Curriculum and Syllabi

PG Diploma in Waste Management and Environmental Hygiene (PGDWMEH) (2021)

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 itsExtended Producer Responsibility (EPR), and Producer Responsibility Organisation (PRO)

Programme Specific Objectives:

1. To enhance the knowledge on the scientificmanagement 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: Encourageentrepreneurs 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.

Syllabi Course wise

Course 1: Overview of Waste Management

21WME501	Overview of Waste Management	4 0 0 4

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

Sl. No.	Unit Title	Unit content
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 Guidehttps://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

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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/cpcbold/upload/Publications/Publication_323_sec6_16.pdf
- Wastes to Resource : Waste Management Handbook
  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

Course 2: Handling and Disposal of major types of Wastes

21WME502	Handling and Disposal of major types of Wastes	4 0 0 4

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 ofBiomedical 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.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, 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=elU32XNj8PM
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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- 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
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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
- 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 Wollogong, 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

Waqas Azeem, 2013, https://www.slideshare.net/WaqasAzeem1/bioremediation-of-contaminated-soils

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- 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
- Ponoma 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/
- 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 Earthhttps://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
- 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

- 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

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=UmVwb3J0RmlsZXMvTmV3SXRlbV8xMTZfR3VpZGVsaW5lc29mIHdhdGVycXVhbGl0eW1vbml0b3JpbmdfMzEuMDcuMDgucGRm

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=3uQOezl_Uos)

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1. Alternatives to Chlorination: Erin Brockovich October, 2010 “Protection or Poison?-Chloramination of Drinking Water”
2. AOP: FélicienMazille 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/wsp170805chap5.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
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9. *http://www.envexp.com/technical/method-downloads/cod-method-410*
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12. Dangers of plastic tanks: https://www.dawn.com/news/1173628
13. Desalination plant at Tamil Nadu: Jovita Arahna, 20 Nov 2017, https://www.thebetterindia.com/121595/india-first-offshore-desalination-plant/
14. De-watering sludge: http://www.dredgingsolutions.com.au/dewatering/GEOTEXTILE-DEWATERING-TUBES
15. Dissolved Oxygen Deletion in Rivers: Special Correspondent, KOCHI, JANUARY 13, 2014 https://www.thehindu.com/news/cities/Kochi/upcoming-regulator-behind-fish-kill-in-periyar-river/article5572836.ece

16. Eco-STP: Shreya Pareek, July 17, 2015 https://www.thebetterindia.com/21508/a-low-cost-stp-that-treats-water-without-chemicals-or-electricity-is-helping-communities-save-lakhs/
17. Electrochemical DO sensors: https://www.fondriest.com/environmental-measurements/equipment/measuring-water-quality/dissolved-oxygen-sensors-and-methods/
18. ETP: Rinkesh Kukreja, Blog: https://www.conserve-energy-future.com/process-of-wastewater-treatment.php, Accessed on Nov 3, 2018.
19. Fog Harvesting: https://www.oas.org/dsd/publications/unit/oea59e/ch12.htm
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21. Govt programmes: www.swachhindia.ndtv.com
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23. Green Bridges: Sayali Joshi, Feb 2015, http://icrier.org/Urbanisation/events/23-2-15/Ecological.pdf
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15. Environmental Law and Policy in India: Cases, Materials, and Statutes by Armin Rosencranz and Shyam Divan
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17. Not in My Backyard - Solid Waste Mgmt in Indian Cities by Sunita Narain & Swati Singh Sambyal
18. Environmental and Pollution Laws In India by Justice T S Doabia

Course 4: Legal Aspects and Mandatory Regulations

21WME504	Legal Aspects and Mandatory Regulations	4 0 0 4

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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- 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

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

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

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	Externa
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. FelixaEskey. *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, Hercourt, 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.
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Course 8: Community mobilization towards Sustainable Development

21WME511	Community mobilization towards Sustainable Development	3 0 0 3

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
2. Hrebiniak, L.G. (2005). *Making Strategy Work: Leading Effective Execution and Change.*, New Jersey: Wharton School Publishing

3. Hurst, David K. (1995) *Crisis & Renewal: Meeting the Challenge of Organisational Change*. Boston, Mass.: Harvard University Press, p. 148.
4. James F Kirle, 'The community leadership Handbook: Framing Ideas, Building relationships and Mobilizing Resources', Fieldstone Alliance (5 May 2013)
5. Jick, Todd (1991). *Implementing Change*. HBS Note, 9-491-114
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

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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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
10. Ellen MacArthur Foundation https://www.ellenmacarthurfoundation.org/publications/india
11. Fairbridge R. Book Review: KanarischeInseln: Lanzarote, Fuerteventura, Gran Canaria, Tenerife, Gomera, La Palma, Hierro (second edition). The Holocene 1998; 8(3):370-372.
12. Frost & Sullivan: Outlook of Indian Waste Management and Recycling Market, 2017
13. Guivarch C, Hallegatte S. 2C or not 2C?. Global Environmental Change 2013; 23(1):179-192.
14. HamsaIyer , Observer Research Foundation,; Case Study of Mumbai ; Decentralized Solid Waste Management Procedia Environmental Sciences 35 (2016) 101 – 109
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 Intellecaphttps://www.innovationpolicyplatform.org/system/files/4%20Integrated%20Waste%20Manangement_Apr6.pdf
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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

