

## Curriculum and Syllabi

### PG Diploma in Waste Management and Environmental Hygiene (PGDWMEH)

#### Need & Objective of the Programme:

##### Need

Collection and disposal of solid waste has become a burning issue for people as well as the local bodies all over India from villages to cities. Polluted and stinking water bodies, leaking drainages are common scene these days almost everywhere. Only a small quantity of solid waste is collected and a miniscule of it is properly segregated and reused. Thus waste are either seen littered along streets or end up in landfills, creating lot of health issues for the people in the society. One of the reasons for not recovering wealth from waste is non-availability of people trained in managing wastes. On the other side is the lack of job opportunity for the expanding youth population of developing India. Our beloved AMMA has taken up the issue of waste long back and has been cleaning streets of India through *Amala Bharatham* Programme for more than 10 years now. Of recent times Prime Minister of India has initiated a clean India movement with the flagship *Swachh bharath* Programme. Thus the present programme, PG Diploma in Waste Management and Environmental Hygiene, is in synchronization with the programme of AMMA and the Swachh bharath.

#### Programme Objectives:

1. To provide fundamental knowledge
2. Impart training in analysis of problems and finding out solutions
3. Educate about environmental sustainability
4. Inculcate ethical thinking
5. Train to manage projects
6. To help in life-long learning
7. To provide training on the usage of modern tools

#### Programme Educational Objectives (PEOs)

**PEO1:** To produce professionally qualified man power to handle solid waste

**PEO2:** To improve the scientific management of solid waste so as to create hygienic and sustainable environment

**PEO3:** To meet the demand for skilled man power in solid waste management industry, manufacturing industry for satisfying its Extended Producer Responsibility (EPR), and Producer Responsibility Organisation (PRO)

#### Programme Specific Objectives:

1. To enhance the knowledge on the scientific management of the waste for a sustainable future and promote environmental hygiene
2. To create man power to fill the lacunae of professionals in waste management sector
3. To create entrepreneurs and increase job opportunity for younger generation in waste management sector

### **Programme Outcomes (POs)**

The general Programme Outcomes (POs) include the following:

**PO1:** Gaining fundamental knowledge in science

**PO2:** Ability to analyse problems and find out solutions

**PO3:** Awareness in environmental sustainability

**PO4:** Ethical thinking

**PO5:** Skills to manage projects

**PO6:** Life-long learning

**PO7:** Skills to use modern tools

### **Programme Specific Outcomes (PSOs)**

The Programme Specific Outcomes (PSOs) are listed below:

**PSO1:** Knowledge on waste management for sustainable future and environmental hygiene

**PSO2:** Skills to meet the professional man power demands of the waste management sector

**PSO3:** Encourage entrepreneurs in waste management, thereby creating employment opportunity in waste management sector

### **Opportunities for the students who pass out this Programme**

Sanitation Dept., Public Health Dept., Water Supply and Drainage Board, CSR Programme, Waste Management Units/Industries, Hospital, Water Treat Plants, Public Health Specialist in State and Central Government Departments; Waste Management specialist in Airports, Hotels, Hospitals; Sanitary Officer in Municipal Corporation and Urban Local Bodies, NGOs working in Sanitation and Public Health, Food Industry Authorised Recycling Agencies, PRO organizations, Startups in Waste Management.

## Curriculum

### SEMESTER I

Course Code	Course Title	L-T-P	Credits
21WME501	Overview of Waste Management	4 0 0	4
21WME502	Handling and disposal of major types of wastes	4 0 0	4
21WME503	Water and Soil Resource Management	4 0 0	4
21WME504	Legal Aspects and Mandatory Regulations	4 0 0	4
21WME581	Water pollution	0 0 4	2
21WME582	Waste Management - Field Visit I	0 0 4	2
21ENG112	Professional Communication	2 0 0	2
	<b>Total</b>		<b>22</b>

### SEMESTER II

Course Code	Course Title	L-T-P	Credits
21WME511	Community Mobilization towards Sustainable Development	3 0 0	3
21WME512	Waste Management as Project Management	3 0 0	3
21WME513	Entrepreneurship in Waste Management	3 0 0	3
21WME514	Occupational Health and Safety, Environmental Cost and Risks	4 0 0	4
21WME515	GIS and RS in Waste Management	3 0 0	3
21WME583	Analysis of constituents in Soil and Air	0 0 4	2
21WME584	Waste Management - Field Visit II	0 0 4	2
21WME591	Internship		Pass/Fail
	<b>Total</b>		<b>20</b>

## **Syllabi Course wise**

### **Course 1: Overview of Waste Management**

21WME501	Overview of Waste Management	4 0 0 4
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#### **Course Objectives:**

- To examine the various types of solid waste and methods to categorise it
- To find out methods to reduce solid waste at the source
- To carry out analysis and audit of waste
- To understand people's responsibility in reducing and managing waste

#### **Course Outcomes:**

CO1: Understanding on the types of waste and methods of its categorisation

CO2: Knowledge on the methods to reduce solid waste at source

CO3: Skills to audit the solid waste

CO4: Knowledge on the people's responsibility in waste management

#### **CO-PO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	-	3	-	-	1	-	3	-	-
CO2	3	-	3	-	-	1	-	3	-	-
CO3	-	3	-	1	-	1	1	1	3	-
CO4	-	-	1	3	-	-	-	-	1	-

#### **Syllabus** - Overview of Waste Management

<b>Sl. No.</b>	<b>Unit Title</b>	<b>Unit content</b>
1	Introduction to waste	Problem of Wastes, Types of Solid Waste, Categories of solid waste, Effects of Excess Waste Generation, Waste Characterisation
2	Source Reduction	Solid Waste Reduction, Waste reduction strategies - How to Start a Waste Reduction Program Guideline, Economic benefits of Waste Reduction, Operation on a daily basis
3	Waste Analysis and Waste Audit	Introduction to Terminology of Waste, Waste Analysis, Introduction to Waste Audit, Checklist for performance audit in Waste Collection, Segregation, Transport, Treatment

4	People's Responsibility of Waste Management	Responsibility of Waste Management, Polluter Pays Principle (PPP), Assimilative Capacity and the Precautionary Principle, World Scenario in Scrap Trade Extended Producer Responsibility (EPR), Carrying Capacity, Precautionary Principle
5	Waste Reduction-Towards Zero Waste	Sustainable Living, Waste Reduction at Business (Producer) Level, Waste Reduction at Individual Level: Zero Waste Living, Waste Reduction at Community Level.

### **Evaluation Pattern:**

Assessment	Internal	External
Periodical 1 (P1)	15	0
Periodical 2 (P2)	15	0
Continuous Assessment (CA)*	20	0
End Semester	0	50
Total Marks	50	50

\*CA - Can be Quizzes, Assignments, Projects, and Reports.

### **Further Readings**

1. [Internal Waste Audit: A Best Practices Guide](https://www.partnersinprojectgreen.com/resources/internal-waste-audit-a-best-practices-guide/)  
<https://www.partnersinprojectgreen.com/resources/internal-waste-audit-a-best-practices-guide/>

### **Video Links**

1. Using Waste Audits to Improve Recycling & Recovery Programs  
<https://www.youtube.com/watch?v=DVbB7mVY42Y>
2. EIA waste sector lecture  
<https://www.youtube.com/watch?v=BbKIkL9qsAM>

### **References**

1. Gitanjali Nain Gill, 2011, SAGE Publications's *Green Technology: An A-Z Guide* (2011) whose work for that encyclopedia formed the basis of her contributions to Britannica.

2. Hester, R. E. and R. M. Harrison, (2002). Environmental and health impact of solid waste management activities. Cambridge: The Royal Society of Chemistry.
3. <https://www.downtoearth.org.in/coverage/costs-and-benefits-of-india-s-waste-disposal-options-5623>
4. <https://swachhindia.ndtv.com/national-aluminium-company-limited-advocates-for-use-of-aluminium-foil-as-alternative-to-plastic-26056/>
5. <https://www.downtoearth.org.in/blog/india-s-challenges-in-waste-management-56753>
6. <http://rsos.royalsocietypublishing.org/content/4/3/160764#sec-17>
7. <https://www.downtoearth.org.in/coverage/waste-smart-cities-54119>
8. Johnson, Michael R.; McCarthy, Ian P. (2014-10-01). "Product recovery decisions within the context of Extended Producer Responsibility". *Journal of Engineering and Technology Management*. Engineering and Technology Management for Sustainable Business Development, 34 (9) doi:10.1016/j.jengtecman.2013.11.002
9. Rees, J.F., (1980). The fate of carbon compounds in the landfill disposal of organic matter. J. Chem. Tech. Biotechnol, Vol.30, pp.161-175.
10. Misi, S. N and Forster, C.F (2002). "Semi-Continuous Anaerobic Co-Digestion of Agro-Waste," Environmental Technology, Vol. 23, No. 1, 2002, pp. 445-451
11. Srilatha,H.R., Krishna, N., Sudhakar Bada, K. and Madhukara, K. 1995. Fungal pretreatment of orange processing waste by solid state fermentation for improved production of methane. Process Biochem. 30 : 327-331.
12. Tchobanoglous, G, Theisen, H, and Eliassen, R (1977).Solid Waste Engineering. Principles and Management Issues McGraw Hill Book Company, New York.
13. Waste Management, IANS (2016), <https://swachhindia.ndtv.com/vegetable-markets-get-rs-10-lakh-setting-waste-management-plants-3722/>

