

# PG Diploma in Waste Management and Environmental Hygiene

## Curriculum 2022

### SEMESTER I

Sl. No.	Course Code	Course Title	L-T-P	Credits
1	22WME501	Overview of Waste Management	4 0 0	4
2	22WME502	Handling and disposal of major types of wastes – I	4 0 0	4
3	22WME503	Water and Soil Resource Management	4 0 0	4
4	22WME504	Legal Aspects and Mandatory Regulations	4 0 0	4
5	22WME581	Water and Soil Analysis	0 0 4	2
6	22WME582	Waste Management - Field Visit I	0 0 4	2
7	22ENG501	Professional Communication	1 0 2	2
8	22AVP103	Mastery Over Mind	1 0 2	2
		<b>Total</b>		<b>24</b>

### SEMESTER II

Sl. No.	Course Code	Course Title	L-T-P	Credits
1	22WME511	Handling and disposal of major types of wastes – II	4 0 0	4
2	22WME512	Community Mobilization towards Sustainable Development	3 0 0	3
3	22WME513	Waste Management as Project Management	3 0 0	3
4	22WME514	Entrepreneurship in Waste Management	3 0 0	3
5	22WME515	Occupational Health and Safety, Environmental Cost and Risks	4 0 0	4
6	22WME516	GIS and RS in Waste Management	3 0 0	3
7	22WME583	Waste Management - Field Visit II	0 0 4	2
8	22WME591	Internship		Pass/Fail
		<b>Total</b>		<b>22</b>
				<b>TOTAL-46</b>

## SYLLABUS

22WME501	<b>Overview of Waste Management</b>	<b>4 0 0 4</b>
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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

Sl. No.	Unit Title	Unit content	Teaching Hours (Approx.)
1	Introduction to waste	Segments of Environment, State of our Environment, Interaction of Spheres, structure and function of an Ecosystem, Climate Change, Ozone depletion, Sustainable living, Problem of Wastes, Types of Solid Waste, Categories of solid waste, Effects of Excess Waste Generation, Waste Characterisation	12
2	Source Reduction	Solid Waste Reduction, Waste reduction strategies - How to Start a Waste Reduction Program Guideline,	13

		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	15
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	12
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.	08

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

<b>22WME502</b>	<b>Handling and Disposal of major types of Wastes – I</b>	<b>4 0 0 4</b>
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To be offered in First Semester. This is the parent Course from which a new Course to be offered in Second Semester was carved out.

### 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 municipal solid waste, hotel, 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 municipal solid waste, hotel, 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

Sl. No.	Unit Title	Unit content	Teaching hours (Approx.)
1	Logistics in Waste Management	Introduction to Waste Management, Logistics, Human Components, Role of woman in Waste Management and Woman Empowerment, Technological Components- Waste Handling Equipment and Technology, Social Aspects and Managerial Goals, Steps in a waste management logistics process, Fleet Management, Information and Communication Technology (ICT) in Waste Management	15
2	Disposal of Municipal Solid Waste	Segregation, collection, transportation and treatment methods (Sanitary landfill methods) for organic waste, inorganic waste, waste to energy, incineration. Home composting methods.	15
3	Disposal of Bulk Waste - Market Waste and Hotel waste	Segregation, collection, transportation and treatment methods (Sanitary landfill methods)	15
4	Disposal of C & D	Segregation, collection, transportation and treatment methods, upcycling of products such as paver blocks, plastic bricks, roofing tiles	5
5	Recycle and Reuse of plastic, metal and other 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	10

### 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>
- 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 Res2011; 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 Control2013, 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>
  - Pomona 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-mula-mutha-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>

22WME503	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

Sl. No.	Unit Title	Unit content	Teaching hours (Approx.)
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)	7
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.	8
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)	25
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, Air Pollution Standards Water Pollution Standards, Soil Pollution Standards, Waste Water Discharge standards Sludge disposal process and Standards	10
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	10

### 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=UmVwb3J0RmlsZXMvTmV3SXRIbV8xMTZfR3VpZGVsaW5lc29mIHdhdGVycXVhbGI0eW1vbml0b3JpbmdfMzEuMDcuMDgucGRm>

## Films

1. Sampling Wastewater at a Wastewater Treatment Facility 1993 EPA Training Film, Duration 23 min  
<https://www.youtube.com/watch?v=MaiWU1kL2wU>
2. The Winkler Method. Duration 6 min. <https://youtu.be/FKdzbgHaQQM>
3. Soil Sampling: How to collect a soil sample for analysis duration 3 min.  
<https://www.youtube.com/watch?v=3YuA20kZ1EA>
4. Determination of Available Nitrogen Content in the Soil by Kjeldahl Method, duration: 7 min.  
[https://www.youtube.com/watch?v=3uQOezI\\_Uos](https://www.youtube.com/watch?v=3uQOezI_Uos)

