# Syllabus For Recycled Plastic Product and Eco bricks Manufacturing Assistant

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| **Course Name** | **Recycled Plastic Product and Eco bricks Manufacturing Assistant** |
| **Sector** | **Environmental Science** |
| **Course Code** | **ENV/2024/RPMA/434** |
| **Occupation & Job Description after completion of course** | **- Eco-Bricks Manufacturer (Self Employment):** Produce eco-bricks using waste plastic materials for construction purposes.<br>**- Plastic Product Manufacturer (Self Employment):** Create various plastic products, such as furniture, decorative items, and household goods, using recycled plastic materials.<br>**- Quality Control Inspector:** Ensure the quality of eco-bricks and plastic products, adhering to industry standards.<br>**- Sales and Marketing Representative:** Promote and sell eco-bricks and plastic products to construction companies, retailers, and individual customers. |
| **Course Duration** | **Total Duration 120 Hrs (T- 45 hrs, P- 75 hrs)** |
| **Trainees' Entry Qualification** | **Basic Qualifications**<br>1. Education: Minimum 8th-grade pass (preferably 10th-grade pass)<br>2. Physical Ability: Ability to work in a manufacturing environment<br>**Preferred Qualifications**<br>1. Relevant Experience: Experience in manufacturing, production, or a related field<br>2. Computer Literacy: Basic computer skills and knowledge of software applications |
| **Trainers Qualification** | **Essential Qualifications**<br>1. Technical Background: Diploma or Bachelor's or Master's degree in a relevant field (plastics engineering, polymer science, mechanical engineering)<br>2. Industrial Experience: Minimum 3 years of experience in manufacturing, production, or a related field, preferably in plastics or polymer industry<br>3. Training Experience: Proven experience in training or teaching, preferably in a vocational or technical training setting<br>**Desirable Qualifications**<br>1. Certifications: Certifications like ISO 9001, ISO 14001, or OHSAS 18001, which demonstrate expertise in quality management, environmental management, or occupational health and safety<br>2. Specialized Knowledge: Knowledge of eco-bricks and plastic products manufacturing processes, including design, production, and quality control |

**Structure of Course:**

| Module No. | Module name | Outcome | Compulsory/ Optional | Theory (Hrs) | Practical (Hrs) | Total (Hrs) [Multiple of 30] |
|---|---|---|---|---|---|---|
| 1 | **Introduction to Solid Waste Management** | Explain the principles of Solid Waste Management System and related policies | Compulsory | 10 | 00 | 10 |

| Module No. | Module name | Outcome | Compulsory/ Optional | Theory (Hrs) | Practical (Hrs) | Total (Hrs) [Multiple of 30] |
|---|---|---|---|---|---|---|
| 2 | **Manufacturing Eco-Bricks** | Manufacture cost-effective good quality eco-bricks | Compulsory | 10 | 25 | 35 |
| 3 | **Handicraft Products using Waste Plastic Materials** | Make Handicraft Products using recycled Plastic | Compulsory | 10 | 20 | 30 |
| 4 | **Biodegradable Waste-to-Wealth** | Practice Vermiculture and Composting techniques | Compulsory | 10 | 20 | 30 |
| 5 | **Integrated Approaches and Case-Studies** | Work effectively in a group to create products using concepts of into waste management | Compulsory | 05 | 10 | 15 |
| | | TOTAL: | | 45 | 75 | 120 |

**SYLLABUS:**

**Module Name: 1. Introduction to Solid Waste Management**

**Outcome:** Explain the principles of Solid Waste Management System and related policies.

**Theory Content: (10 hours)**

*Lecture 1:* Definition and Importance (1 hour)- Overview of solid waste management- Environmental and health impacts of poor waste management

*Lecture 2:* Types of Solid Waste (2 hours)- Biodegradable and Non-biodegradable waste- Municipal, industrial, hazardous, and organic waste- Characteristics of different waste types

*Lecture 3:* Waste Management Hierarchy (2 hours)- Reduce, reuse, recycle, recover, and dispose- Strategies for effective waste management

*Lecture 4:* Waste Collection and Segregation (2 hours)- Collection methods and technologies-Importance of segregation at source

*Lecture 5:* Policy and Legislation (1 hour)- Overview of waste management laws and regulations- Role of government and community

*Lecture 6:* Sustainable Practices (2 hours)- Cradle-to-Cradle Approach- Best practices in solid waste management- Community involvement and awareness