## Annexures

- Manual on Sampling, Analysis and Characterization of Hazardous Wastes  
[http://cpcb.nic.in/cpcb/old/upload/Publications/Publication\\_323\\_sec6\\_16.pdf](http://cpcb.nic.in/cpcb/old/upload/Publications/Publication_323_sec6_16.pdf)
- Wastes to Resource : Waste Management Handbook  
[http://cbs.teriin.org/pdf/Waste\\_Management\\_Handbook.pdf](http://cbs.teriin.org/pdf/Waste_Management_Handbook.pdf)
- Performance audit on "management of Waste in India"  
<https://swachcoop.com/pdf/CAG%20Audit.pdf>
- Technical EIA guidance manual for common hazardous waste treatment, storage and disposal facilities

[http://environmentclearance.nic.in/writereaddata/Form-1A/HomeLinks/TGM\\_%20Comman%20Municipal%20Solid%20Waste%20Management\\_160910\\_NK.pdf](http://environmentclearance.nic.in/writereaddata/Form-1A/HomeLinks/TGM_%20Comman%20Municipal%20Solid%20Waste%20Management_160910_NK.pdf)

## Course 2: Handling and Disposal of major types of Wastes

21WME502	Handling and Disposal of major types of Wastes	4 0 0 4
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### Course Objectives:

- To learn the logistics of waste management
- To understand the segregation of waste in the logistics of waste management
- To study the handling of hotel, biomedical, hazardous, electronic, plastic, C & D waste
- To acquire knowledge on recycling and reuse of waste

### Course Outcomes:

CO1: Knowledge on the logistics in waste management

CO2: Awareness on the significance of segregation of waste in waste management

CO3: Ability to manage hotel, biomedical, hazardous, electronic, plastic, C & D waste

CO4: Skill to recycle and reuse of waste materials

### CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	-	3	-	-	1	-	3	-	-
CO2	1	2	2	1	-	1	-	3	-	-
CO3	1	3	2	-	1	1	1	1	3	1
CO4	0	3	1	-	1	-	1	1	3	1

### Syllabus - Handling and Disposal of major types of Wastes

Sl. No.	Unit Title	Unit content
1	Logistics in Waste Management	Introduction to Waste Management, Logistics, Human Components, Technological Components- Waste Handling Equipment and Technology, Social Aspects and Managerial Goals, Steps in a waste management logistics process
2	Disposal of Municipal and Market Waste, Hotel waste	Segregation, collection, transportation and treatment methods (Sanitary landfill methods)
3	Disposal of Biomedical and Hazardous	Segregation, collection, transportation and treatment methods



	Waste	
4	Disposal of electronic, C & D and Plastic	Segregation, collection, transportation and treatment methods
5	Recycle and Reuse of Waste	Re-use, General Process of Recycling, Precautions for Recycling –Aluminium, Glass, Precautions while Recycling of Plastics, Precautions while Recycling paper Amplifying benefits from waste

### **Evaluation Pattern:**

Assessment	Internal	External
Periodical 1 (P1)	15	0
Periodical 2 (P2)	15	0
Continuous Assessment (CA)*	20	0
End Semester	0	50
Total Marks	50	50

\*CA - Can be Quizzes, Assignments, Projects, and Reports.

### **Further Reading**

- Tupen, Holley (2014), 'Reducing And Managing Food Waste In Hotels', <http://www.greenhotelier.org/know-howguides/reducing-and-managing-food-waste-in-hotels/>
- International Tourism Partnership (2008): *Environment Management For Hotels The Industry Guide To Sustainable Operation*
- American Hotel & Lodging Association (AH&LA). 2014. *History of Lodging*. <http://www.ahla.com/content.aspx?id¼4072>
- [https://www.hotel-online.com/press\\_releases/release/effective-ways-of-waste-management-in-the-hotel-industry-and-its-importance](https://www.hotel-online.com/press_releases/release/effective-ways-of-waste-management-in-the-hotel-industry-and-its-importance)
- <https://www.nea.gov.sg/docs/default-source/resource/3r-guidebook-for-hotels.pdf>
- [http://www.wrap.org.uk/sites/files/wrap/Food\\_Waste\\_Tracking\\_Sheet\\_v1.1\\_0\\_050115.pdf](http://www.wrap.org.uk/sites/files/wrap/Food_Waste_Tracking_Sheet_v1.1_0_050115.pdf), Food Tracking Form
- \$19,000 saving in food cost- <https://www.unileverfoodsolutions.com.au/chef-inspiration/chef->

[training-and-resources/managing-food-waste/waste-reduction-a-success-story.html](https://www.unileverfoodsolutions.com.au/chef-inspiration/chef-training-and-resources/managing-food-waste/waste-reduction-a-success-story.html)

- Environmental Engineering Series - Environmental Management by T.V.Rama Chandra & Vijay Kulkarni
- Text book of Solid Wastes Management by Naved Ahsan & Iqbal H.khan
- Wealth from Waste - Agricultural food and chemical Processing Waste by S.C.Bhatia
- Integrated Solid Waste Management, Engineering Principles and Management Issues by George Teho Banglous Hilary Theisen Samuel A. Vigal
- Solid Waste Management of Municipalities Dr P.S Ajith & Dr P.N. Hari Kumar
- Solid Waste Management - Present and Future Challenges - Jagbir Singh & AL Ramanathan
- Smart Cities - Transforming India - Prof M.P Dube
- Environmental Engineering Series - Management of Municipal Solid Waste - T.V.Rama Chandra
- Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha
- Environmental Studies by R. Rajagopalan
- Environmental pollution control engineering by C.S. Rao
- Waste Management Practices by John Pichtel
- Solid wastes management by Stephen Burnley
- Eco-Economy: Building an Economy For The Earth by Lester R.Brown
- Environmental Law and Policy in India: Cases, Materials, and Statutes by Armin Rosencranz and Shyam Divan
- Environmental Law in India by P. Leelakrishnan
- Not in My Backyard - Solid Waste Mgmt in Indian Cities by Sunita Narain & Swati Singh Sambyal
- Environmental and Pollution Laws In India by Justice T S Doabia
- *Collapse: How Complex Societies Choose to Fail or Survive*, Jared Diamond

### Video Links

- \$19,000 saving in food cost -  
<https://www.unileverfoodsolutions.com.au/chef-inspiration/chef-training-and-resources/managing-food-waste/waste-reduction-a-success-story.html> , Accessed on Nov 28, 2018 @ 16:00

### Films

1. How fast fashion adds to the world's clothing problem, Duration 22 min  
<https://www.youtube.com/watch?v=eIU32XNj8PM>
2. A cluttered life: Middle class abundance. Duration 19 min.  
<https://www.youtube.com/watch?v=3AhSNsBs2Y0>
3. Why I live a zero waste life, Lauren Singer, TEDxTeen Duration: 14 min

<https://www.youtube.com/watch?v=pF72px2R3Hg&feature=youtu.be>

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## References

- Baveja G, Muralidharar S, Aggarwal P. Hospital Waste Management - an overview. Hospital today 2000; 5(9): 485-486.
- Bio-Medical Waste (Handling and Management) Rules 1998. Available from: <http://www.moef.nic.in/legis/hsm/biomed.html> [Last accessed on 2014 Jan 20].
- Centre for Science and Environment. Bio Medical Waste Rules made stringent. Available from: <http://www.cseindia.org/node/3702> [Last accessed on 2014 Jan 20].
- EU Directive on Incineration of Hazardous Waste 2000/76/EC; [http://faolex.fao.org/cgi-bin/faolex.exe?rec\\_id=030016&database=faolex&search\\_type=link&table=result&lang=eng&format\\_name=@ERALL](http://faolex.fao.org/cgi-bin/faolex.exe?rec_id=030016&database=faolex&search_type=link&table=result&lang=eng&format_name=@ERALL)
- Mathur P, Patan S, Shobhawat S. Need of biomedical waste management system in hospitals - an emerging issue - A review. Curr World Environ 2012;7:117-24.
- Omidiani, Afsanehsadat and HashemiHezaveh, Seyed Mohsen (2016) Waste Management in Hotel Industry in India: A Review , International Journal of Scientific and Research Publications, 6(9).
- Pasupathi P, Sindhu S, Ponnusha BS, Ambika A. Biomedical waste management for health care industry. Int J Biol Med Res 2011; 2: 472-486.
- Shanklin CW, Petrillose MJ, Pettay A (1991) Solid Waste Management Practices in Selected Hotel Chains and Individual Properties. J Hosp Tour Res 15(1):59-74. <https://doi.org/10.1177/109634809101500106>
- Singh N, Cranage D, Lee S (2014) Green Strategies for Hotels: Estimation of Recycling Benefits. Int J Hosp Manag 43:13-22. <https://doi.org/10.1016/j.chemosphere.2007.10.024>
- Singh, N., Cranage, D., and Lee, S. 2014. Green strategies for hotels: Estimation of recycling benefits. International Journal of Hospitality Management, 43, 13-22.
- Tang, J. 2004. A Case Study of a Hotel Solid Waste Management Program in Bali, Indonesia. <http://www.collectionscanada.gc.ca/obj/s4/f2/dsk3/OWTU/TC-OWTU373.pdf>
- Vishal Khandelwal, Sushma Khandelwal, Jandel Singh Thakur. Healthcare waste disposal among private dentist in an Indian city: it's time to act. Int J Infect Control 2013, v9:i2 doi: 10.3396/ijic.v9i2.016.13.