## References

1. Alternatives to Chlorination: Erin Brockovich October, 2010 "Protection or Poison?-Chloramination of Drinking Water"
2. AOP: Félicien Mazille 27 April 2018 <https://sswm.info/sswm-university-course/module-6-disaster-situations-planning-and-preparedness/further-resources-0/advanced-oxidation-processes>
3. Avoid Pesticides: Water Pollution- By Dr. B. K. Sharma
4. Biohazard: World Health Organization,  
[http://www.who.int/water\\_sanitation\\_health/publications/wsp170805c\\_hap5.pdf](http://www.who.int/water_sanitation_health/publications/wsp170805c_hap5.pdf)
5. CETP: Types of Wastewater Treatment Process: ETP, STP and CETP
6. Cheap method of desalination: PTI, San Francisco, The Hindu, 06 Feb 2017 <https://www.thehindu.com/todays-paper/tp-national/Indian-American-teen-finds-way-to-turn-seawater-potable/article17200032.ece>

7. Chlorination: America Chemistry Council, Wastewater Chlorination: An Enduring Public Health Practice, <https://chlorine.americanchemistry.com/Chlorine/Wastewater-Chlorination/> , Accessed on Nov 3, 2018
8. COD: [www.sciencedirect.com](http://www.sciencedirect.com)  
<http://blog.hannainst.com/cod-testing>
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<b>22WME504</b>	<b>Legal Aspects and Mandatory Regulations</b>	<b>4 0 0 4</b>
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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

Sl. No.	Unit Title	Unit content	Teaching hours (Approx.)
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	10
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), EIA notifications 1994 and draft 2020 CRZ notifications 1991 and 2018	16
3	Acts, Rules and Regulations in Waste Management-I	Municipal Solid Waste Management Rules 2016, The Plastic Waste Management Rules 2016, The Construction and Demolition Waste Management Rules 2016, EPR- Extended Producer Responsibility, Cleaner Production Option and Waste Management	16
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	10
5	Treaties and Conventions in Environment	International Treaties, International Conventions, Corporate Social Responsibility, INGO's and NGO's responsibility in Protecting Environment	8

### 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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10. <http://envfor.nic.in/rules-regulations/public-liability-insurance>
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12. <http://www.envfor.nic.in/divisions/ic/wssd/doc2/ch2.html>
13. <http://vikaspedia.in/social-welfare/unorganised-sector-1/the-public-liability-insurance-act1991/view>
14. <http://envfor.nic.in/rules-regulations/national-green-tribunal-ngt>
15. <http://egazette.nic.in/> The gazette of India, Ministry of Law and Justice
16. <https://www.iasscore.in/topical-analysis/national-green-tribunal-analysis>
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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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### 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

22WME581	Water and Soil Analysis	0 0 4 2
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### Course Objectives:

- To analyse the important parameters in water and soil
- To learn the basic principles involved in the analysis of water and soil.

### Course Outcomes:

CO1: Basic knowledge in determining the physical and chemical parameters of water and soil samples.

CO2: Skills on the analysis important parameters in water and soil.

### CO-PO Mapping

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

### Syllabus

Sl. No.	Lab Slot	Parameters
1	S1	pH, EC, Temperature – Water and Soil
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	Total organic matter, organic carbon in soil
10	S10	Total phosphorous, moisture content in soil

### **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.

<b>22WME582</b>	<b>Waste Management – Field Visit – I</b>	<b>0 0 4 2</b>
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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
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### Syllabus

Sl. No.	Places of visit
1	Municipal Solid Waste Management Facility Centre such as Resource Recovery Park (RRP), Material Collection Facility (MCF), Material Recovery Facility (MRF). Day to day operations like 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	Composting Unit/MCC (Micro Composting Centres), Visit to Model Community in Waste Management
3	Sustainable agriculture using Organic Fertilizers, EM solution, Panchagavya
4	Waste to energy projects
5	Construction & Demolition Waste Management Unit
6	Decentralised Waste Water Treatment Systems (DEWATS)
7	Faecal Sludge Treatment Plant (FSTP)
8	Visit to Hazardous Waste Management Units

### Evaluation Pattern:

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

**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. Felixa 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.

<b>22WME511</b>	<b>Handling and Disposal of major types of Wastes - II</b>	<b>4 0 0 4</b>
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### Course Objectives:

- To study the handling of biomedical, hazardous, electronic and plastic waste
- To acquire knowledge on managing waste generated during disasters
- To acquire knowledge on the recovery of materials from electronic, plastic and biomedical waste

**Course Outcomes:**

CO1: Ability to manage biomedical, hazardous, electronic and plastic waste

CO2: Skill to recover materials from electronic, plastic and biomedical waste materials