**Practical Content:** NIL

**Tools & Equipment needed:** Blackboard, Chalk, Duster/Smart Board/Projector

**Module Name: 2. Manufacturing Eco Bricks**

**Outcome:** Manufacture cost-effective good quality eco-bricks.

**Theory Content: (10 hours)**

*Lecture 1:* Introduction to Eco Bricks (1 hour)- Definition and benefits of eco-bricks- Materials used in eco-brick production
*Lecture 2:* Eco Brick Production Process (2 hours)- Steps involved in manufacturing eco-bricks- Quality control measures
*Lecture 3:* Applications of Eco Bricks (3 hours)- Use in construction and landscaping- Case studies of eco-brick projects-Milstein modules-Dieleman Lego
*Lecture 4:* Innovations in Eco Brick Technology (2 hours)- Recent advancements in materials and processes
*Lecture 5:* Economic and Environmental Impact (2 hours)- Cost-benefit analysis of eco-brick production- Environmental sustainability

**Practical Content: (25 hours)**

*Practical 1:* Eco Brick Manufacturing (15 hours)- Hands-on experience in mixing materials- Moulding and curing eco-bricks
*Practical 2:* Testing and Quality Assessment (10 hours)- Testing strength and durability- Analyzing eco-brick properties of a customized social space made by eco-brick modules.

**Tools & Equipment needed:(For class room Lecture*)*** - Blackboard, Chalk, Duster/Smart Board/Projector
**(For Practical Class)**
**Primary Equipment**

1. Eco-Brick Machine: A specialized machine designed for compressing and molding plastic waste into eco-bricks.
2. Shredder: A machine used to shred plastic waste into smaller pieces.
3. Granulator: A machine used to granulate shredded plastic into uniform sizes.
4. Mixer: A machine used to mix granulated plastic with other materials (e.g., sand, cement).
5. Hydraulic Press: A machine used to compress and mold the plastic mixture into eco-bricks.

**Secondary Equipment**

1. Weighing Scale: Used to measure the weight of plastic waste and other materials.
2. Measuring Cups and Spoons: Used to measure the quantity of materials.
3. Safety Gear: Gloves, goggles, masks, and steel-toed boots for protecting trainees from injuries.
4. Hand Tools: Hammers, screwdrivers, pliers, and wrenches for minor repairs and adjustments.
5. Cleaning Equipment: Brooms, dustpans, and cleaning solutions for maintaining a clean workspace.

**Raw Materials**

1. Plastic Waste: Various types of plastic waste (e.g., PET, HDPE, PVC).
2. Sand: Used as an aggregate in the eco-brick mixture.
3. Cement: Used as a binding agent in the eco-brick mixture.
4. Water: Used to mix with the eco-brick mixture.

**Protective Gear and Safety Equipment**

1. First Aid Kit
2. Fire Extinguisher
3. Ventilation System
4. Personal Protective Equipment (PPE): Gloves, goggles, masks, and steel-toed boots.

## Module Name: 3. Handicraft Products using Waste Plastic Materials

**Outcome:** Make Handicraft Products using recycled Plastic.

**Theory Content: (10 hours)**

*Lecture 1:* Understanding Plastics (1 hour)- Types of plastics and their properties- Environmental concerns related to plastic waste- Dangers of microplastic pollution

*Lecture 2:* Recycling Plastics (3 hours)- The recycling process and technologies- Challenges and opportunities in plastic recycling
*Lecture 3:* Eco-Friendly Plastic Alternatives (2 hours)- Bioplastics and their applications- Innovations in sustainable materials
*Lecture 4:* Regulations and Standards (2 hours)- Overview of standards for plastic products- Role of certifications in sustainable manufacturing
*Lecture 5:* Market Trends and Future Directions (2 hours)- Current trends in the plastic industry- Future of sustainable plastic products

**Practical Content: (20 hours)**

*Practical 1:* Plastic Recycling Process (10 hours)- Collection and segregation of plastic waste- Mechanical recycling techniques
*Practical 2:* Product Development from Recycled Plastics (10 hours)- Designing and creating products (e.g., containers, utensils, handicrafts)- Evaluating product performance

**Tools & Equipment needed: (For class room Lecture)**Blackboard, Chalk, Duster/Smart Board/Projector
**(For Practical Class)**
**Primary Equipment**

**1**. Washing Machine: Cleaning of waste plastic materials.
2. Dryer Machine: Drying of waste plastic materials after washing.
2. Plastic Shredder: Used to crush shredded plastic into granules.
3. Heat Press: Used to melt and shape plastic granules into desired forms.
4. Molding Machine: Used to create molds for shaping plastic into various forms.
5. Hand Tools: Used for cutting, shaping, and assembling plastic parts.