- WHO (1985). Management of waste from hospitals and other health care establishments. Report on a WHO meeting, Bergen, 28 June-1 July 1983. Copenhagen, World Health Organization Regional Office for Europe (EURO Reports and Studies, No. 97).
  - Zein, K., Wazner, M.S., Meylan, and G. 2008. Best Environmental Practices for the Hotel.
  - Applying MSW to Farms :Almitra Patel  
<http://www.almitrapatel.com/composting.htm>
  - Anaerobic Digestion:  
[https://www.researchgate.net/publication/322099575\\_Effect\\_of\\_Oil\\_Content\\_on\\_Biogas\\_Production\\_Process\\_Performance\\_and\\_Stability\\_of\\_Food\\_Waste\\_Anaerobic\\_Digestion](https://www.researchgate.net/publication/322099575_Effect_of_Oil_Content_on_Biogas_Production_Process_Performance_and_Stability_of_Food_Waste_Anaerobic_Digestion)
  - Ban on scrap import: <http://greatforest.com/sustainability101/china-ban-what-to-do/>
  - <https://www.wastedive.com/news/china-situation-scrap-import-green-fence-national-sword-blue-sky/520306/>
  - Bioaccumulation and Biomagnification: University of Wollongong, Australia and Greenpeace, UK  
<https://www.uow.edu.au/~sharonb/STS300/science/regulation/infoprinciple.html>
  - Steel Scrap: Institute of Scrap Recycling Industries (ISRI), U.S.A
  - Biodegradable bags: <https://www.plasticplace.com/blog/5-surprising-secrets-of-biodegradable-plastic-bags>
  - Bioreactor Landfill:  
<https://www.wm.com/sustainability/pdfs/bioreactorbrochure.pdf>
  - Bioremediation:  
<https://www.slideshare.net/WaqasAzeem1/bioremediation-of-contaminated-soils>
  - Cartridge based Razor:  
<http://www.greatrecovery.org.uk/resources/3682/>
  - Extended Producers Responsibility:  
[https://www.oecd.org/environment/waste/Session\\_1-EPR-Toxics-Link1-Ravi\\_Agarwal.pdf](https://www.oecd.org/environment/waste/Session_1-EPR-Toxics-Link1-Ravi_Agarwal.pdf)
- Waqas Azeem, 2013,  
<https://www.slideshare.net/WaqasAzeem1/bioremediation-of-contaminated-soils>
- Jawaharnagar Capping: Newspaper reports in leading English dailies
  - Life Cycle Analysis and Circular Economy:  
<http://www.greatrecovery.org.uk/resources>
  - Paper recycling: <https://www.thehindu.com/todays-paper/tp-miscellaneous/tp-others/want-that-waste-paper/article2765272.ece>
  - Plastic recycling codes: Plastics by numbers, written by Greg Seaman, May 2012

- Polluter Pays: <https://www.thequint.com/news/india/know-the-polluter-pays-principle-who-pays-and-how-much>
  - Ponomia College Case Study: Char Miller and Bowen Close, Trash Talk: A case study of waste analysis at Pomona College March 28, 2011, The Journal of Sustainability Education. Accessed on 19th Nov, 2018. [http://www.susted.com/wordpress/content/trash-talk-a-case-study-of-waste-analysis-at-pomona-college\\_2011\\_03/](http://www.susted.com/wordpress/content/trash-talk-a-case-study-of-waste-analysis-at-pomona-college_2011_03/)
  - Precautionary Principle in Environmental Science: Kriebel D1, The precautionary principle in environmental science. Environ Health Perspect. 2001 Sep; 109(9):871-6. <https://www.ncbi.nlm.nih.gov/pubmed/11673114>
  - Preventive Maintenance: <https://www.micromain.com/what-is-preventive-maintenance>
  - Producer Responsibility Organisation (PRO): Dinesh Raj Bandela July 2018, Down to Earth <https://www.downtoearth.org.in/news/waste/how-plastic-producing-companies-can-make-waste-recycling-viable-61272>
  - Reuse of Tyre Scraps: Sustainability Issues in Civil Engineering edited by G.L. Sivakumar Babu, Sireesh Saride, B. Munwar Basha
  - Reverse Logistics: <https://www.ecomena.org/reverse-logistics>
  - Sikkim: The Logical Indian, Story by Prakash Chandra Bhatt
  - SWM During Festivals: [http://timesofindia.indiatimes.com/articleshow/48026617.cms?utm\\_source=contentofinterest&utm\\_medium=text&utm\\_campaign=cppst](http://timesofindia.indiatimes.com/articleshow/48026617.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst)
  - Anisha Bhatia. Sept 2017. <https://swachhindia.ndtv.com/mumbai-comes-together-city-cleaned-post-ganesh-chaturthi-festival-11626/>
  - Gopi Karelia, Sep 2018, <https://swachhindia.ndtv.com/ganesh-chaturthi-pune-diverts-120-tonnes-of-waste-from-going-into-the-mulamutha-river-25267/>
- (<https://www.youtube.com/watch?v=7XQM9ff8YYE>)
- DC news, Kottayam, 24 Oct 2018.
  - Sustainable Development: <https://www.environmentalscience.org/sustainability>
  - Three Bin Culture: <http://www.newindianexpress.com/cities/bengaluru/2017/may/23/mr-prime-minister-three-bins-are-more-swachh-than-two-1607839.html>
  - Used Cooking Oil: <http://indianbioenergy.com/used-cooking-oil/>
  - Waste Prevention: <https://learn.eartheasy.com>
  - Waste transport, SWM enterprise profitable,: <http://www.open.edu/openlearncreate/mod/oucontent/view.php?id=80575&printable=1>
  - Waste tracking: [https://www.wm.com/about/community/pdfs/follow\\_the\\_waste\\_stream.pdf](https://www.wm.com/about/community/pdfs/follow_the_waste_stream.pdf)

- Zero-waste living: Janey D: <https://www.lifeadvancer.com/zero-waste-living>

### Course 3: Water and Soil Resource Management

21WME503	Water and Soil Resource Management	4 0 0 4
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#### Course Objectives:

- To find out types of water and soil pollution, its causes and consequences
- To learn procedures in water and soil quality monitoring
- To understand the responsibility of individuals, community and local administration in handling water and waste water
- To acquire knowledge on monitoring and management of landfill sites

#### Course Outcomes:

CO1: Knowledge on the issues in water and soil pollution

CO2: Development of skills in water and soil quality management

CO3: Understanding on the responsibility of individuals, community and local administration in handling water and waste water.

CO4: Ability on management of landfill sites

#### CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1	2	-	-	-	-	2	-	-
CO2	1	2	2	-	-	1	1	1	1	-
CO3	-	1	1	3	-	2	-	1	-	-
CO4	-	2	1	-	2	-	2	2	1	1

#### Syllabus - Water and Soil Resource Management

Sl. No.	Unit Title	Unit content
1	Water Quality Issues, monitoring and its Management	Causes, Types and Consequences of Water Pollution. Water sampling procedures, water quality monitoring and important water quality parameters. Individual, community and municipal responsibility in water quality management, handling waste water (production, disposal and treatment)
2	Conventional Water and Waste Water Technologies	Conventional system of sewage and wastewater treatment – primary, secondary, tertiary treatments. Issues in operating and maintenance of STPs and WWTPs, Water reclamation and reuse, sludge disposal and its application.

3	Modern and innovative Water and Waste Water Technologies	Modern technologies for waste water treatment – DEWATS, planted filter, constructed wetlands, Biological Nutrient Removal Systems, Disinfection, sludge management, Faecal Sludge Management (FSM), Ecological Sanitation (Ecosan)
4	Soil quality management	Soil sampling, monitoring and study on important soil quality parameters. Causes, Types and Consequences of Soil Pollution. Soil restoration and recovery, soil remediation – bioremediation
5	Land Resource Management	Monitoring and management of landfill sites, scientific bio-mining of accumulated inert waste, improving quality of waste dump yards and land reclamation

### **Evaluation Pattern:**

Assessment	Internal	External
Periodical 1 (P1)	15	0
Periodical 2 (P2)	15	0
Continuous Assessment (CA)*	20	0
End Semester	0	50
Total Marks	50	50

\*CA - Can be Quizzes, Assignments, Projects, and Reports.

