# Scheme & Syllabi

# for

# Diploma in Solid & Hazardous Waste Management

**One Year Programme**

**(W.e.f-2024-2025)**

**(Through Distance Education)**

**Directorate of Distance Education,**
**Guru Jambheshwar University of Science & Technology,**
**Hisar-125001(Haryana)**

## Guru Jambheshwar University of Science & Technology

## Hisar -125001

| Name of Course | Diploma In Solid & Hazardous Waste Management (w.e.f. 2024-25) |
|---|---|

### Semester-I

| S.N. | Course No. | Title | External Marks | Internal Marks | Total | Credits |
|---|---|---|---|---|---|---|
| 1. | SHWM-101 | Solid Waste | 70 | 30 | 100 | 4 |
| 2. | SHWM-102 | Solid Waste Treatment & Disposal | 70 | 30 | 100 | 4 |
| 3. | SHWM-103 | Swachh Bharat Mission | 70 | 30 | 100 | 4 |
| 4. | SHWM-104 | Summer Training* | -- | 100 | 100 | 4 |

### Semester-II

| S.N. | Course No. | Title | External Marks | Internal Marks | Total | Credits |
|---|---|---|---|---|---|---|
| 1. | SHWM-201 | Plastic Waste | 70 | 30 | 100 | 4 |
| 2. | SHWM-202 | Hazardous Waste | 70 | 30 | 100 | 4 |
| 3. | SHWM-203 | Biomedical Waste | 70 | 30 | 100 | 4 |
| 4. | SHWM-204 | E-Waste | 70 | 30 | 100 | 4 |

***Summer training (3-5 weeks) to be undertaken at the end of I$^{st}$ semester. Passing marks are 40% of the total marks. This criteria is also applicable to previous year examinations.**

# SHWM-101 Solid Waste

**Maximum Marks: 100**
**External Marks: 70**
**Internal Marks: 30**
**Time: 3 Hours**

**Note:**

**Nine questions will be set by the examiners, two from each unit & one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit & the compulsory question. Each question will be of 14 marks.**

**Unit-1**

**Classification& Characterization:** Classification of Solid Waste-Based on Type & Sources, Segregation, Categorization & Composition of Waste, Factors Influencing Waste Generation; Waste Characteristics: Physical &Chemical Characterization, Public Health & Environment Effects.

**Unit-2**

**Waste Collection, Transportation & Storage:** Waste Collection – Types of Collection Systems, Collection Services & Equipment, Frequency of Collection, Waste Storage, Waste Storage Methods, Storage Capacity, Storage Containers, Record Keeping-Control, Inventory & Monitoring, Waste Transfer-Transfer Mean & Methods, Transfer Station.

**Unit-3**

**Waste Processing &Minimization:** Waste Processing: Pulverization, Gasification, Pyrolysis & Incineration, Composting (Aerobic& Anaerobic),Volume Reduction – Compaction, Shredding, Separation, Bailing Etc. Waste Minimization: 3R'S,4R'S, 5R'S, Techniques of Waste Management, Metal Recovery, Utilization of Fly Ash.

**Unit-4**

**Solid Waste Management Rules:** Overview of Waste Management Legislations: The Solid Waste Management Rules, 2016, The Construction & Demolition Waste Management Rules, 2016

Suggested Reference Books:


1. Management of Municipal Solid waste-T.V. Ramachandra
2. Solid waste Engineering- P. Aarne Vesilind, William A. Worrell, Debra R. Reinhart
3. Solid Waste Management Manual CPCB, New Delhi
4. Ecotechnology for Pollution Control & Environmental Management by Trivedy R.K. & Arvind Kumar
5. Basic Environmental Technology Nathanson, J.A.

# SHWM-102 Solid Waste Treatment & Disposal

**Maximum Marks: 100**
**External Marks: 70**
**Internal Marks: 30**
**Time: 3 Hours**

**Note:**

**Nine questions will be set by the examiners, two from each unit & one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit & the compulsory question. Each question will be of 14 marks.**

**Unit-1**

**Biological Transformation:** Composting &Vermi-Composting – Definition, Processes &Technologies, Benefits of Composts, Biogas Plant Operation &Process: Application of Biogas, Biogas Plants in India.

**Unit-2**

**Chemical Transformation:** Incineration - Types of Incinerators, Factor Affecting Incineration, Methods of Incineration, (Mass Burning System, Refused Derived Fuel), Air Emission & Control, **Pyrolysis**– Types of Pyrolysis Processes, Factors Affecting Pyrolysis, Advantages &Limitation, **Gasification** – Types, Processes, Advantages & Limitations.