**Secondary Equipment**

1. Drilling Machine: Used for making holes in plastic parts.
2. Sanding Machine: Used for smoothing and polishing plastic surfaces.
3. Painting and Printing Equipment: Used for adding colors and designs to plastic products.
4. Weighing Scale: Used for measuring the weight of plastic materials and finished products.
5. Measuring Cups and Spoons: Used for measuring the quantity of plastic materials and additives.

**Hand Tools**

1. Cutting Tools: Knives, scissors, and cutting machines for cutting plastic sheets and parts.
2. Shaping Tools: Hammers, mallets, and shaping machines for shaping plastic parts.
3. Assembling Tools: Wrenches, pliers, and screwdrivers for assembling plastic parts and products.
4. Finishing Tools: Sandpaper, files, and polishing machines for smoothing and finishing plastic surfaces.

**Raw Materials**

1. Waste Plastic Materials: Various types of waste plastic materials, such as plastic bottles, containers, and sheets.
2. Additives and Colorants: Chemical additives and colorants used to enhance the properties and appearance of plastic products.
3. Adhesives and Sealants: Used for bonding and sealing plastic parts.

**Protective Gear and Safety Equipment**

1. First Aid Kit
2. Fire Extinguisher
3. Ventilation System
4. Personal Protective Equipment (PPE): Gloves, goggles, masks, and steel-toed boots.

**Other Requirements**

1. Electrical and Water Supply: A reliable electrical and water supply for operating equipment and machinery.

**Module Name: 4. Biodegradable Waste-to-Wealth**

**Outcome:** Practice Vermiculture and Composting techniques.

**Theory Content: (10 hours)**

*Lecture 1:* Techniques for biodegradable waste segregation at source (2 hours)- Manual vs. mechanical collection- Smart waste management solutions- various Landfill methods and their utilities
*Lecture 2:* Composting techniques (2 hours)- Aerobic composting process- Factors influencing composting (moisture, temperature, aeration, etc.)- Application of compost in agriculture and landscaping
*Lecture 3:*Vermiculture (3 hours)- Vermiculture basics- Role of earthworms in waste processing- Design of vermiculture systems and applications in organic farming
*Lecture 4:* Biogas production from organic waste (3 hours)- Overview of technology- Anaerobic digestion process- types of biogas plants (fixed-dome, floating-drum, and plug-flow)- Role of bacteria and biogas- Application of biogas energy

**Practical Content: (20 hours)**

*Practical 1:* Field Visits (10 hours)- Focus on Waste-to-Energies in action- Visits to local recycling facilities, biogas plants and interaction with industry experts and waste management professionals- Presentations and peer feedback
*Practical 2:* Hands-on Workshop (10 hours)- Composting and Vermiculture practices

**Tools & Equipment needed: (For class room Lecture)**Blackboard, Chalk, Duster/Smart Board/Projector
**(For Practical Class)**

**Primary Equipment**

1. Vermi-Composting Units: Specialized containers or beds for housing worms and decomposing organic waste.
2. Worm Bins: Small, enclosed bins for breeding and maintaining worm populations.
3. Grinder / Shredder: A machine used to shred organic waste into smaller pieces.
4. Mixing Machine (optional): A machine used to mix shredded organic waste with other materials (e.g., soil, microorganisms).
5. Moisture Meter: A device used to measure the moisture content of the composting mixture.

**Secondary Equipment**

1. Aeration Tools: Hand tools or machines used to aerate the composting mixture and maintain oxygen levels.
2. pH Meter: A device used to measure the pH level of the composting mixture.
3. Temperature Probe: A device used to measure the temperature of the composting mixture.
4. Turning Tools: Hand tools or machines used to turn and mix the composting mixture.
5. Sieves and Screens: Used to separate worms from the composting mixture and to grade the finished compost.

**Hand Tools**

1. Gloves: Protective gloves for handling organic waste and worms.
2. Shovels and Trowels: Hand tools used for mixing and turning the composting mixture.
3. Rakes and Forks: Hand tools used for aerating and turning the composting mixture.
4. Measuring Cups and Spoons: Used to measure the quantity of materials added to the composting mixture.
5. Sprayers and Watering Cans: Used to maintain the optimal moisture level in the composting mixture.