### **Further Reading**

Guidelines for water quality monitoring, CPCB,

<http://cpcb.nic.in/openpdffile.php?id=UmVwb3J0RmlsZXNmV3SXRlbV8xMTZfR3VpZGVsaW5lc29mIHdhbGVycXVhbGl0eW1vbml0b3JpbmdfMzEuMDcuMDgucGRm>

### **Films**

1. Sampling Wastewater at a Wastewater Treatment Facility 1993 EPA Training Film, Duration 23 min  
<https://www.youtube.com/watch?v=MaiWU1kL2wU>
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## Course 4: Legal Aspects and Mandatory Regulations

21WME504	Legal Aspects and Mandatory Regulations	4 0 0 4
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### Course Objectives:

- To know the Constitutional provisions and legal institutions in India
- To study important Environmental Acts and Public Acts in India
- To understand the Acts, Rules and Regulations in waste management
- To get knowledge on Treaties and Conventions to protect environment

### Course Outcomes:

CO1: Information on the Constitutional provisions and legal institutions

CO2: Awareness on the Environmental Acts and Public Acts in India

CO3: Understanding on the Acts, Rules and Regulations in waste management

CO4: Knowledge on Treaties and Conventions to protect environment

### CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	-	1	0	-	-	-	3	-	-
CO2	3	-	1	-	1	-	-	2	-	-
CO3	3	-	1	-	1	-	-	2	-	-
CO4	1	-	1	-	-	-	-	2	-	-

### Syllabus - Legal Aspects and Mandatory Regulations

Sl. No.	Unit Title	Unit content
1	Constitutional provisions for the protection of Environment	Fundamental Rights and Fundamental Duties, Directive Principles of State Policy and other Constitutional mandates, Legal and Regulatory Framework in India, Public Interest Litigation, National Green Tribunal, The Ministry of Environment, Forest and Climate Change, CPCB, Pollution Control Committee, SPCB, DPCB
2	Environmental and Public Acts	Forest & Wildlife Act, Air, Water and Noise Act, Environment Protection Act 1986, The Motor Vehicles Act 1988, Public Liability Insurance Act 1991, Shops and Establishment Act, Minimum Wages Act, Social Security Act (ESI, PF)
3	Acts, Rules and	Municipal Solid Waste Management Rules 2016, The Plastic Waste Management Rules 2016, The Construction

	Regulations in Waste Management-I	and Demolition Waste Management Rules 2016, EPR-Extended Producer Responsibility, Cleaner Production Option and Waste Management
4	Acts, Rules and Regulations in Waste Management-II	The Hazardous Waste Management Rules, Biomedical Wastes (Management and Handling) Rules 2016 & 2018. E-waste (Management and Handling) Rules 2016, 2019. The Batteries (Management and Handling) Rules 2001, 2016, 2020 with latest amendments
5	Treaties and Conventions in Environment	International Treaties, International Conventions, Corporate Social Responsibility, INGO's and NGO's responsibility in Protecting Environment

### **Evaluation Pattern:**

Assessment	Internal	External
Periodical 1 (P1)	15	0
Periodical 2 (P2)	15	0
Continuous Assessment (CA)*	20	0
End Semester	0	50
Total marks	50	50

\*CA - Can be Quizzes, Assignments, Projects, and Reports.

### **Video Lessons**

Conservation of Biodiversity Biological Diversity Act

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Indian Law Institute. Polluter Pays Principle and the Supreme Court of India. (108-116) Pdf- by Satish C Shastri, Assoc. Proffesor, University of Rajasthan.

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17. <https://www.legalbites.in/national-green-tribunal/>
18. [http://iced.cag.gov.in/?page\\_id=1069](http://iced.cag.gov.in/?page_id=1069)
19. <http://www.conservationindia.org/resources/ngt> -Everything you need to know about the National Green Tribunal (NGT)-by [Praveen Bhargav](#)
20. <https://www.lawteacher.net/free-law-essays/environmental-law/>
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22. Caselets- <http://www.indialegallive.com/cover-story-articles/focus/solid-waste-management-waste-building-54490>

## Books for Reference

- Environmental Law and Policy in India: Cases, Materials, and Statutes by Armin Rosencranz and Shyam Divan
- Environmental Law in India by P. Leelakrishnan
- Environmental and Pollution Laws In India by Justice T S Doabia

## Course 5: Water pollution

21WME581	Water pollution	0 0 4 2
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### Course Objectives:

- To analyse the important pollutants in water
- To learn the basic principles involved in the analysis of water.

### Course Outcomes:

CO1: Apply the basic knowledge in determining the physical parameters and oxygen demand of water samples.

CO2: Analyze the cationic pollutants present in water.

CO3: Estimate the amount of anionic pollutants present in water.

### CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	1	1	-	-
CO2	2	1	-	-	-	-	1	1	-	-
CO3	2	1	-	-	-	-	-	1	-	-

### Syllabus – Water Pollution

Sl. No.	Lab Slot	Parameters
1	S1	Water colour, pH, EC, Temperature,
2	S2	TS, TDS, TSS, Turbidity
3	S3	DO
4	S4	Hardness, Calcium and Magnesium
5	S5	Alkalinity, Carbonates and Bicarbonates
6	S6	Total chloride
7	S7	Estimation of ferrous ion
8	S8	BOD
9	S9	Model Lab
10	S10	Final Lab Exam

**Evaluation Pattern:**

Assessment	Internal	External
Continuous Assessment (CA)	30	0
End Semester	0	70
Total Marks	30	70

**Reference books**

1. A Comprehensive Laboratory Manual for Environmental Science and Engineering by P R Sreemahadevan Pillai, New Age International publishers, 2009.
2. Environmental laboratory exercises for Instrumental Analysis and Environmental chemistry by Frank M Dunnivant, Wiley International, 2004.

## Course 6: Waste Management – Field Visit – I

21WME582	Waste Management – Field Visit – I	0 0 4 2
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### Course Objectives:

- To study the technological options in solid and liquid waste management
- To understand the design and functions of different waste management modules in treating the solid and liquid wastes
- To learn the recovery of products from waste

### Course Outcomes:

CO1: Understanding technological options in solid and liquid waste management

CO2: Knowledge on the design and functions of different waste management modules in treating the solid and liquid wastes

CO3: Skills to recover products from waste

### CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	2	3	-	3	2	2	3	-	2
CO2	1	2	3	-	3	2	2	3	-	2
CO3	-	3	2	-	3	2	3	1	3	3

### Syllabus – Waste Management – Field Visit – I

Sl. No.	Places of visit
1	Municipal Solid Waste Management Facility Centre (Morning Roll call, Allocation of duties to Green Friends or Conservancy workers, Collection Practices, Primary and Secondary Transportation, Waste Processing, Recyclable and Inert Waste Handling, End Product marketing)
2	e-waste handling facility centre
3	Biomedical Waste Management Plant
4	Composting Unit/MCC (Micro Composting Centres)
5	Sustainable Agriculture using Organic Fertilizers
6	EM Solution, Panchagavya preparation and its application in Agriculture and Waste Management
7	Waste to energy projects
8	Amrita Biomedical Waste Management Centre (Kochi)
9	Construction & Demolition Waste Management Unit
10	Decentralised Waste Water Treatment Systems (DEWATS)

11	Faecal/ Sludge Management Unit
12	Visit to the Offices of Green Tribunal, PCB, Hazardous Waste Management Units, Crematorium

**Evaluation Pattern:**

Assessment	Internal	External
Continuous Assessment (CA)	30	0
End Semester	0	70
Total Marks	30	70

## Course 7: Professional Communication

21ENG112	Professional Communication	1 0 2 2
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### Course Objectives:

- To convey and document information in a formal environment
- To acquire the skill of self-projection in professional circles
- To inculcate critical and analytical thinking

### Course Outcomes:

CO1: Demonstrate competency in oral and written communication

CO2: Apply different styles of communication in professional context

CO3: Participate in different planned & extempore communicative activities

CO4: Interpret and discuss facts and information in a given context

CO5: Develop critical and analytical thinking

### CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	1	1	-	2	1
CO2	2	-	-	-	-	2	1	-	2	2
CO3	2	-	-	-	-	1	-	-	2	2
CO4	1	1	-	-	-	-	-	-	1	1
CO5	-	2	-	1	-	-	1	-	3	2

### Syllabus - Professional Communication

Sl. No.	Unit Title	Unit content
1	Unit-1	Vocabulary Building: Prefixes and Suffixes; One-word substitutes, Modal auxiliaries, Error Analysis: Position of Adverbs, Redundancy, misplaced modifiers, Dangling modifiers – Reported Speech
2	Unit-2	Instruction, Suggestion & Recommendation - Sounds of English: Stress, Intonation - Essay writing: Analytical and Argumentative
3	Unit-3	Circulars, Memos – Business Letters - e - mails
4	Unit-4	Reports: Trip report, incident report, event report - Situational Dialogue - Group Discussion
5	Unit-5	Listening and Reading Practice - Book Review



**Evaluation Pattern:**

Assessment	Internal	External
Periodical 1 (P1)	20	0
Periodical 2 (P2)	20	0
Continuous Assessment (CA)*	40	0
End Semester	0	20
Total Marks	80	20

\*CA – Oral Communication skills based on class activities, GD/ debate, situational dialogues, *etc.* **20**; Listening and Reading Comprehension – **20**

**References**

1. Felix Eskey. *Tech Talk*, University of Michigan. 2005
2. Michael Swan. *Practical English Usage*, Oxford University Press. 2005
3. Anderson, Paul. *Technical Communication: A Reader Centered Approach*, V Edition, Harcourt, 2003.
4. Raymond V. Lesikar and Marie E. Flatley. *Basic Business Communication*, Tata McGraw Hill Pub. Co. New Delhi. 2005. Tenth Edition.
5. Thampi, G. Balamohan. *Meeting the World: Writings on Contemporary Issues*. Pearson, 2013.
6. Lynch, Tony. *Study Listening*. New Delhi: CUP, 2008.
7. Kenneth, Anderson, Tony Lynch, Joan Mac Lean. *Study Speaking*. New Delhi: CUP, 2008.
8. Marks, Jonathan. *English Pronunciation in Use*. New Delhi: CUP, 2007.
9. Syamala, V. *Effective English Communication For You (Functional Grammar, Oral and Written Communication)*: Emerald, 2002.

