# GUJARAT TECHNOLOGICAL UNIVERSITY

**Bachelor of Engineering**
**Subject Code: 3152303**
**Semester – V**
**Subject Name: Plastic Recycling & Waste Management**

**Type of course: Humanities and Social Science**

**Prerequisite: NA**

**Rationale:** At the end of the course, the student will understand the sources of plastic waste & recycling techniques for plastic waste. The student will also have knowledge of various methods of recycling individual plastics and plastic products. They can apply this knowledge in effective waste management of plastics.

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Credits | Examination Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|
| | | | | Theory Marks | | Practical Marks | | |
| L | T | P | C | ESE (E) | PA (M) | ESE (V) | PA (I) | |
| 3 | 0 | 0 | 3 | 70 | 30 | 0 | 0 | 100 |

**Content:**

| Sr. No. | Content | Total Hrs |
|---|---|---|
| 1 | Introduction to Plastic Waste<br>Definitions regarding plastic waste<br>Sources of Plastic Waste<br>Plastics Cycle-Flow of plastics products & plastics waste<br>Generation of Industrial Plastic waste.<br>Concept of 4R | 2 |
| 2 | Seperation<br>Separation of components of municipal solid refuse-Size reduction & Separation methods, Separation Processes Specific to plastics-Separation of Paper/Plastics mixture, Separation of plastics from Plastic-coated fabric, Separation of mixtures of Plastics<br>Separation using Recycling Codes | 6 |
| 3 | Primary Recycling<br>Degradation of thermoplastics due to repetitive processing-Mechanisms<br>Granulators, Granulating difficult materials- Cryogenic Grinding, Reprocessing low Bulk-density plastic waste with plunger and screw type of stuffer, In-line Automatic Recycling Systems | 7 |
| 4 | Secondary Recycling<br>Approaches to secondary Recycling<br>Equipment Requirements<br>Equipments for Reworking of Mixed Plastic waste-Mitsubishi Reverzer, Klobbe, FN machine | 5 |

| | | |
|---|---|---|
| | Secondary Recycling by Co-extrusion and Co-injection Molding<br>Use of Plastic waste as fillers | |
| **5** | Tertiary Recycling<br>Pyrolysis and Pyrolysis systems for Municipal solid refuse<br>Pyrolysis of Plastics waste-Pyrolysis reactions<br>Reactors for Pyrolysis of Plastics-Union Carbide's apparatus, Japan Steel works Ltd. System<br>Chemical decomposition of plastics waste | **7** |
| **6** | Quaternary Recycling<br>Energy recovery from municipal solid refuse<br>Incinerators<br>Incineration of predominantly plastics waste- Problems associated with incineration of pure plastic waste, Incinerators suitable for Plastics waste | **6** |
| **7** | Disposal of waste plastics without the recovery of value<br>Incineration without the recovery of energy<br>Landfill-Open Dumping & Sanitary Landfill<br>Plastics in Landfill | **2** |
| **8** | Recycling of various Plastics and Plastic Products<br>Recycling of HDPE containers, Recycling of PP/HDPE woven sacks to pellets, Recycling of PE films/plastic bags, PET Recycling, recycling of PVC, Recycling of PS, Recycling of PU, Recycling of medical waste<br>Environmental Implications of Recycling & Polymer Degradation | **7** |

**Suggested Specification table with Marks (Theory): (For BE only)**

| **Distribution of Theory Marks** | | | | | |
|---|---|---|---|---|---|
| R Level | U Level | A Level | N Level | E Level | C Level |
| **20** | **20** | **15** | **10** | **3** | **2** |

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**Reference Books:**

**1. Plastics Waste by Jacob Leidner**

**2. Plastics Fabrication and Recycling by Manas Chanda & Salil Roy**

**3. Introduction to Plastics recycling by Vannessa Goodship**

**4. Plastic Waste management Processing and Disposal by Muralisrinivasan Natamai Subramanian**

# GUJARAT TECHNOLOGICAL UNIVERSITY

**Bachelor of Engineering**
**Subject Code: 3152303**

**Course Outcomes:**

The theory should be taught and practical should be carried out in such a manner that students are able to acquire required learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

| Sr. No. | CO statement | Marks % weightage |
|---|---|---|
| CO-1 | Identify the sources of plastic waste, define the terminologies and understand the life cycle of plastic waste and 4 R concept. | 15 |
| CO-2 | Understand and explain the separation process specific to municipal refuse and plastic waste. | 25 |
| CO-3 | Apply the knowledge Primary, Secondary, Tertiary & Quaternary recycling techniques for recycling of plastics. | 30 |
| CO-4 | Understand the Landfill techniques for disposal of plastics | 5 |
| CO-5 | Explain the recycling techniques specific to particular plastic and plastic products and apply this knowledge in practical field. | 25 |

**List of Experiments: - As per the syllabus topics**

**Major Equipment:**

**List of Open Source Software/learning website:**

i. https://www.pantechco.jp/english/recycling/pe/

ii. https://en.wikipedia.org/wiki/Plastic_recycling

iii. https://earth911.com/inspire/what-do-those-plastic-recycling-codes-mean/