**Raw Materials**

1. Organic Waste: Biodegradable waste materials, such as food waste, crop residues, and animal manure.
2. Worms: Red wiggler worms (Eiseniafetida) or other composting worm species.
3. Bedding Materials: Carbon-rich materials, such as coconut coir, straw, or shredded newspaper.
4. Microorganisms (Optional): Beneficial microorganisms, such as effective microorganisms (EM), to enhance the composting process.

**Protective Gear and Safety Equipment**

1. First Aid Kit
2. Gloves and Masks: Protective gear for handling organic waste and worms.
3. Ventilation System: A well-ventilated workspace to prevent inhalation of dust and gases.

**Module Name: 5. Integrated Approaches and Case Studies**

**Outcome:** Work effectively in a group to create products using concepts of into waste management.

**Theory Content: (05 hours)**

*Lecture 1:* Integrated Waste Management Strategies (1 hour)- Combining different waste management practices- Community-based approaches
*Lecture 2:* Case Studies in Solid Waste Management (2 hours)- Successful local and international case studies- Lessons learned and best practices
*Lecture 3:* Waste-to-Energy Technology (2 hours)- Incineration, Pyrolysis and Gasification- Energy recovery and Carbon Footprint reduction- Mechanical Biological Treatment (MBT)- Integration with renewable energy systems e.g. solar and wind power

**Practical Content: (10 hours)**

*Practical 1:* Project Development (10 hours)- Group projects on designing waste management solutions- Presentations and peer feedback

**Tools & Equipment needed:**

1. Computers: For data analysis, modeling, and simulation of waste management scenarios.
2. GIS Mapping Tools: For spatial analysis and mapping of waste generation and management infrastructure.
3. Data Loggers and Sensors: For monitoring and tracking waste management metrics, such as waste generation rates, composition, and disposal methods.
4. Communication Equipment: For stakeholder engagement, community outreach, and education.
5. Whiteboards / Blackboard, Chalk, Duster/Smart Board Tools: For brain storming, idea generation, and presentation of strategies.
6. Printers and Plotters: For printing and plotting maps, reports, and other visual aids.
7. Scanners and Photocopiers: For digitizing and reproducing documents and reports.
8. Audio-Visual Equipment (Projector and Presentation): For presentations, workshops, and training sessions.
9. Notebooks and Pens: For note-taking, idea generation, and brainstorming.
10. Sticky Notes and Markers: For brainstorming, idea generation, and prioritization.
11. Calculators and Spreadsheets: For data analysis and financial modeling.
12. Camera and Photography Equipment: For documenting waste management practices and infrastructure.
13. Collaboration and Communication Tools: For stakeholder engagement, community outreach, and education.
14. Internet and Communication Services: For accessing digital tools, software, and communication platforms.

**Learning Outcome – Assessment Criteria**

| Module No. | Outcome | Assessment Criteria |
|---|---|---|
| 1 | Explain the principles of Solid Waste Management System and related policies | **After completion of this module students will be able to:**<br>1.1 define solid wastes and solid waste management<br>1.2 explain the differences between various types of solid wastes<br>1.3 describe the effective strategies for waste management<br>1.4 explain waste collection, segregation, and importance of segregation at source<br>1.5 describe waste management policies and sustainable practices for solid waste management. |
| 2 | Manufacture cost-effective good quality eco-bricks | **After completion of this module students will be able to:**<br>2.1 explain the importance of using eco-bricks and know the materials required<br>2.2 describe the production process<br>2.3 describe applications of eco-bricks as different module types<br>2.4 manufacture eco-bricks<br>2.5 test the qualities of materials manufactured by eco-bricks |
| 3 | Make Handicraft Products using recycled Plastic | **After completion of this module students will be able to:**<br>3.1 explain chemical and physical properties of different types of plastic materials and dangers of microplastic pollution<br>3.2 demonstrate the recycling process and technologies as well as the challenges and opportunities in plastic recycling<br>3.3 develop products from recycled plastics and evaluate their properties<br>3.4 describe the standards and regulations in this regard<br>3.5 infer market trends, sells and strategies and future directions |
| 4 | Practice Vermiculture and Composting techniques | **After completion of this module students will be able to:**<br>4.1 outline technologies for smart bio-waste management<br>4.2 demonstratevermiculture, composting and biogas production<br>4.3summarize contents of interaction with the industry experts and management professionals |

| Module No. | Outcome | Assessment Criteria |
|---|---|---|
| | | 4.4identify various tools and machineries related to this field. |
| 5 | Work effectively in a group to create products using concepts of into waste management | **After completion of this module students will be able to:**<br>5.1 outline strategies on integrated waste management<br>5.2 explain case-study methods on local and international levels<br>5.3 explain Waste-to-Energy technologies, MBT and BT integrated with renewable energy sources<br>5.4 summarize energy recovery and carbon-footprint reduction<br>5.5 develop group projects on innovative waste management solutions |