## Course 8: Community mobilization towards Sustainable Development

21WME511	Community mobilization towards Sustainable Development	3 0 0 3
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### Course Objectives:

- To pursuit of knowledge for community mobilization
- To provide tools that drive community efforts on sustainable development.
- To determine the role of individuals and communities in sustainable development by changing their habits and lifestyles
- To assess the practices of community with the help of key indicators and design, development programs for sustainable living and its sustenance

### Course Outcomes:

CO1: Awareness on community mobilization

CO2: Knowledge on the tools that drive community efforts on sustainable development.

CO3: Understanding on the role of individuals and communities in sustainable development

CO4: Information on the practices followed in community for sustainable living

### CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	2	2	2	-	1	-	-	-	-
CO2	2	1	2	-	-	1	2	-	-	-
CO3	1	2	3	2	1	1	-	-	1	-
CO4	-	1	3	3	-	2	-	1	1	-

### Syllabus - Community mobilization towards Sustainable Development

Sl. No.	Unit Title	Unit content
1	Community Dynamics	Introduction to Community Dynamics, Significance, Community based programs, Community Level and groups, Community Motivation, Gender Empowerment, Case studies
2	Change Management	Overview of Change Management, Importance of Change Management, Understanding System Perspective of Community Change Management, Key Process Flow, Team for Change Management, Understanding the

		Stakeholders, Characteristics of Change Leaders
3	Sustainable Communities	Concept and Principle of Sustainable Community, Characteristic of Sustainable Community, Design of Sustainable Community, Community Sustainable Indicators, Sustainable Sustenance, Case Studies
4	Behaviour Change Communication	Social Change and Behavioural Change, Social-Ecological Model-An overarching theory of change, Behaviour Change Process, Effective communication, Quality of Good Communicator, Interpersonal Communication, Personality development, Use of IEC materials, Theory of Adult Learning, Facilitation Skills, BCC in Waste Management
5	Community Mobilization	Community Mobilization and Social Mobilization, Importance of Community Mobilization, Employment opportunities at Community Level, Community Learning, Adapting to New Sustainable System

### **Evaluation Pattern:**

Assessment	Internal	External
Periodical 1 (P1)	15	0
Periodical 2 (P2)	15	0
Continuous Assessment (CA)*	20	0
End Semester	0	50
Total Marks	50	50

\*CA - Can be Quizzes, Assignments, Projects, and Reports.

### **References:**

1. Jick, Todd (1991). *Implementing Change*. HBS Note, 9-491-114
2. Hurst, David K. (1995) *Crisis & Renewal: Meeting the Challenge of Organisational Change*. Boston, Mass.: Harvard University Press, p. 148.
3. Gopakumar, M. G. (2005) *Project Manthan at Tata Chemicals Limited: Case*, Tata Management Training Centre, Pune
1. Gopakumar, M. G. (2005) *Project Manthan at Tata Chemicals Limited: Case*, Tata Management Training Centre, Pune
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4. James F Kirle, 'The community leadership Handbook: Framing Ideas, Building relationships and Mobilizing Resources', Fieldstone Alliance (5 May 2013)
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6. John Kotter, 'Leading Change' , Harvard Business Review Press, 1996
7. John Kotter, 'Leading Change' , Harvard Business Review Press, 1996
8. Patil A. R, 'Community Organization and Development: An Indian Perspective', Prentice Hall India Learning Private Limited (2012)
9. William Bridges, 'Managing Transitions: Making the Most of the Change', Da Capo Lifelong Books; 3 edition 2009
10. William Bridges, 'Managing Transitions: Making the Most of the Change', Da Capo Lifelong Books; 3 edition 2009

### **Books for Reference**

1. Text book of Solid Wastes Management by Naved Ahsan & Iqbal H.khan
2. Wealth from Waste - Agricultural food and chemical Processing Waste by S.C.Bhatia
3. Integrated Solid Waste Management, Engineering Principles and Management Issues by George Teho Banglous Hilary Theisen Samuel A. Vigal
4. Smart Cities - Transforming India - Prof M.P Dube
5. Waste Management Practices by John Pichtel
6. Solid wastes management by Stephen Burnley
7. Eco-Economy: Building an Economy For The Earth by Lester R.Brown
8. Not in My Backyard - Solid Waste Mgmt in Indian Cities by Sunita Narain & Swati Singh Sambyal

## Course 9: Waste Management as Project Management

21WME512	Waste Management as Project Management	3 0 0 3
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### Course Objectives:

- To understand the waste management scenario, scientific and technological options to manage waste
- To study the trends in recycling of waste, market for recycled and recovered products
- To learn the practices and innovations in waste management
- To acquire knowledge on the conceptualization and management of projects in waste management

### Course Outcomes:

CO1: Understanding on the waste management scenario and options to manage waste

CO2: Information on the trends in recycling of waste and marketing of recovered products

CO3: Knowledge on the practices and innovations in waste management

CO4: Skills to conceptualize and manage waste management projects

### CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	1	2	-	2	-	-	3	2	3
CO2	1	2	2	-	2	-	1	3	2	1
CO3	1	2	2	1	2	1	1	2	3	3
CO4	-	3	2	-	2	2	2	2	3	3

### Syllabus - Waste Management as Project Management

Sl. No.	Unit Title	Unit content
1	Overview of Waste and Resource	Knowing waste, Waste management: Scenario in India and abroad, Scientific approach in waste management Sustainable development goals – waste management connect in business practice
2	Waste Market Survey	Changing scenarios in waste market, recycling trends and status in India. Market linkages and waste management credits perspective - Circular Economy

3	Practices and Innovation	Technological options, practices and innovation in waste management, Common Waste Management Practices & Strategies – CAMS (Collective Alternative Management Systems), CMS (Competence Management System), NAMAs (Nationally Appropriate Mitigation Actions)
4	Conception of project	Context based approaches of managing wastes, Project Management – Conception, Planning, design, development, Implementation, Resource allocation
5	Project management	Project Management – Costing, Affordability, market requirement; PERT (Program Evaluation and Review Technique), CPM (Critical Path Method), SWOT (Strengths, Weakness, Opportunities & Threats) Analysis and Gantt chart, Demand Management – Contracting and sub-contracting, Out-sourcing and in-sourcing, Risk analysis & Management techniques, Hands-on exercises on Activity planning & scheduling tools including PERT/CPM using Microsoft Project/ProjectLibre

### **Evaluation Pattern:**

Assessment	Internal	External
Periodical 1 (P1)	15	0
Periodical 2 (P2)	15	0
Continuous Assessment (CA)*	20	0
End Semester	0	50
Total Marks	50	50

\*CA - Can be Quizzes, Assignments, Projects, and Reports.

### **References**

1. Baud, I., Grafakos, S., Hordijk, M., Post J., 2001. Quality of Life and Alliances in Solid Waste Management: Contributions to Urban Sustainable Development Cities 18 (1), 3–12.
2. C.P. Balde, R. Kuehr, K. Blumenthal, S. Fondeur Gill, M. Kern, P. Micheli, E. Magpantay, J. Huisman (2015), *E-waste statistics: Guidelines on classifications, reporting and indicators*. United Nations University, IAS - SCYCLE, Bonn, Germany.
3. Cheremisinoff N. Handbook of solid waste management and waste minimization technologies. Amsterdam: Butterworth-Heinemann, 2003, 98.

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6. D. Hoornweg, P. Bhada-Tata (2012), *What a Waste: A Global Review of Solid Waste Management*. The World Bank, Urban Development & Local Government Unit, Washington, USA.
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8. Ecoreco: <http://ecoreco.com/services-weee-recycling.aspx>; WEEE 2020 Raw Material Partnership
9. Ellen MacArthur Foundation : Circular Economy [https://www.ellenmacarthurfoundation.org/assets/downloads/publications/Circular-economy-in-India\\_5-Dec\\_2016.pdf](https://www.ellenmacarthurfoundation.org/assets/downloads/publications/Circular-economy-in-India_5-Dec_2016.pdf)
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15. He R, Liu X, Zhang Z, Shen D. Characteristics of the bioreactor landfill system using an anaerobic-aerobic process for nitrogen removal. Bioresource Technology 2007; 98(13):2526-2532.
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17. How technology can help informal waste pickers solve India's recycling problem <https://nextbillion.net/from-trash-to-resource-how-technology-can-help-informal-waste-pickers-solve-indias-recycling-problem/>
18. Inclusive Innovations, Editors are Elaine Tinsley and Natalia, Researched and developed by Intellect [https://www.innovationpolicyplatform.org/system/files/4%20Integrated%20Waste%20Manangement\\_Apr6.pdf](https://www.innovationpolicyplatform.org/system/files/4%20Integrated%20Waste%20Manangement_Apr6.pdf)
19. International Labour Organization (2012), *working towards sustainable development: opportunities for decent work and social inclusion in a green economy*. International Labour Office, Geneva, Switzerland.
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31. CPHEEO (2000), Manual on Municipal Solid Waste Management, pp. 219-227, Central Public Health and Environmental Engineering, New Delhi, India.