CO3: Capacity to manage waste generated during disasters

**CO-PO Mapping**

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

**Syllabus**

Sl. No.	Unit Title	Unit content	Teaching hours (Approx.)
1	Disposal of Biomedical Waste	Segregation, collection, transportation and treatment methods. Case Studies, Reports	10
2	Disposal of Hazardous Waste	Segregation, collection, transportation and treatment methods, Case Studies, Reports	10
3	Disposal of electronic Waste	Segregation, collection, transportation and treatment methods, Case Studies, Reports	10
4	Disposal of Plastic Waste	Segregation, collection, transportation and treatment methods, Case Studies, Reports Marine litter and their management	15
5	Disaster Waste Management	Global Status, pre-disaster, Impacts of Disaster Waste, Types of Disaster Waste, Stages of Disaster Waste Management, Managing post-disaster debris, Disaster Waste Management Guidelines. Case Studies.	15

**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>
- 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

4. How fast fashion adds to the world's clothing problem, Duration 22 min <https://www.youtube.com/watch?v=eIU32XNj8PM>
5. A cluttered life: Middle class abundance. Duration 19 min. <https://www.youtube.com/watch?v=3AhSNsBs2Y0>
6. 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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- Baveja G, Muralidharar S, Aggarwal P. Hospital Waste Management - an overview. *Hospital today* 2000; 5(9): 485-486.
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- 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.



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- Pasupathi P, Sindhu S, Ponnusha BS, Ambika A. Biomedical waste management for health care industry. Int J Biol Med Res2011; 2: 472-486.
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<https://doi.org/10.1016/j.chemosphere.2007.10.024>
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- 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 Control2013, v9:i2 doi: 10.3396/ijic.v9i2.016.13.
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- 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>
  - Pomona 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/)
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  - 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-mula-mutha-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>

22WME512	<b>Community mobilization towards Sustainable Development</b>	<b>3 0 0 3</b>
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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

Sl. No.	Unit Title	Unit content	Teaching hours (Approx.)
1	Community Dynamics	Introduction to Community Dynamics, Significance, Community based programs, Community Level and groups, Community Motivation, Gender Empowerment, Case studies	8
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	10
3	Sustainable Communities	Concept and Principle of Sustainable Community, Characteristic of Sustainable Community, Design of Sustainable Community, Community Sustainable Indicators, Sustainable Sustenance, Case Studies	10
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	10
5	Community Mobilization	Community Mobilization and Social Mobilization, Importance of Community Mobilization, Employment opportunities at Community Level, Community Learning, Adapting to New Sustainable System	7

### 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.
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9. William Bridges, 'Managing Transitions: Making the Most of the Change', Da Capo Lifelong Books; 3 edition 2009
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## 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

<b>22WME513</b>	<b>Waste Management as Project Management</b>	<b>3 0 0 3</b>
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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

Sl. No.	Unit Title	Unit content	Teaching hours (Approx.)
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	10
2	Waste Market Survey	Changing scenarios in waste market, recycling trends and status in India. Market linkages and waste management credits perspective - Circular Economy	15
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)	10
4	Conception of project	Context based approaches of managing wastes, Project Management – Conception, Planning, design, development, Implementation, Resource allocation	10
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	15

### 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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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.
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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.
7. Delivering good practice waste minimization and management <http://www.wrap.org.uk/sites/files/wrap/Waste%20man%20technical1.pdf>
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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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 Intellectcap  
[https://www.innovationpolicyplatform.org/system/files/4%20Integrated%20Waste%20Manangement\\_Apr6.pdf](https://www.innovationpolicyplatform.org/system/files/4%20Integrated%20Waste%20Manangement_Apr6.pdf)
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  25. United Nations, Department of Economic and Social Affairs, Population Division (2013). *World Population Prospects: The 2012 Revision, Key Findings and Advance Tables*. Working Paper No. ESA/P/WP.227. p.15, 20.
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  27. World Economic Forum <https://www.weforum.org>
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  31. CPHEEO (2000), *Manual on Municipal Solid Waste Management*, pp. 219-227, Central Pubic 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