Tool Kit

- Making waste work : A tool kit : 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

- 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

- Toolkit for Public Private Partnership frameworks in Municipal Solid Waste Management

https://smartnet.niua.org/sites/default/files/resources/India_SolidWasteMgmt_PPP_Tookit-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

- 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

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

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/zMAWbXIwrXw
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

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 managementhttps://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_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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2. Chandrashekar et.al. (2014), 'Factors that influence Entrepreneurship in India- an Exploratory Study', Conference proceedings by 7th 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=Ih3zRI0ADt2inI262DJRal4AK7Y%3D&response-content-

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7. Narayan T. 2008. Municipal solid waste management in India: from waste disposal to recovery of resources? Waste Manage. 29, 1163–1166. (doi:10.1016/j.wasman.2008.06.038)
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/Tookit-Public.pdf
2. Handbook onScaling up Solid and LiquidWaste Management in Rural Areashttp://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

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

*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 Safetycand Health (OSH) Profile - 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
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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.drishtiias.com/to-the-points/paper3/environmental-impact-assessment-1

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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
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

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8. Best out of waste: Duration 1 hour: SatyamevJayate Season 2 | Episode 3 | Don't Waste Your Garbage |
9. Full episode (English Subtitles) https://www.youtube.com/watch?v=lS0_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

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 RSin 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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Course 13: Analysis of constituents in Soil and Air

21WME583	Analysis of constituents in Soil and Air	0 0 4 2

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_2 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

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

Annexure – IIa
Equipment
PG Diploma in Waste Management and Environmental Hygiene

12c. Essential Resources: Major Equipments to be created & when (please list in detail the resources in each category)

b. Equipment

Sl. No.	Name of the instruments	Used for	Availability	To be procured
1	Aerator small	Dissolved oxygen		TO BE PROCURED
2	Autoclave	Sterilization	Civil lab	
3	BOD incubator	Biological Oxygen Demand estimation	Civil lab	
4	Centrifuge	Multiuse	Chemistry lab	
5	COD Digester	Chemical Oxygen Demand estimation		TO BE PROCURED
6	Conductivity meter (table top)	Electrical Conductivity	Chemistry lab	
7	Desiccator	TS, TSS, TDS Estimation	Chemistry lab	
8	Double distillation unit	Kjeldahl method Nitrogen estimation	Chemistry lab	
9	Electric Colorimeter	Iron, Metals, Nitrate	Chemistry lab	
10	Electric Hot plate	Preparation of organic matter, carbon	Chemistry lab	
11	Electric Mantle (compound) 4 or 6	COD	Civil lab	
12	Electric Mantle (Single)	Distillation	Chemistry lab	
13	Electronic balance (0.00g)	Multiuse	Chemistry lab	
14	Flame Photometer	Sodium, Potassium	Chemistry lab	
15	Hot air oven	TS, TDS, TSS	Chemistry lab	
16	Ice Box	Sample preservation	Chemistry lab	
17	KjeldahlDigestion Unit	Nitrogen estimation		TO BE PROCURED
18	Magnetic stirrer	Sulphate	Chemistry lab	
19	Mechanical shaker	Preparing soil solutions	Chemistry lab	

20	Microscope – compound	Biological observation - Coliform	Biosensor lab	
21	Microscope – Advanced	Biological observation - Coliform	Biosensor lab	
22	Nephelometric Turbidity Meter	Turbidity	Civil lab	
23	Sound Level Meter	Noise pollution estimation		TO BE PROCURED
24	pH meter (Table top)	Multiuse	Chemical lab	
25	Platform Scale - manual	Weigh solid waste, compost		TO BE PROCURED
26	Respirable Dust Sampler (PM2.5)	Air pollution SPM, RPM, SO2 estimation		TO BE PROCURED
27	Secchi Disc	Field level turbidity		TO BE PROCURED
28	Sling Psychrometer	Relative Humidity		TO BE PROCURED
29	Soil Testing Kit	Multiuse		TO BE PROCURED
30	Thermometer	Multiuse	Chemistry lab	
31	UV-Vis-Spectrophotometer	Phosphorous, Sulphate, Nitrate	Chemistry lab	
32	Water Bath (Multi)	To increase temperature of solution	Chemistry lab	
33	Laminar airflow	Coliform estimation	Biosensor lab	
34	Atomic Absorption Spectroscope	Heavy metals	Chemical Engg. lab	