### **Student Take away – Knowledge tool kit**

1. An interactive knowledge repository, transfer and exchange platform to inform, empower and connect  
<http://knowwaste.net/>
2. [Asia waste management outlook, 2017](http://knowwaste.net/Documents/Asia%20Waste%20Management%20Outlook%20SEP%202017_131527007771045828.pdf)  
[http://knowwaste.net/Documents/Asia%20Waste%20Management%20Outlook%20SEP%202017\\_131527007771045828.pdf](http://knowwaste.net/Documents/Asia%20Waste%20Management%20Outlook%20SEP%202017_131527007771045828.pdf)

### **Tool Kit**

- Making waste work : A tool kit : [https://ciwm-journal.co.uk/downloads/Making-Waste-Work\\_Toolkit-Vol-1.pdf](https://ciwm-journal.co.uk/downloads/Making-Waste-Work_Toolkit-Vol-1.pdf)
- Tool kit for solid waste management Jawaharlal Nehru National Urban Renewal; November,  
[2012Missionhttp://www.indiawaterportal.org/sites/indiawaterportal.org/files/tool\\_kit\\_on\\_solid\\_waste\\_management.pdf](http://www.indiawaterportal.org/sites/indiawaterportal.org/files/tool_kit_on_solid_waste_management.pdf)
- Tool kit for implementation of solid waste management rules, [2016](http://www.npcindia.gov.in/wp-content/uploads/2017/11/Guidelines-of-implementation-for-SWM-Rules-2016.pdf)  
<http://www.npcindia.gov.in/wp-content/uploads/2017/11/Guidelines-of-implementation-for-SWM-Rules-2016.pdf>
- Toolkit for Public Private Partnership frameworks in Municipal Solid Waste Management



[https://smartnet.niua.org/sites/default/files/resources/India\\_SolidWasteMgmt\\_PP\\_Toolkit-Volume-I\\_EN.pdf](https://smartnet.niua.org/sites/default/files/resources/India_SolidWasteMgmt_PP_Toolkit-Volume-I_EN.pdf)

- [Tool kit for implementation of solid waste management rules, 2016,](http://www.npcindia.gov.in/wp-content/uploads/2017/08/Tool-kit-on-Plastic-Waste-Management-Rules-2016.pdf)  
<http://www.npcindia.gov.in/wp-content/uploads/2017/08/Tool-kit-on-Plastic-Waste-Management-Rules-2016.pdf>
- [Tool kit on e-waste management rules, 2016.](http://www.npcindia.gov.in/wp-content/uploads/2017/08/Tool-Kit-on-e-Waste-Management-Rules-2016.pdf)  
<http://www.npcindia.gov.in/wp-content/uploads/2017/08/Tool-Kit-on-e-Waste-Management-Rules-2016.pdf>

### **Books for Reference**

1. Environmental Engineering Series - Environmental Management by T.V.Rama Chandra & Vijay Kulkarni
2. Text book of Solid Wastes Management by Naved Ahsan & Iqbal H.khan
3. Wealth from Waste - Agricultural food and chemical Processing Waste by S.C.Bhatia
4. Integrated Solid Waste Management, Engineering Principles and Management Issues by George Teho Banglous Hilary Theisen Samuel A. Vigal
5. Solid Waste Management of Municipalities Dr P.S Ajith & Dr P.N. Hari Kumar
6. Solid Waste Management - Present and Future Challenges - Jagbir Singh & AL Ramanathan
7. Smart Cities - Transforming India - Prof M.P Dube
8. Environmental Engineering Series - Management of Municipal Solid Waste - T.V.Rama Chandra
9. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha
10. Environmental Studies by R. Rajagopalan
11. Environmental pollution control engineering by C.S. Rao
12. Waste Management Practices by John Pichtel
13. Solid wastes management by Stephen Burnley
14. Eco-Economy: Building an Economy For The Earth by Lester R.Brown
15. Not in My Backyard - Solid Waste Mgmt in Indian Cities by Sunita Narain & Swati Singh Sambyal

## Course 10: Entrepreneurship in Waste Management

21WME513	Entrepreneurship in Waste Management	3 0 0 3
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### Course Objectives:

- To provide theoretical knowledge to improve the skills on managing waste at management facility centre
- To study the roles of government and non-government organisations in waste management
- To learn to organize and integrate waste collectors in waste management and finding out means to improve their livelihood
- To understand the Public Private Partnership in waste management

### Course Outcomes

CO1: Understanding to establish and manage waste disposal facility centre

CO2: Information on the roles of government and non-government organisations in waste management

CO3: Skills to organize and integrate waste collectors in waste management in order to improve their livelihood

CO4: Knowledge on Public Private Partnership in waste management

### CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	3	3	-	2	1	1	1	2	3
CO2	-	1	1	1	1	-	2	1	2	1
CO3	-	1	1	1	1	1	3	1	3	2
CO4	-	-	-	-	3	1	-	-	2	3

### Syllabus - Entrepreneurship in Waste Management

Sl. No.	Unit Title	Unit content
1	An Overview of Entrepreneurship	Model of Entrepreneurship, Nature of Entrepreneurship, Factors Influencing Entrepreneurship, Classification of Entrepreneurs, Qualities of an Entrepreneur, Innovation & Entrepreneurship, IOT and AI Application in Waste Management
2	Entrepreneurial	Entrepreneurship in Waste Management, Major Trends, Challenges and Future Prospects of Waste Management

	Opportunities in Waste Management Sector	Sector, Overview Scenario of Waste Policy
3	Role of Various Bodies in Waste Management	Role of Government and Private Agencies in Waste Management, Role of Organised and Unorganised sectors in waste management. Government Schemes, Local Bodies. Scientific management (Methods of composting like Windrow, Pit, Vermi) of RRP (Resource Recovery Park), MRF (Material Recovery Facilities)
4	Waste Organisers	Improving Livelihoods – Organising Waste Collectors Dynamics of Organising and Integrating Waste Collectors in Waste Management, Overview of Reports of Commissions and Committees, Upcycling of Waste
5	Public Private Partnerships and Community Driven Waste Management	Role of Public-Private Partnerships (PPPs) in Waste Management. Public Private Partnerships (PPP) – Project. Scoping and Implementation in Waste Management. Community Based Waste Management (CBOs) and Role of NGOs. List of Swachhta Awarded Institutions as per 2018 Ranking. Financial and Banking Role in Waste Management. Case-studies of successful startups involved in waste management

### **Evaluation Pattern:**

Assessment	Internal	External
Periodical 1 (P1)	15	0
Periodical 2 (P2)	15	0
Continuous Assessment (CA)*	20	0
End Semester	0	50
Total Marks	50	50

\*CA - Can be Quizzes, Assignments, Projects, and Reports.

## Case Studies

1. Swachh Bharat Mission Exposure Workshops (May - October 2017)  
<https://smartnet.niua.org/content/480f1fbd-2cd7-43ac-98ae-dcc87ff190f6>
2. Best Practices on Solid Waste Management in India  
<https://www.susana.org/en/knowledge-hub/regional-chapters/indian-chapter/library-indian-chapter/details/2939>
3. Waste management <http://www.infrastructurene.ws/2013/11/13/funding-proposals-for-effective-waste-management/>
4. Making biogas user-friendly for cooking as solution to Urban Waste  
<https://youtu.be/zMAWbXlwrXw>
5. How to Finance Solid Waste Management  
<http://www.worldbank.org/en/news/video/2014/10/30/how-to-finance-solid-waste-management>
6. Case study of SWM Unit in Mudichur GP in Tamil Nadu,  
[http://www.nird.org.in/nird\\_docs/sb/doc5.pdf](http://www.nird.org.in/nird_docs/sb/doc5.pdf)

## Further Reading

1. Public-Private Partnership (PPP) in Solid Waste Management in India  
<https://www.youtube.com/watch?v=JfBeQm0KirI>
2. The role of the private sector <https://www.coursera.org/lecture/solid-waste-management/2-3-the-role-of-the-private-sector-z7xNy>
3. Capacity building on waste management: <http://cedindia.org/wp-content/uploads/2013/08/Capacity-Building-for-Solid-Waste-Management.pdf>
4. The Role of Community Members in waste management <https://www.coursera.org/lecture/solid-waste-management/2-5-the-role-of-community-members-pt4pt>
5. Municipal Solid Waste Management : Role of NGOs, Rag Pickers and Public Sectors [https://www.powershow.com/view/402969-ODM50/Municipal\\_Solid\\_Waste\\_Management\\_Role\\_of\\_NGOs\\_Rag\\_Pickers\\_and\\_Public\\_Sectors\\_powerpoint\\_ppt\\_presentation](https://www.powershow.com/view/402969-ODM50/Municipal_Solid_Waste_Management_Role_of_NGOs_Rag_Pickers_and_Public_Sectors_powerpoint_ppt_presentation)
6. Financing Solid Waste Management  
<http://www.worldbank.org/en/news/feature/2014/10/30/how-to-finance-solid-waste-management>