**Tools & Equipment** required to Develop strategies for integrating sustainable practices into waste management

## List of Tools, Equipment & materials needed for 30 Trainees (Practical)

| Sl No | Items Name | Specification | Qty |
|---|---|---|---|
| **Manufacturing of Eco-Bricks and Handicraft Products using Waste Plastic Materials** | | | |
| 1 | Eco-Brick Machine | 1. Machine Type: Hydraulic or manual compression machine<br>2. Machine Size: 4-6 feet in length, 2-3 feet in width, and 3-4 feet in height<br>3. Machine Weight: 200-500 kg (440-1100 lbs)<br>4. Power Source: Electric motor, hydraulic pump, or manual operation | 01 |
| 2 | Shredder | 1. Machine Type: Single-shaft, double-shaft, or four-shaft shredder<br>2. Machine Size: 4-12 feet in length, 2-4 feet in width, and 3-6 feet in height<br>3. Machine Weight: 500-2000 kg (1100-4400 lbs)<br>4. Power Source: Electric motor, hydraulic motor | 01 |
| 3 | Granulator | 1. Machine Type: Rotary granulator, hammer mill granulator, or centrifugal granulator<br>2. Machine Size: 4-12 feet in length, 2-4 feet in width, and 3-6 feet in height<br>3. Machine Weight: 500-2000 kg (1100-4400 lbs)<br>4. Power Source: Electric motor, hydraulic motor | 01 |
| 4 | Mixer | 1. Machine Type: Horizontal mixer, vertical mixer, or ribbon mixer<br>2. Machine Size: 2-10 feet in length, 1-5 feet in width, and 2-6 feet in height<br>3. Machine Weight: 200-2000 kg (440-4400 lbs) | 01 |

| Sl No | Items Name | Specification | Qty |
|---|---|---|---|
| | | 4. Power Source: Electric motor, hydraulic motor, or diesel engine | |
| 5 | Hydraulic Press | 1. Machine Type: Single-acting or double-acting hydraulic press<br>2. Machine Size: 4-12 feet in length, 2-4 feet in width, and 3-6 feet in height<br>3. Machine Weight: 1000-5000 kg (2200-11000 lbs)<br>4. Power Source: Electric motor, hydraulic pump, or diesel engine<br>Hydraulic Configurations<br>1. Hydraulic Pressure: 1000-5000 psi (6.9-34.5 bar)<br>2. Hydraulic Flow Rate: 10-50 liters per minute (2.6-13.2 gallons per minute)<br>3. Hydraulic Cylinder Size: 2-10 inches in diameter, 10-50 inches in stroke length | 1 |
| 6 | Weighing Scale | General Specifications<br>1. Type: Digital or analog weighing scale<br>2. Capacity: 1-1000 kg (2.2-2200 lbs)<br>3. Accuracy: ±0.1-1% of the measured weight<br>4. Resolution: 0.1-10 kg (0.2-22 lbs)<br>5. Unit of Measurement: Kilograms, pounds, or both<br>Technical Specifications<br>1. Sensitivity: 1-10 kg (2.2-22 lbs)<br>2. Repeatability: ±0.1-1% of the measured weight<br>3. Linearity: ±0.1-1% of the measured weight<br>4. Temperature Range: -10°C to 40°C (14°F to 104°F)<br>5. Humidity Range: 20-80% RH<br>Display and Interface<br>1. Display Type: LCD, LED, or backlit display<br>2. Display Size: 2-6 inches (5-15 cm)<br>3. Interface: USB, RS-232, or wireless connectivity<br>4. Language: Multiple language options | 3 |
| 7 | Measuring Cups and Spoons | 1. Material: Stainless steel, plastic, or silicone<br>2. Capacity: 1-1000 ml (0.04-33.8 oz)<br>3. Gradations: Markings for different units of measurement (e.g., ml, oz, cups)<br>4. Accuracy: ±1-5% of the measured volume<br>5. Size: 5-20 cm (2-8 in) in diameter, 5-20 cm (2-8 in) in height<br>Measuring Spoons<br>1. Material: Stainless steel, plastic, or silicone<br>2. Capacity: 1-100 ml (0.04-3.4 oz)<br>3. Gradations: Markings for different units of measurement (e.g., ml, oz, tsp, tbsp) | 10 |