Equipment to be purchased: Cost Estimation

Sl. No.	Name of the instruments	Used for	Price (`) approximate
1	Aerator small	Dissolved oxygen	15,000
2	COD Digester	Chemical Oxygen Demand estimation	35,000
3	Flame Photometer	Sodium, Potassium	50,000
4	KjeldahlDigestion unit	Nitrogen estimation	10,000
5	Noise Level Meter	Noise level estimation	3,000
6	Platform Scale - manual	Weigh solid waste, compost	10,000

7	Respirable Dust Sampler (PM2.5)	Air pollution SPM, RPM, SO2 estimation	70,000
8	Secchi Disc	Field level turbidity	2,000
9	Sling Psychrometer	Relative Humidity	1,000
10	Soil Testing Kit	Multiuse	5,000
11	UV-Vis-Spectrophotometer	Phosphorous, Sulphate, Nitrate	1,00,000
			3,01,000

Annexure – IIb
Books

SL NO	TITLE	AUTHOR	PUBLISHER	YEAR	Ed	PRICE (Rs.)	NO OF COPIES IN LIBRARY
1	Environmental and health impact of solid waste management activities	Hester, R. E. and R. M. Harrison	Cambridge: The Royal Society of Chemistry	2002		3422.00	Nil
2	Solid Waste Engineering. Principles and Management Issues	Tchobanoglous, G, Theisen, H, and Eliassen, R	McGraw Hill Book Company, New York.	1977		14592.00	Nil
3	SAGE Publications's *Green Technology: An A-Z Guide* (2011) whose work for that encyclopedia formed the basis of her contributions to Britannica.	Gitanjali Nain Gill	SAGE Publication	2011		4000.00	Nil
4	Water Pollution	B.K. Sharma	Goel Publishing House, Meerut.	2005		OUT OF STOCK	Nil
5	Environmental Chemistry	B.K. Sharma	Krishnan Prakashan	2014		850.00	Nil
6	Handbook of Solid Waster Management	George Tchobanoglous and Frank Kreith	McGraw Hill	1994		14000.00	Nil
7	*Project Manthan at Tata Chemicals Limited: Case*	Gopakumar, M. G	Tata Management Training Centre, Pune	2005			Nil
8	*Making Strategy Work: Leading Effective Execution and Change*	Hrebiniak, L.G	New Jersey: Wharton School Publishing	2005		1525.00	Nil

9	*Crisis & Renewal: Meeting the Challenge of Organisational Change*	Hurst, David K. (1995)	Boston, Mass.: Harvard University Press	1995		1300.00	Nil
10	Community Organization and Development: An Indian Perspective	Patil A. R	, Prentice Hall	2012		195.00	1
11	Managing Transitions: Making the Most of the Change',Da Capo Lifelong Books	William Bridges		2009	3	599.00	Nil
12	Handbook of solid waste management and waste minimization technologies	Cheremisinoff N.	Amsterdam: Butterworth-Heinemann	2003		16290.00	Nil
13	Solid waste technology & management	Christensen T	Wiley	2011		28739.00	Nil
14	ENVIRONMENTAL AND ECOLOGICALCHEMISTRY – Vol. II – Bioremediation for Soil Reclamation	Dan L. McNally, James R. Mihelcic, J. Mark Stapleton		2006			Nil
15	Environmental bioremediation technologies	Singh SN, Tripathi RD	Springer	2007		18596.00	Nil
16	Standard Methods for the Examination of Water	Edited by: Eugene W. Rice, Rodger B. Baird, Andrew D. Eaton, Lenore S. Clesceri	American Public Health Association, American Water Works Association, Water Environment Federation		22	Ed.22-Out of Stock Ed 23-Rs.21000	Nil
17	Wastewater Engineering: Treatment and Reuse	Metcalf & Eddy Inc.	McGraw-Hill	2013		1450.00	6
18	Soil Analysis Handbook of Reference Methods	J. Benton Jones, Jr.	CRC Press	1999		12671.00	Nil

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20	The Complete Technology Book on E-Waste Recycling (Printed Circuit Board, LCD, Cell Phone, Battery, Computers)	NPCS Board of Consultants & Engineers	National Institute of Industrial Research (NIIR);	2015		1975.00	Nil
21	Solid Waste Management: An Indian Perspective	M.S. Bhatt	Synergy Books India	2012		795.00	Nil
22	Waste Management the Ultimate Step-By-Step Guide	Gerardus Blokdyk	5starcooks	2018		OUT OF STOCK	Nil
23	Solid Waste Management	J. M. Dewan	Discovery Publishing Pvt.Ltd	1999		OUT OF STOCK	Nil
24	Landfill waste pollution and control.	Kenneth Westlake	Woodhead Publishing Limited. Cambridge	1995		6995.00	Nil
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26	Biodegradation and Bioremediation	Ajay Singh and Owen P Ward	Springer	2004		995.00	1
27	Bioremediation: Principles and Applications	Ronald L. Crawford and Don L. Crawford.	. Cambridge University Press,	1996		995.00	Nil
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