Course: Waste Management

Programme Learning Outcomes (PLOs)

PLO1: To develop scientific understanding of end-to-end solid waste management

PLO2: To gain knowledge and build capacity for decentralized waste management and governance framework

PLO3: To gain theoretical knowledge and technical competence to run and operate smoothly composting and vermicomposting unit as entrepreneurship

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Semester-I

Course Title: Fundamentals of Solid Waste **Course Type: Skill**
Course Code: FSW126 **Credits: 04:(Theory: 02; Practical: 02)**
Max. Marks: 100 (Theory:50; Practical:50)

Course Learning Outcomes (CLOs):

CLO1: To have a comprehensive understanding of solid waste categories
CLO2: To have a thorough understanding of solid waste stream
CLO3: To get exposure and training of understanding generation, collection, segregation and disposal of solid waste

Unit I: Solid waste categorization

Concept of solid waste; Municipal waste; Industrial waste; Agricultural waste; Biomedical waste; Electronic waste; Plastic waste

Unit II: Solid waste stream

Composition and generation of solid waste; Biodegradable and non-biodegradable waste; Recyclable and non-recyclable; Hazardous/special waste; Collection and disposal of solid waste; Environmental and public health concerns of waste disposal

Unit III and IV (Practicals:02 Credits)

1. Survey of solid waste generation in households or institutional premises
2. Collection and composition of solid waste from locality or institution
3. Characterization of solid waste (Dry and wet weight)
4. Field visit to any solid waste collection and disposal system and report preparation
5. Life Cycle Assessment of polyethylene and polypropylene based products

Suggested readings:

1. Vesilind, P. A., Worrell, W. A., & Reinhart, D. R. (2002). *Solid waste engineering*. Cengage Learning.
2. Tchobanoglous, G., & Theisen, H. (2003). *Integrated solid waste management: Engineering principles and management issues* (3rd ed.). McGraw-Hill.
3. Bhatia, S. C. (2007). *Solid and hazardous waste management*. Atlantic Pub. & Distr. (P) Ltd.
4. Masters, G. M., & Ela, W. P. (2008). *Introduction to environmental engineering and science* (3rd ed.). Pearson.
5. Nathanson, J. A., & Schneider, R. A. (2014). *Basic environmental technology: Water supply, waste management, and pollution control* (6th ed.). Pearson.
6. World Bank. (2018). *What a waste 2.0: A global snapshot of solid waste management to 2050*. World Bank.

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Semester-II

Course Title: Waste management and Governance **Course Type: Skill**
Course Code: WMG226 **Credits: 04:(Theory: 02; Practical: 02)**
Max. Marks: 100 (Theory:50; Practical:50)

Course Learning Outcomes (CLOs):
CLO1: *To develop broader understanding of waste management practices and strategies*
CLO2: *To gain an understanding of waste governance framework and waste auditing*
CLO3: *To prepare and assess the waste management plan of an institution*

Unit I: Waste management practices

Concept of integrated solid waste management (ISWM); Waste minimization strategies: concept of $5R^s$; Design and operation of sanitary landfill; Waste to energy conversion; Role of community and local institutions in waste management

Unit II: Waste governance

Solid Waste Management Rules-2024; Management of plastic and electronic waste; Extended Producer Responsibility (EPR); Institutional frameworks for waste governance; Waste audit: procedure and principles

Unit III and IV (Practicals:02 Credits)

1. Conduct of waste audit of institution/campus/organization
2. Economic assessment of Household/institutional waste for recycling/reuse potential
3. Preparation of a waste management plan for an institution or residential area
4. Survey on assessment of environmental and health impact of solid waste disposal
5. Conduct of solid waste awareness programme among the masses regarding solid waste management

Suggested readings:

1. Tchobanoglous, G., & Theisen, H. (2003). *Integrated solid waste management: Engineering principles and management issues* (3rd ed.). McGraw-Hill.
2. Kothari, C. R. (2004). *Research methodology: Methods and techniques* (2nd ed.). New Age International.
3. Visvanathan, C. (2007). Industrial waste auditing. In M. Kutz (Ed.), *Environmentally conscious materials and chemicals processing* (pp. 125–153). John Wiley & Sons. https://doi.org/10.1002/9780470168219.ch5
4. Davis, M. L. (2010). *Water and waste engineering: Design principles and practice*. McGraw-Hill.
5. Stahel, W. R. (2016). *The circular economy: A wealth of flows*. Routledge.
6. Singh, P., Agarwal, P., & Vivekanand, V. (Eds.). (2026). *Solid waste management: Challenges, sustainability and advancements*. Wiley.

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Semester-III

Course Title: Composting and vermicomposting **Course Type: Skill**
Course Code: CV326 **Credits: 04:(Theory: 02; Practical: 02)**
Max. Marks: 100 (Theory:50; Practical:50)

Course Learning Outcomes (CLOs):
CLO1: *Develop a detailed understanding of the process of compositing*
CLO2: *Able to implement composting and vermicomposting as a possible way for entrepreneurship*
CLO3: *Able to execute operation of composting and vermicomposting units at local level*

Unit I: Compost processes

Compost and vermicompost: types and characteristics; Microbes and earthworms: role in composting process; Vermiculture and Vermicomposting: Essential requirements; Design and operation of composting and vermicomposting; Methods of composting: Indore, Bangalore, Windrow and Pit

Unit II: Opportunities and entrepreneurship

Principles and practices of commercial scale composting and vermicomposting; Factors influencing composting and vermicomposting process; Benefits, opportunities and risks; Application and economics; Role in sustainable agriculture; Circular economy

Unit III and IV (Practicals:02 Credits)

1. Designing and establishment of composting system (Pit/Heap/Bin)
2. Designing and establishment of vermicomposting system
3. Site, material selection and feedstock preparation (shredding and mixing of green and brown waste)
4. Monitoring of moisture content, pH, temperature and aeration in composting process
5. Harvesting, packaging, transport, storage and rate of production of compost and vermicompost

Suggested readings:

1. Edwards, C. A., Arancon, N. Q., & Sherman, R. (2011). *Vermiculture technology: Earthworms, organic wastes, and environmental management*. CRC Press.
2. Lohani, H. P., Joshi, R. C., & Pant, R. C. (2013). *A handbook of vermiculture and vermicomposting*. Daya Publishing House.
3. Central Public Health and Environmental Engineering Organisation. (2016). *Manual on municipal solid waste management*. Ministry of Urban Development, Government of India.
4. Rynk, R., Black, G., Gilbert, J., Biala, J., Bonhotal, J., Schwarz, M., & Cooperband, L. (2021). *The composting handbook: A how-to and why manual for farm, municipal, institutional, and commercial composters*. Academic Press.
5. Singh, P., Verma, P., Singh, R., Ahamad, A., & Batalhão, A. C. S.(Eds.). (2022). *Waste management and resource recycling in the developing world*. Elsevier.
6. Walia, S. S., & Kaur, T. (2024). *Earthworms and vermicomposting: Species, procedures and crop application*. Springer.

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