**Unit-3**

**Material & Energy Recovery: Material Recovery** – Hand Picking, Screens, Float, Sink Separators, Magnetic Separators & Material Recovery Plants. **Energy Recovery** – Heat Value of Waste, Waste to Energy, Combustors, Mass Burn System &RDF – Plant Design, Process Design, Efficiency, Residue Handling.

**Unit-4**

**Landfill:** Dumping, Land Filling - Site Selection, Leachate Contamination, Land Filling Methods, Design and Operation of Landfills, Occurrence and Movement of Gases and Leachate in Landfills, Treatments of Leachates, Land Farming and Deep Well Injection.

**Suggested Reference Books:**


1. Solid Waste Management by Sasikumar K.
2. Elements of Solid Hazardous Waste & Management by O. P. Gupta
3. Solid &Liquid Waste Management: Waste to Wealth by Rajaram Vasudevan
4. Solid Waste Management: Present & Future Challenges by AL. Ramanathan Jagbir Singh
5. Textbook of Solid Wastes Management by KHAN I.H

# SHWM- 103 Swachh Bharat Mission

**Maximum Marks: 100**
**External Marks: 70**
**Internal Marks: 30**
**Time: 3 Hours**

**Note:**

**Nine questions will be set by the examiners, two from each unit & one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit & the compulsory question. Each question will be of 14 marks.**

**Unit-1**

**Introduction:** Terminology, Gandhian Philosophy of Cleanliness, Swachh Bharat Abhiyan (SBA), Hygiene, Sanitation & Sustainable Waste Management, Different Phases of the SBA &Its Evaluation, Citizens' Responsibilities: Role of Swacchagrahi, Swachata Pledge, Symbols, SBM guidelines

**UNIT- 2**

**Swachh Bharat**: Indicators for Swachh Bharat, Rural – Sanitation Coverage Across Households (2014 vs. 2022), Open Defecation Free (ODF) Villages Parameters, ODF Plus Model, Key Indicators, Urban-Sustainable Sanitation, Garbage Free Cities, Garbage Free Star Rating (Cities)

**UNIT- 3**

**Prospects & Challenges**: Attitudes & Perceptions, Operational & Financial Issues, Monitoring & Supervision, Community Mobilization, Ranking of Cities, Swachh Tourist Destinations

**UNIT- 4**

**Events Details Related to SBA**: Case Studies, Schemes & Programs of Government Swachh Bharat Abhiyaan. Case Studies - Success Stories on Swachh Bharat Abhiyaan Mission in Indian states.

**Suggested Reference Books:**

1. Swachh Bharat Abhiyan by Dr. Saurabh Mishra

# SHWM-201 Plastic Waste

**Maximum Marks: 100**
**External Marks: 70**
**Internal Marks: 30**
**Time: 3 Hours**

**Note:**

**Nine questions will be set by the examiners, two from each unit & one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit & the compulsory question. Each question will be of 14 marks.**

**Unit-1**

**Introduction:** Plastic Waste, Types – Thermoplastic &Thermosetting, Sources & Color Coding, Uses, Plastics in LandFilling, Present &Future Trends of Plastic in India & Globally.

**Unit-2**

**Impact of Plastic**: Nuisance Plastic, Impact of Plastic on MarineLife, Wildlife &Human Health & Environment, PlasticBan, Economic Impacts.

**Unit-3**

**Plastic Waste Management:** Waste Disposal Methods – Recycling of Plastic Waste, 4R'S, (Reduction, Reuse, Recycle, Recovery), Plastic in LandFilling, Recycling Methods of PVC, PET, PMMA,HDPE, LDPE, PS, Uses of Plastic in Roads: Issues/Challenges, Possible Alternative Materials of Plastic, Plastic Recovery & Economic.

**Unit-4**

**Plastic Waste Management Rules:** Central Pollution Control Board Guidelines for Plastic Waste, Plastic Waste Management Rules, 2016 &Amendments.

**Suggested Reference Books:**


1. Plastics Waste Management, Muralisrinivasan Natamai Subramanian, 9781119555872, 2019 Scrivener Publishing.
2. SWACHH BHARAT MISSION, Municipal Solid Waste Management Manual, Central Public Health & Environmental Engineering Organization (CPHEEO) 2016.

# SHWM-202 Hazardous Waste

**Maximum Marks: 100**
**External Marks: 70**
**Internal Marks: 30**
**Time: 3 Hours**

**Note:**

**Nine questions will be set by the examiners, two from each unit & one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit & the compulsory question. Each question will be of 14 marks.**

**Unit-1**

**Introduction**: Definition, Sources, Characterization & Classification &Symbols of Corrosive, Reactive, Toxic(Heavy Metals & Pesticides)&Flammable Waste – Types &Toxic Impact on Human Health &Environment.