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disposition=inline%3B%20filename%3DProceedings of the 7th Annual Conference.pdf#page=1349 , accessed on Nov 19, 2018 at 15:44)

3. Heller, R (2006), 'Nine qualities that make a great entrepreneur', <https://www.leadershipreview.net/nine-qualities-make-great-entrepreneur>, Accessed on Nov 19, 2018 at 16:16.
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8. Ramesh, V., 2016, Entrepreneurship as a Business Model “A Review on Indian Innovations and Practices in Waste Management” International Journal of Advances in Agricultural & Environmental Engg. (IJAAEE) Vol. 3, Issue 1 (2016) ISSN 2349-1523 EISSN 2349-1531.
9. Waste Management in India - Shifting Gears, Report by ASSOCHAM, PWC, March 2017
10. Wilson DC, Velis C, Cheeseman C. 2006. Role of informal sector recycling in waste management in developing countries. Habitat Int. 30, 797–808. (doi:10.1016/j.habitatint.2005.09.005)

#### Annexures

1. Toolkit for Public Private Partnership frameworks in Municipal Solid Waste Management <http://swachhbharaturban.gov.in/writereaddata/Toolkit-Public.pdf>
2. Handbook on Scaling up Solid and Liquid Waste Management in Rural Areas <http://swachhbharatmission.gov.in/sbmcms/writereaddata/images/pdf/technical-notes-manuals/Scaling-up-SLWM-in-Rural-areas.pdf>

## Course 11: Occupational Health and Safety, Environmental Cost and Risks

21WME514	Occupational Health and Safety, Environmental Cost and Risks	4 0 0 4
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### Course Objectives:

- To learn basic Acts and Rules in Occupational Health and Safety Management System
- To understand the process, preparedness and practices during emergency
- To study the concepts of Environmental Economics, and approach to efficient use of resources and products
- To gain knowledge on the Environmental Impact Assessment

### Course Outcomes:

CO1: Knowledge on the Acts and Rules in Occupational Health and Safety Management System

CO2: Understanding on the process, preparedness and practices during emergency

CO3: Information on the concepts of Environmental Economics, and approach to efficient use of resource and products

CO4: Ability to carry out Environmental Impact Assessment

### CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	-	1	-	-	1	-	2	-	-
CO2	1	2	-	-	1	1	1	-	1	1
CO3	-	1	1	-	1	-	1	2	1	1
CO4	-	1	1	1	1	-	2	-	-	1

### Syllabus - Occupational Health and Safety, Environmental Cost and Risks

Sl. No.	Unit Title	Unit content
1	Safety Management System, Acts & Rules (Basics)	Safety Definition, Unsafe Act, Unsafe Condition, Near Miss Theory of Accident, Cost of accidents, Accident Investigation, Accident reporting – Internal and External PSSR (Pre Start up Safety Review) and HAZOP (Hazard and Operability) in Waste Management. The Factories act – 1948, Amendment 2019, Tamil Nadu Factories Rule 1950, Tamil Nadu Safety Officers (Duties, Qualifications

		and Conditions of Service) Rule 2005, MOC (Management Of Change), The value of Education in risk elimination
2	Hazards Identification Risk Assessment (HIRA)	Definitions of Hazard, Risk, Types of Hazard: Mechanical, Physical, Chemical, Biological, Ergonomical, Hazard Identification, Risk Evaluation, Mitigation Plan, Implementation and review, Record Keeping. Hierarchy of Hazard Control Elimination, Substitution, Engineering Control, Admin Control, Personal Protective Equipment (PPE), Industrial Hygiene : Permissible Limits, TLV - Threshold Limit Value , STEL – Short Term Exposure Limit, TWA – Time Weighted Average, LEL – Lower Explosive Limits, UEL – Upper Explosive Limits
3	Emergency Preparedness	Emergency Types – On site Emergency, off - site Emergency, Emergency Response Team Mock Drills, preparedness and plan for natural and man-made emergencies. Safety Audit IS 14489: 1998, HSE – Management Information System (MIS) Report
4	Environmental Cost and Risk	Introduction to Environmental Economics, Socio-economic, Ecological and Environmental Costs, Cost-Benefit Analysis, Vulnerability assessment/analysis, DALY and QALY, Economic costs. Economic Cost of Not Managing Waste, Waste – to be Contained at Source, Consumerism, Efficiency of Resource Use- Production and Consumption, Closing-loop Approaches, Circular Economy and Life Cycle Assessment and Long-term Sustainability
5	Environment Impact Assessment	Fundamentals of EIA, Values of EIA, Benefits of EIA, Roles and Responsibility of Project Proponents, Consultants, Pollution Control Board, Public and Impact Assessment Authority (IAA), Steps and Procedures in EIA, Environmental Management Plan (EMP), Green Belt, Applications of EIA and EMP in Waste Management

### **Evaluation Pattern:**

Assessment	Internal	External
Periodical 1 (P1)	15	0
Periodical 2 (P2)	15	0
Continuous Assessment (CA)*	20	0
End Semester	0	50

Total Marks	50	50
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\*CA - Can be Quizzes, Assignments, Projects, and Reports.

### Reference Books

1. EIA Manual of Ministry of Environment, Forests and Climate Change.  
<http://www.moef.nic.in/division/eia-manual>
2. Convention on Biodiversity: <https://www.cbd.int/programmes/cross-cutting/impact/search.aspx>

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2. Sarma. (2019). Occupational Hazards Safety & Enviro.Studies, Publisher: Pharma Med Press, ISBN: 9789387593817
3. Occupational Health and Safety-  
<https://boilersinfo.com/books/occupational-health-safety-books-pdf/>  
(Open Access)
4. National Occupational Safety and Health (OSH) Profile -  
[https://dgfasli.gov.in/sites/default/files/service\\_file/Nat-OSH-India-Draft%281%29.pdf](https://dgfasli.gov.in/sites/default/files/service_file/Nat-OSH-India-Draft%281%29.pdf)
5. Robert G Confer, Thomas R Confer. (1999). Occupational Health and Safety : Terms, Definitions and Abbreviations, 2nd Edition, CRC Press, SBN: 1566703611 / 9781566703611
6. Nicolas R. Dalezios (2017). Environmental Hazards Methodologies for Risk Assessment and Management, IWA publishing, ISBN13: 9781780407128
7. eISBN: 9781780407135
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10. Jerie, S. (2016). Occupational Risks Associated with Solid Waste Management in the Informal Sector of Gweru, Zimbabwe. Journal of Environmental and Public Health, 2016, 1–14. doi:10.1155/2016/9024160
11. John Glasson, Riki Therivel. (2019). Introduction To Environmental Impact Assessment, Taylor & Francis, ISBN:9780429894619, 0429894619
12. Environmental Impact Assessment - <https://www.drishtiias.com/to-the-points/paper3/environmental-impact-assessment-1>



13. Understanding EIA - <https://www.cseindia.org/understanding-eia-383>
14. Air Pollution: National Toxics Network, Australia.14 Oct 2014, <https://ntn.org.au/10-reasons-why-burning-waste-for-energy-is-a-bad-idea/>
15. Bee Pollination: Pennsylvania State University.<https://news.psu.edu/story/416642/2016/07/06/research/bee-s-ability-forage-decreases-air-pollution-increases>
16. Bio Char: Mohd. Asif Naeem, Pakistan <https://www.tandfonline.com/doi/full/10.1080/03650340.2017.1325468>
17. Bhopal Remediation: Aug 28, 2017 Technical guidelines for cleanup at the Union Carbide India Ltd (UCIL) site in Bhopal, Madhya Pradesh, India, Greenpeace International, 2002 <https://www.cseindia.org/technical-guidelines-for-cleanup-at-the-union-carbide-india-ltd-ucil-site-in-bhopal-madhya-pradesh-india-greenpeace-international-2002-7840>
18. CBA: Rajgopal R, Cox R, Lambur M, Lewis E. Cost-benefit analysis indicates the positive economic benefits of the expanded food and nutrition education program related to chronic disease prevention. J NutriEducBehav. 2002;34(1):26-37.
19. Case Study SEA of Human River Irrigation Project, Maharashtra: <https://www.cbd.int/impact/case-studies/cs-impact-nl-ibsea-in2-en.pdf>
20. Case Study EIA on River Rafting: Parth SarathiMahapatra, H.B.Vasistha , Rajiv Pandey, International Journal of Environmental Sciences Volume 1, No 5, 2011, Socio environ impact of river rafting industry on Ganges in Uttarakhand, India, <http://greencleanguide.com/eia-its-role-a-case-study-on-river-rafting-industry/>
21. Case Study: Jindal Power plant: CSE, Jan 2010, <https://www.cseindia.org/eia-analysis-of-jindal-thermal-power-plant--464>
22. Case Study: India Looks to South Korea: Ramandeep Singh and Soyen Park, King's College, University of Cambridge. Feb 21 2018 <https://www.livemint.com/Opinion/V2CgeiUq89kl1k2fDwJXML/Swachh-Bharats-waste-management-problem.html>
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<https://www.thenewsminute.com/article/walk-through-ghost-village-brahmapuram-deserted-thanks-kochis-garbage-41040>
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### **Films:**