22WME514	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

Sl. No.	Unit Title	Unit content	Teaching hours (Approx.)
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 Opportunities in Waste Management Sector	Entrepreneurship in Waste Management, Major Trends, Challenges and Future Prospects of Waste Management 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-ODM5O/Municipal\\_Solid\\_Waste\\_Management\\_Role\\_of\\_NGOs\\_Rag\\_Pickers\\_and](https://www.powershow.com/view/402969-ODM5O/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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1. Annepu RK. 2012. Report on sustainable solid waste management in India. Waste-to-Energy Research and Technology Council (WTER) 1-189. See <http://swmindia.blogspot.in/>
2. Chandrashekar et.al. (2014), 'Factors that influence Entrepreneurship in India- an Exploratory Study', Conference proceedings by 7<sup>th</sup> Annual EUROMED Academy of Business Conference, Norway, [https://s3.amazonaws.com/academia.edu.documents/35271901/euromed2014-book-of-proceedings-2014-10-13-FINAL.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1542625120&Signature=Ih3zRIOADt2inI262DJRaI4AK7Y%3D&response-content-disposition=inline%3B%20filename%3DProceedings\\_of\\_the\\_7th\\_Annual\\_Conference.pdf#page=1349](https://s3.amazonaws.com/academia.edu.documents/35271901/euromed2014-book-of-proceedings-2014-10-13-FINAL.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1542625120&Signature=Ih3zRIOADt2inI262DJRaI4AK7Y%3D&response-content-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.
4. Higgins, B (1997), 'The Economic Development', p.219.
5. Kao, J and Stevenson, H (1984), 'Entrepreneurship-What it is and How to teach it', Harvard Business School, P.7.
6. Kao, J.J (1989), 'Entrepreneurship, Creativity and Organization: Text, Cases and Readings', Indiana University, Prentice Hall Publications.
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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>

22WME515	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

Sl. No.	Unit Title	Unit content	Teaching hours (Approx.)
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	10
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	15
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, Environmental and health impacts while handling the waste materials or working in recycling plants	10
4	Environmental Cost and Risk	Introduction to Environmental Economics, Socio-economic, Ecological and Environmental Costs, Cost-Benefit	15

		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, Environmental and health impacts while handling the waste materials or working in recycling plants	
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	10

### **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.

### **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>

## References

1. Koradecka. (2019). Handbook Of Occupational Safety And Health, T&F India ISBN: 9780367270315
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
8. Rodrigues, M. A., Sá, A., Masi, D., Oliveira, A., Boustras, G., Leka, S., & Guldenmund, F. (2020). Occupational Health & Safety (OHS) management practices in micro- and small-sized enterprises: The case of the Portuguese waste management sector. Safety Science, 129, 104794. doi:10.1016/j.ssci.2020.104794
9. Baral, Y. R. (2018). Waste Workers and Occupational Health Risks. International Journal of Occupational Safety and Health, 8(2), 1–3. doi:10.3126/ijosh.v8i2.23328
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.drishtias.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/V2CgeiUq89kI1k2fDwJXML/Swachh-Bharats-waste-management-problem.html>
23. Cost of species services: BBC Wild magazine, 9 May 2018, <https://www.pressreader.com/uk/bbc-wildlife-magazine/20180509/282729112508531>
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[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 |
9. Full episode (English Subtitles)  
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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

<b>22WME516</b>	<b>GIS and RS in Waste Management</b>	<b>3 0 0 3</b>
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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



Sl. No.	Unit Title	Unit content	Teaching hours (Approx.)
1	Geographical Information System	Fundamentals of GIS, Elements of GIS, Data Structure, Processing of data with GIS, GIS Data Editing, Attribute Data Linking, Spatial and Non-Spatial data Analysis, Coordinate System Map Preparation, Digital Cartography, Advantages and Benefits of GIS	12
2	Global Positioning System	Introduction to GPS, Accuracy and Accuracy factors, Types of GPS, Global Navigation System, GPS Today and Uses of GPS Technology	8
3	Remote Sensing	Fundamentals of RS, Spectral Reflectance Signature, Digital Image Processing, Visual Interpretation of Satellite data, Aerial photo and its Interpretation, Advances in Remote Sensing Technologies, Advantages and Benefits of RS	15
4	<i>Trends in Geospatial Technology</i>	Introduction to open source software, collection of GIS data and Satellite images, Web-Based GIS, Enterprise GIS, Mobile GIS, 3-D Visualization and Flythrough, Open GIS, Trends and Technology of GIS, RS and GPS	12
5	Application of GIS, RS and GPS Technology 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 Centres using GIS, RS and GPS. Identification of hotspots of waste and development of plan for its management with the help of QGIS	13

### 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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22WME583

Waste Management – Field Visit – II

0 0 4 2

### 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: Skills to apply technology in waste disposal sites

CO3: 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

### Syllabus

Sl. No.	Places of visit
1	e-waste handling unit/recycling unit
2	Biomedical Waste Management Plant/ Amrita Biomedical Waste Management Centre (Kochi)
3	Upcycling units/Out-of-Waste Material Craft
4	GIS based approaches in Waste Management
5	EIA – Waste Management Plant
6	Health and Safety –Management Information System (MIS)
7	Plastic Waste Recycling Unit

**Evaluation Pattern:**

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