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|---|---|---|---|
| | | 4. Accuracy: ±1-5% of the measured volume<br>5. Size: 5-20 cm (2-8 in) in length, 1-5 cm (0.4-2 in) in width | |
| 8 | Safety Gear: Gloves, goggles, masks, and steel-toed boots for protecting trainees from injuries. | Best Quality | 60 sets |
| 9 | Hand Tools: Hammers, screwdrivers, pliers, and wrenches for minor repairs and adjustments | Best Quality | 60 sets |
| 10 | Cleaning Equipment: Brooms, dustpans, and cleaning solutions for maintaining a clean workspace. | Best Quality | 60 sets |
| 11 | Plastic Waste: Various types of plastic waste (e.g., PET, HDPE, PVC). | Supplied by District PWM Unit | As required |
| 12 | Sand | Locally arranged | As required |
| 13 | Cement | Locally arranged | As required |
| 14 | Water | Locally arranged | As required |
| 15 | Washing Machine | 1. Type: Industrial washing machine or custom-built washing machine for plastic waste<br>2. Capacity: 50-500 kg (110-1100 lbs) per cycle<br>3. Power Source: Electric motor, 3-phase or single-phase<br>4. Voltage: 220-440V, 50-60Hz<br>5. Weight: 500-2000 kg (1100-4400 lbs) | 1 |
| 16 | Dryer Machine | 1. Type: Industrial dryer machine or custom-built dryer machine for plastic waste<br>2. Capacity: 50-500 kg (110-1100 lbs) per cycle<br>3. Power Source: Electric motor, 3-phase or single-phase<br>4. Voltage: 220-440V, 50-60Hz<br>5. Weight: 500-2000 kg (1100-4400 lbs)<br>6. Drying Cycle: Multiple drying cycles, including pre-drying, drying, and cooling<br>7. Air Flow Rate: 100-500 CFM (cubic feet per minute)<br>8. Humidity Control: Optional humidity control system to maintain optimal drying conditions | 1 |
| 17 | Heat Press | 1. Type: Hydraulic heat press, pneumatic heat press, or electric heat press<br>2. Machine Size: 2-10 feet in length, 1-5 feet in width, and 2-6 feet in height<br>3. Machine Weight: 500-5000 kg (1100-11000 lbs)<br>4. Power Source: Electric motor, hydraulic pump, or pneumatic system<br>Heating Specifications<br>1. Heating Type: Electric heating elements, steam heating, or hot oil heating<br>2. Heating Capacity: 5-50 kW (6.7-67.1 HP)<br>3. Temperature Range: 100-400°C (212-752°F)<br>4. Temperature Control: Digital temperature control system with ±1°C (±1.8°F) accuracy | 1 |

| Sl No | Items Name | Specification | Qty |
|---|---|---|---|
| 18 | Molding Machine | 1. Type: Injection molding machine, blow molding machine, or compression molding machine<br>2. Machine Size: 5-20 feet in length, 3-10 feet in width, and 5-15 feet in height<br>3. Machine Weight: 1000-10000 kg (2200-22000 lbs)<br>4. Power Source: Electric motor, hydraulic motor, or pneumatic system<br><br>5. Molding Capacity: 100-10000 grams per shot<br>6. Molding Pressure: 100-1000 bar (1450-14500 psi)<br>7. Molding Temperature: 100-400°C (212-752°F)<br>8. Molding Cycle Time: 10-60 seconds | 1 |
| 19 | Hand Tools: Used for cutting, shaping, and assembling plastic parts | Utility knives, Hacksaws, Bolt cutters, pitchfork, shovel, compost turner, Scissors, Craft knives, Files and rasps, Sandpaper and sanding blocks, Drill presses and hand drills, Rakes and Forks, Jigsaw and coping saw, Chisels and gouges, Wrenches and sockets, Pliers and punches, Screwdrivers and bits, Clamps and fixtures, Adhesives and sealants, Measuring tapes and calipers, Marking tools. | 60 sets |
| 20 | Drilling Machine | 1. Type: Bench drill press, floor-standing drill press, or radial drill press<br>2. Machine Size: 2-6 feet in length, 1-3 feet in width, and 2-5 feet in height<br>3. Machine Weight: 100-1000 kg (220-2200 lbs)<br>4. Power Source: Electric motor, 1-phase or 3-phase<br>4. Drilling Capacity: 1-50 mm (0.04-2 in) diameter, 100-1000 mm (3.9-39.4 in) depth<br>5. Drilling Speed: 100-5000 rpm<br>6. Feed Rate: 0.1-10 mm/rev (0.004-0.4 in/rev)<br>7. Spindle Taper: MT2, MT3, or MT4 | 2 |