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2. How To Make A Biochar Machine – TLUD, Duration: 6 min <https://www.youtube.com/watch?v=YIbGkmt1VdE>
3. How to inoculate biochar. Duration 5 min: <https://www.youtube.com/watch?v=f-yAq2LBVku>
4. What Could Happen in a World That's 4 Degrees Warmer | WIRED Brand Lab, Duration 15 min, [https://www.youtube.com/watch?v=\\_\\_Kt\\_oU9iss](https://www.youtube.com/watch?v=__Kt_oU9iss)
5. Recycling tyres: road to success - business planet, duration: 4 min, <https://www.youtube.com/watch?v=6kD9YJ9iSfc>
6. Deonar fire, 3 min <https://www.youtube.com/watch?v=2yeKYfhjviM>

7. The Plastic Cow: Duration 33 min. <https://youtu.be/SifRIYqHfcY>
8. Best out of waste: Duration 1 hour: SatyamevJayate Season 2 | Episode 3 | Don't Waste Your Garbage |
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[https://www.youtube.com/watch?v=ISO\\_FCBzI\\_w](https://www.youtube.com/watch?v=ISO_FCBzI_w)
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### **Books for Reference**

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2. Solid Waste Management of Municipalities Dr P.S Ajith & Dr P.N. Hari Kumar
3. Solid Waste Management - Present and Future Challenges - Jagbir Singh & AL Ramanathan
4. Smart Cities - Transforming India - Prof M.P Dube
5. Waste Management Practices by John Pichtel
6. Solid wastes management by Stephen Burnley
7. Eco-Economy: Building an Economy For The Earth by Lester R.Brown
8. Not in My Backyard - Solid Waste Mgmt in Indian Cities by Sunita Narain & Swati Singh Sambyal

## Course 12: GIS and RS in Waste Management

21WME515	GIS and RS in Waste Management	3 0 0 3
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### Course Objectives:

- To study the fundamentals of GIS and GPS and its application in waste management
- To learn techniques in Remote Sensing and processing of digital and satellite images
- To get training on field data collection and processing of web-based data

### Course Outcomes:

CO1: Knowledge on the fundamentals of GIS, GPS and Remote Sensing

CO2: Skills in processing of digital and satellite images, field and web-based data

CO3: Ability to apply GIS and GPS technologies in Waste Management

### CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	2	1	-	-	1	2	1	2	-
CO2	-	2	1	-	-	1	3	1	2	1
CO3	-	2	1	-	-	1	2	1	1	1

### Syllabus – GIS and RS in Waste Management

Sl. No.	Unit Title	Unit content
1	Geographical Information System	Fundamental of GIS, Elements of GIS, Data Structure, Processing of data with GIS, Spatial and Non-Spatial data Analysis, Map Preparation, Digital Cartography, GIS Trends and Technology
2	Global Positioning System	Introduction to GPS, Accuracy and Accuracy factors, Types of GPS, Global Navigation System, Recent trends in GPS
3	Remote Sensing	Fundamental of RS, Spectral Reflectance Signature, Digital Image Processing, Visual Interpretation of Satellite data, Aerial photo and its Interpretation, Advances in Remote Sensing Technologies, Remote Sensing Trends and Technology
4	Web based GIS and RS	Introduction to open source software, collection of GIS data and Satellite images, Web Based GIS, Enterprise GIS,

		Mobile GIS, 3-D Visualization and Flythrough
5	Application of GIS and RS in Waste Management	Monitoring, collection, transportation and disposal of waste material using GIS and GPS, Site selection and monitoring of environmental components in and around waste disposal facility centres, Identification of hotspots of waste and development of plan for its management with the help of QGIS, Case-Studies of successful GIS based Waste Management

### **Evaluation Pattern:**

Assessment	Internal	External
Periodical 1 (P1)	15	0
Periodical 2 (P2)	15	0
Continuous Assessment (CA)*	20	0
End Semester	0	50
Total Marks	50	50

\*CA - Can be Quizzes, Assignments, Projects, and Reports.

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1. Sahoo, R.N., Sehgal, V.K., Pradhan, S., Gupta, V.K. and Kamble, K.H. 2012, Practical Manual on Basics of Remote Sensing Data Processing, GPS and GIS, Division of Agricultural Physics, Indian Agricultural Research Institute, New Delhi – 110 012, India, pp 100.
2. Fundamentals of Remote Sensing and its Applications in GIS.  
<http://giswin.geo.tsukuba.ac.jp/sis/tutorial/koko/remotesensing/FundamentalRemoteSensing.pdf>
3. Basudeb Bhatta. (2021). Remote Sensing and GIS, OUP India; 3rd edition (27 January 2021), 752 pages, ISBN-10 : 0199496641
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8. Sunil Kumar, *Integrated Waste Management* - <https://www.intechopen.com/books/integrated-waste-management-volume-i> (open access)
9. Khan, D., & Samadder, S. R. (2014). Municipal solid waste management using Geographical Information System aided methods: A mini review. *Waste Management & Research*, 32(11), 1049–1062. doi:10.1177/0734242x14554644
10. Mussa, A., & Suryabhagavan, K. V. (2019). Solid waste dumping site selection using GIS-based multi-criteria spatial modeling: a case study in Logia town, Afar region, Ethiopia. *Geology, Ecology, and Landscapes*, 1–13. doi:10.1080/24749508.2019.1703311
11. Dutta, D., & Goel, S. (2017). Applications of Remote Sensing and GIS in Solid Waste Management – A Review. *Advances in Solid and Hazardous Waste Management*, 133–151. doi:10.1007/978-3-319-57076-1\_7
12. Kallel, A., Serbaji, M. M., & Zairi, M. (2016). Using GIS-Based Tools for the Optimization of Solid Waste Collection and Transport: Case Study of Sfax City, Tunisia. *Journal of Engineering*, 2016, 1–7. doi:10.1155/2016/4596849



## Course 13: Analysis of constituents in Soil and Air

21WME583	Analysis of constituents in Soil and Air	0 0 4 2
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### Course Objectives:

- To analyse the constituents, present in soil and air
- To gain experimental skills in the analysis of soil and air.

### Course Outcomes:

CO1: Analyze the physical parameters of soil.

CO2: Estimate the constituents present in soil.

CO3: Determine the pollutants in air.

### CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	1	-	-
CO2	2	1	-	-	-	-	-	1	-	-
CO3	2	1	-	-	-	-	-	1	-	-

### Syllabus - Analysis of constituents in Soil and Air

Sl. No.	Lab Slot	Parameters
1	S1	pH, EC, colour of soil
2	S2	Total Organic matter, Organic Carbon in soil
3	S3	Total Phosphorus in soil
4	S4	Moisture content in soil
5	S5	Texture of soil
6	S6	Monitoring of CO <sub>2</sub> gas in air
7	S7	Suspended Particulates Matter (SPM) in air
8	S8	Model Lab
9	S9	Final Lab Exam

**Evaluation Pattern:**

Assessment	Internal	External
Continuous Assessment (CA)	30	0
End Semester	0	70
Total Marks	30	70

**Reference books**

1. A Comprehensive Laboratory Manual for Environmental Science and Engineering by P R Sreemahadevan Pillai, New Age International publishers, 2009.
2. Laboratory manual for Air quality monitoring and Analysis, IIT, Delhi

## Course 14: Waste Management – Field Visit – II

21WME584	Waste Management – Field Visit – II	0 0 4 2
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### Course Objectives:

- To understand functioning of model business centres and entrepreneurship in waste management
- To study the working of community waste management units
- To learn the application of technology in waste disposal sites
- To understand the safety management systems in waste management plant

### Course Outcomes:

CO1: Understanding the functioning of model business centres and entrepreneurship in waste management

CO2: Knowledge on the working of community waste management units

CO3: Skills to apply technology in waste disposal sites

CO4: Information on the safety management systems in waste management plant

### CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	2	2	-	3	0	1	1	2	3
CO2	2	-	1	2	1	1	-	2	1	1
CO3	-	3	2	-	2	1	3	1	3	2
CO4	2	1	1	3		2	2	2	1	1

### Syllabus – Waste Management – Field Visit– II

Sl. No.	Places of visit
1	Visit to Model Community in Waste Management (Musri, Kudumbasree, Vriddhachalam)
2	Model Business Centre and entrepreneurship
3	Out-of-Waste Material Craft
4	Sustainable Agriculture using Organic Wastes
5	GIS based approaches in Waste Management
6	EIA – Waste Management Plant
7	Safety Measures in Waste Management Plant
8	Health and Safety –Management Information System (MIS)

**Evaluation Pattern:**

Assessment	Internal	External
Continuous Assessment (CA)	30	0
End Semester	0	70
Total Marks	30	70