Handling also encompasses the movement of loaded containers to the point of collection. Separating different types of waste components is an important step in the handling and storage of solid waste at the source.

**COLLECTION AND TRANSFER**

The types of means and facilities that are now used for the recovery of waste materials that have been separated at the source include curbside collection, drop off and buy back centers. The separation and processing of wastes that have been separated at the source and the separation of commingled wastes usually occur at a materials recovery facility, transfer stations, combustion facilities and disposal sites.

This element involves two main steps. First, the waste is transferred from a smaller collection vehicle to larger transport equipment. The waste is then transported, usually over long distances, to a processing or disposal site.

**OFF-SITE PROCESSING**

The residential wastes collected and transported directly to a landfill site, residual materials from [materials recovery facilities](http://en.wikipedia.org/wiki/Materials_recovery_facilities) (MRFs), residue from the combustion of solid waste, [compost](http://en.wikipedia.org/wiki/Compost), or other substances from various solid waste processing facilities. A modern sanitary landfill is not a dump; it is an engineered facility used for disposing of solid wastes on land without creating nuisances or hazards to public health or safety, such as the breeding of insects and the contamination of ground water

**DISPOSAL**

The disposal of wastes by land filling or land spreading is the ultimate fate of all solid wastes. A modern sanitary landfill is not a dump; it is an engineered facility used for disposing of solid wastes on land without creating nuisances or hazards to public health or safety, such as the breeding of insects and the contamination of ground water.

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***Performa for Criteria 3***

**Subject Code/Title : EN6501 MUNICIPAL SOLID WASTE MANAGEMENT**

**Academic Year : 2016-2017**

**Sem/Year : VII/ IV (A & B sec)**

**Staff Name T.ADHAVANATHAN**

Course Outcomes:

**COURSE OUTCOMES:**

|  |  |
| --- | --- |
| **EN6501.1** | Students will be able to discuss the Sources and types of municipal solid wastes |
| **EN6501.2** | Students will be able to Interpret the various methods of handling, separation, storage and processing of wastes at the source |
| **EN6501.3** | Students will be able to identify the methods of collection and transfer of solid wastes. |
| **EN6501.4** | Students will be able to list the Off –site Processing techniques. |
| **EN6501.5** | Students will be able to Evaluate the various options for disposal of wastes and their selection criteria. |

**CO – PO MATRIX :**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| **CE6301.1** | **-** | - | **√** | **-** | - | **√** | **√** | **√** | **√** | **√** | - | **√** |
| **CE6301.2** | **√** | - | **√** | **-** | **√** | **√** | **√** | **√** | **√** | **√** | - | **√** |
| **CE6301.3** | **√** | - | **√** | **-** | **√** | **√** | **√** | **√** | **√** | **√** | - | **√** |
| **CE6301.4** | **√** | - | **√** | **√** | **√** | **√** | **√** | **√** | **√** | **√** | - | **√** |
| **CE6301.5** | **√** | **-** | **√** | - | **√** | **√** | **√** | **√** | **√** | **√** | - | **√** |

**GAP ANALYSIS:**

1. **Engineering properties of rocks:**

Drilling, Core recovery, RQD, Sample preparation, tests on rock samples - compression, tensile, shear and slake durability tests.

1. **Remote sensing techniques**

 Study of air photos and satellite images

**Method :** Guest lecture & workshop