| Sl No | Items Name | Specification | Qty |
|---|---|---|---|
| 21 | Sanding Machine | 1. Type: Belt sander, orbital sander, or vibratory sander<br>2. Machine Size: 2-6 feet in length, 1-3 feet in width, and 2-5 feet in height<br>3. Machine Weight: 50-500 kg (110-1100 lbs)<br>4. Power Source: Electric motor, 1-phase or 3-phase<br>4. Sanding Speed: 100-3000 rpm<br>5. Sanding Belt Size: 10-60 inches in length, 1-6 inches in width<br>6. Sanding Belt Material: Aluminum oxide, silicon carbide, or ceramic<br>7. Sanding Pressure: Adjustable pressure control system | 1 |
| 22 | Painting and Printing Equipment | 1. Type: Spray painting, screen printing, pad printing, or digital printing<br>2. Machine Size: 2-10 feet in length, 1-5 feet in width, and 2-6 feet in height<br>3. Machine Weight: 100-2000 kg (220-4400 lbs)<br>4. Power Source: Electric motor, 1-phase or 3-phase<br>5. Painting Method: Spray painting, electrostatic painting, or powder coating<br>6. Painting Capacity: 100-1000 pieces per hour<br>7. Painting Speed: 10-100 mm/s (0.4-3.9 in/s)<br>8. Painting Thickness: 10-100 microns | 1 |
| 23 | Vermi-Composting Units | Three Beds (6ft x 3ft) | 1 unit |
| 24 | Worm Bins | 1. Type: Small, enclosed bins for breeding and maintaining worm populations<br>2. Material: Durable plastic, wood, or metal<br>3. Size: 12-24 inches in length, 6-12 inches in width, and 6-12 inches in height<br>4. Capacity: 1-5 cubic feet<br>5. Ventilation: Adequate ventilation system to maintain oxygen levels and prevent anaerobic conditions<br>6. Moisture Control: System to maintain optimal moisture levels (60-80%) for worm growth and health<br>7. Temperature Control: Insulation and/or heating/cooling system to maintain optimal temperature range (55-77°F) for worm growth and health<br>8. pH Control: System to maintain optimal pH range (6.5-7.5) for worm growth and health | 5 |

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|---|---|---|---|
| 25 | Grinder / Shredder (for Bio degradabele waste) | 1. Type: Electric, hydraulic, or diesel-powered grinder/shredder<br>2. Machine Size: 3-10 feet in length, 2-6 feet in width, and 4-10 feet in height<br>3. Machine Weight: 500-5000 kg (1100-11000 lbs)<br>4. Power Source: Electric motor, hydraulic motor<br>5. Grinding/Shredding Capacity: 100-1000 kg/h (220-2200 lbs/h)<br>6. Grinding/Shredding Speed: 10-100 rpm<br>7. Grinding/Shredding Chamber Size: 10-50 inches in diameter, 10-50 inches in length<br>8. Grinding/Shredding Tool Material: High-carbon steel, stainless steel, or tungsten carbide | 1 |
| 26 | Mixing Machine | 1. Type: Horizontal mixer, vertical mixer, or drum mixer<br>2. Machine Size: 3-10 feet in length, 2-6 feet in width, and 4-10 feet in height<br>3. Machine Weight: 500-5000 kg (1100-11000 lbs)<br>4. Power Source: Electric motor, hydraulic motor<br>5. Mixing Capacity: 100-1000 kg/batch (220-2200 lbs/batch)<br>6. Mixing Speed: 10-100 rpm<br>7. Mixing Time: 5-30 minutes<br>8. Mixing Tool Material: Stainless steel, carbon steel, or rubber | 1 |
| 27 | Moisture Meter | 1. Type: Digital moisture meter, analog moisture meter, or handheld moisture meter<br>2. Sensor Type: Capacitance sensor, resistance sensor, or infrared sensor<br>3. Measurement Range: 0-100% moisture content<br>4. Accuracy: ±1-5% moisture content<br>4. Sensor Frequency: 1-100 kHz<br>5. Sensor Depth: 1-10 inches (2.5-25 cm)<br>6. Response Time: 1-10 seconds<br>7. Temperature Range: -20°C to 80°C (-4°F to 176°F) | 4 |
| 28 | Aeration Tools | Worm Turner: A handheld tool with a flat or curved blade, used for gently turning and aerating vermi-compost beds.<br>- Length: 24-36 inches<br>- Material: Stainless steel, aluminum, or durable plastic<br>- Blade width: 4-6 inches | 4 |
| 29 | pH Meter | 1. Type: Digital pH meter, analog pH meter, or handheld pH meter<br>2. Sensor Type: Glass electrode, polymer electrode, or ISFET (Ion-Sensitive Field-Effect Transistor)<br>3. Measurement Range: 0-14 pH<br>4. Accuracy: ±0.01-0.1 pH<br>5. Sensor Frequency: 1-100 Hz<br>6. Response Time: 1-10 seconds<br>7. Temperature Range: -20°C to 80°C (-4°F to 176°F)<br>8. Temperature Compensation: Automatic temperature compensation (ATC) or manual temperature compensation (MTC) | 4 |