**Unit-2**

**Storage & Transportation of Hazardous Waste:** Compatibility of Waste, Storage of Hazardous Waste – Guidelines Containers, Tanks, Surface Impoundment, Land Filling, Underground Injection, Transportation – Waste Accumulation &Transportation Guidelines/Regulation, Manifest, Record Keeping &Reporting, Hazardous Waste Packing - Labeling, Marking &Placarding, Modes of Transportation of Hazardous Waste.

**Unit-3**

**Hazardous Waste Treatment:** Filtration &Separation, Chemical Precipitation, Chemical Oxidation, Solidification &Stabilization, Evaporation, Ozonation, Thermal Treatment – Incineration, Pyrolysis, Biological Treatment – Bio-reclamation, Bioremediation, Deep Well Injection, Aerobic &Anaerobic Treatment.

**Unit-4**

**Hazardous Waste Management Rules:** Hazardous Waste (Management & Transboundary Movement) Rules, 2016.

**Suggested Reference Books:**


1. Handbook on chemicals & hazardous waste management & handling in India by MOEFCC.
2. Hazardous Waste Management, Volume II, Characterization & treatment process by Sukalyan Sengupta.
3. Solid & Hazardous Waste Management by S. C. Bhatia.
4. Solid & Hazardous Waste Management, Second Edition by M. N. Rao.
5. Environmental Law 7/e, 2022 by S.C. Shastri.

# SHWM-203 Biomedical Waste

**Maximum Marks: 100**
**External Marks: 70**
**Internal Marks: 30**
**Time: 3 Hours**

**Note:**

**Nine questions will be set by the examiners, two from each unit & one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit & the compulsory question. Each question will be of 14 marks.**

**Unit-1**

**Introduction:** Sources &Classification of Biomedical Waste,Causes of Biomedical Waste Production, Health Hazards of Biomedical Waste.

**Unit-2**

**Biomedical Waste Collection, Transportation &Storage:** Waste Collection, Segregation &Labeling, Waste Handling - Onsite/Offsite Transportation, Protocol for Transportation of Waste, Spill Management, Patient Safety for Infection Control &Prevention.

**Unit-3**

**Treatment of Biomedical Waste:** Needs of Disposal of Biomedical Waste, Standards Operating Procedure &Protocols for Biomedical Waste Treatment – Wet Treatment Technology, Incineration - Microwave, Autoclave, Electrothermal Activation, Waste Disposal Methods – Deep Burial Pit, Sharp Disposal Pit,Secure Landfill.

**Unit-4**

**Biomedical Waste Management Rules:** The Bio-Medical Waste Management Rules, 2016; & Amendments, National Guidelines for Hospital Waste Management, Monitoring Performa for Hospital Waste Management.

**Suggested Reference Books:**


1. Biomedical Waste: Management, Recycling, &Applications by Himadri Panda.
2. Environmental law 7/e, 2022 by S.C. Shastri.

# SHWM-204 E-Waste

**Maximum Marks: 100**
**External Marks: 70**
**Internal Marks: 30**
**Time: 3 Hours**

**Note:**

**Nine questions will be set by the examiners, two from each unit & one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit & the compulsory question. Each question will be of 14 marks.**

**Unit-1**

**Introduction**: Sources, Characteristics, Generation of E-Waste, Indian &Global Scenario of E-Waste, Health Hazards of E-Waste, Growth of Electrical & Electronics Industry in India,

**Unit-2**

**Collection, Storage &Transportation of E – Waste:** Methods of E-Waste Collection, Safety Protocols for Handling, Storage of E-Waste, Onsite/Offsite Storage &Transportation of E-Waste.

**Unit-3**

**Treatment &Disposal of E-Waste:** Sorting, Crushing, Separation & Purification of E-Waste, Recycling & Recovery of Materials from E-Waste, Methods of E-Waste Disposal - LandFilling, Incineration etc.

**Unit-4**

**E-Waste Management Rules:** E-Waste Management Rules2016, The Batteries (Management & Handling Rules) 2001.

**Suggested Reference Books:**


1. E-waste: Regulations, Management Strategies & Current Issues by Zeng, Xianlai.
2. E-waste: Management, Types & Challenges by Li, Yuan Chun.
3. E-Waste Management: Challenges & Opportunities in Indiaby Varsha Bhagat-Ganguly.
4. E-waste: implications, regulations, & management in India & current global best practices by Rakesh Johri.
5. Environmental Law 7/e, 2022 by S.C. Shastri.