| Sl No | Items Name | Specification | Qty |
|---|---|---|---|
| 30 | Temperature Probe | 1. Type: Digital temperature probe, analog temperature probe, or thermocouple probe<br>2. Sensor Type: Thermistor, thermocouple, or RTD (Resistance Temperature Detector)<br>3. Measurement Range: -20°C to 150°C (-4°F to 302°F)<br>4. Accuracy: ±0.1-1.0°C (±0.2-2.0°F)<br>5. Sensor Frequency: 1-100 Hz<br>6. Response Time: 1-10 seconds<br>7. Temperature Resolution: 0.1-1.0°C (0.2-2.0°F)<br>8. Probe Length: 10-100 cm (4-39 in) | 4 |
| 31 | Sieves and Screens | 1. Type: Circular, rectangular, or square sieves and screens<br>2. Material: Durable materials (e.g., stainless steel, aluminum, or plastic)<br>3. Size: Varies depending on the application (e.g., 12-48 inches in diameter or length)<br>4. Mesh Size: Varies depending on the application (e.g., 1/8 inch to 1 inch) | 6 |
| 32 | Gloves and Masks | Best Quality (for multiple use) | 60 set |
| 33 | Shovels and Trowels | Best Quality (for multiple use) | 60 set |
| 34 | Sprayers and Watering Cans | 1. Type: Manual or automatic sprayers, and watering cans<br>2. Material: Durable materials (e.g., stainless steel, plastic)<br>3. Size: Varies depending on the application (e.g., 1-10 liters)<br>4. Weight: 0.5-10 kg (1.1-22 lbs) | 30 |
| 35 | Organic Waste | Supplied by District SWM Unit | As required |
| 36 | Worms | 1. Species: Red Wiggler Worms (Eiseniafetida) or other composting worm species suitable for tropical climates (e.g., Eudriluseugeniae, Perionyxexcavatus)<br>2. Origin: Locally sourced or imported from reputable suppliers<br>3. Size: 1-5 inches (2.5-13 cm) in length<br>4. Weight: 0.1-1 gram per worm | 10 kg. |
| 37 | Bedding Materials | Carbon-rich materials, such as coconut coir, straw, or shredded newspaper (to be arranged locally) | As required |
| 38 | Microorganisms | 1. Type: Beneficial microorganisms, such as Effective Microorganisms (EM), lactic acid bacteria, yeast, and phototrophic bacteria<br>2. Form: Liquid, powder, or granular form<br>3. Concentration: 1-10 billion CFU (Colony-Forming Units) per gram or milliliter<br>4. Shelf Life: 6-24 months when stored properly | As required |
| 39 | First Aid Kit | As required | 4 set |
| 40 | Masks | Best Quality (for single use) | 120 set |
| 41 | Goggles and steel-toed boots | Best Quality | 60 set |
| 42 | Computers | Best Quality | 2 set |
| 43 | Whiteboards / Blackboard, Chalk, Duster/Smart Board Tools | Best Quality | As required |
| 44 | Printers and Plotters | Best Quality | 2 set |
| 45 | Scanners and Photocopiers | Best Quality | 2 set |

| | | | |
|---|---|---|---|
| 46 | Audio-Visual Equipment (Projector and Presentation) | Best Quality | 1 set |
| 47 | Sticky Notes and Markers | Best Quality | As required |
| 48 | Notebooks and Pens | Best Quality | As required |
| 49 | Calculators and Spreadsheets | Best Quality | 60 |
| 50 | Internet and Communication Services | As per local availability | 1 |

**Marks Distribution:**

Theory 200

Practical 800