



# GUJARAT TECHNOLOGICAL UNIVERSITY

**Program Name: Engineering**

**Level: Under Graduate**

**Branch: Plastic Technology**

**Subject Code: BE05023041**

**Subject Name :Plastic Recycling & Waste Management**

w. e. f. Academic Year:	2024-25
Semester:	5
Category of the Course:	Professional Elective Course - 1

<b>Prerequisite:</b>	Students should have the knowledge and understanding of basics of polymer chemistry. They should have the knowledge of the characteristics of different commodity and engineering thermoplastics polymers and how they behave under stress, heat, and chemical exposure. Since recycled plastic rarely has the same flow properties as virgin resin, knowledge of polymer rheology is also essential.
<b>Rationale:</b>	The rationale for this course is to transition students, from material production to <b>resource circularity</b> . The student will understand the sources of plastic waste & different recycling techniques to recycle plastic waste. They can apply this knowledge in effective waste management of plastics. This course provides the technical framework necessary for a modern engineer.

### Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes
01	Identify the sources of plastic waste, define the terminologies and understand the life cycle of plastic waste and concept of 4 R in recycling.
02	Understand and explain the degradation of plastics and separation processes specific to plastic waste.
03	Explain the Primary, Secondary, Tertiary and Quaternary recycling techniques and apply this knowledge to recycle waste plastics.
04	Understand the Landfill techniques for disposal of plastics, Environment implications of recycling, Plastic Waste Management (PWM) Rules , Extended Producer Responsibility (EPR)

### Teaching and Examination Scheme:

Teaching - Learning Scheme (in Hours per Semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
L	T	P	PBL	TH		Theory		Tutorial /Practical			
						ESE (E)	PA (M)	PA (I)	TW/ SL(I)	ESE (V)	
45	00	30	15	90	03	70	30	20	30	50	200



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Where L = Lecture, T= Tutorial, P= Practical, PBL=Problem Based Learning, TH = Total Hours, ESE = End-Semester Examination, PA = Progressive Assessment

## Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Introduction to Plastic Waste Definitions regarding plastic waste Sources of Plastic Waste, 4 's in Recycling Flow of plastics products & plastics waste	5	10
2	Introduction to polymer degradation Chain and random degradation , Types of degradation like Mechanical degradation, Thermal degradation, Hydrolytic degradation Seperation of plastic waste Seperation methods, Separation of Paper/Plastics mixture, Separation of plastics from Plastic-coated fabric, Separation of mixtures of Plastics , Recycling Codes of plastics, BIS Standard-IS 14534: Guidelines for Recycling of Plastics	10	20
3.	Primary Recycling Problems in Primary recycling, 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	15
4.	Secondary Recycling Technical approaches to Secondary Recycling Machinery for Reworking of Mixed Plastic waste- Reverzer, Klobbie Secondary Recycling by Co-extrusion and Co-injection Molding Use of Plastic waste as fillers	7	15
5.	Tertiary Recycling Pyrolysis, Advantages of Pyrolysis, Effect of pyrolysis temperature on product yield, Pyrolysis systems for Municipal solid refuse, Pyrolysis of Plastics waste, Pyrolysis reactions, Problems associated with pyrolysis of plastics, Union carbide reactor for Pyrolysis of Plastics, Chemical decomposition of plastics waste through Hydrolysis and Glycolysis	9	20
6.	Quaternary Recycling Incineration , Parts of an Incinerator, Incineration of predominantly plastics waste- Problems associated with incineration of pure plastic waste, Characteristics of Incinerators suitable for Plastics waste	7	20



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	Landfill-Open Dumping & Sanitary Landfill, Plastics in Landfill, Environmental Implications of Recycling & Polymer Degradation Plastic Waste Management (PWM) Rules , Extended Producer Responsibility (EPR)		
	<b>Total</b>	<b>45</b>	<b>100</b>

R Level	U Level	A Level	N Level	E Level	C Level
25	25	15	5	0	0

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

## References/Suggested Learning Resources:

### (a) Books:

1. Plastics Waste by Jacob Leidner
2. Polymer Science by Gowariker
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 M. N. Subramanian

### (b) Open source software and website:

1) <https://nptel.ac.in/>

2) <https://pslc.ws/>

## Suggested Course Practical List: If any

Practical based on above topics.

## Sustainable Development Goal:

The Plastic Recycling & Waste Management course aligns primarily with SDG 12 (Responsible Consumption and Production) by emphasizing the "4 Rs" and the transition from material production to resource circularity. It advances SDG 9 (Industry, Innovation, and Infrastructure) and SDG 11 (Sustainable Cities and Communities) through the study of specialized recycling machinery, municipal waste pyrolysis, and sanitary landfill techniques. Additionally, by exploring the environmental implications of polymer degradation and regulatory frameworks like Extended Producer Responsibility (EPR) and Plastic Waste Management (PWM) Rules, the syllabus supports SDG 13 (Climate Action) and the protection of terrestrial and aquatic ecosystems.



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## • Problem Based Learning Activities:

Sr. No.	Activity	No. of hours	Total hours claimed	Evaluation Criteria
1	Seminar based on technical topics	Duration- 10 hrs	10	Based on content, report preparation and presentation
2	Mini project	Duration-10 hrs	10	Based on content, literature review, report preparation and presentation
3	Micro project	Duration-05 hrs	05	Based on content, literature review, report preparation and presentation
4	Industry/Research laboratory visit	Visit = 5h, Report preparation = 5h	10	Based on report submitted.
5	Poster/chart/power point preparation on technical topics	Duration = 10 h	10	Based on Poster/Chart/PPT preparation and presentation skills
6	Assignment writing.	5 assignments of 2h each.	10	Based on the assignment submitted.
7	Technical Video based learning related to the subject	Duration of video = 5h Report preparation = 5h	10	Report /presentation based on the video learning outcomes.
8	Group Discussion on emerging/trending technical topics based on subject	Duration = 1 h each	--	Based on performance in group discussion, technical depth, knowledge etc.
9	Attending Expert Lecture/Webinar/Seminar	Duration- 1hr each	--	Based on Short report
10	Self-learning on-line course	Minimum duration of the course should be 10h.	10	Examination based assessment at the end of course. Based on the certificate produced
11	Exhibition/ Conference/ Trade Fair/ Industrial exposure for 2-3 days	Visit- 15 hr Report preparation- 5 hr	20	Based on learning, observations and short report.
12	Working model on technical topics	Working = 15 h	15	Based on design, understanding & presentation of the model



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13	Non-working model on technical topics	Non- working = 5 h	5	Based on design, understanding & presentation of the model
14	Videos on Industrial safety aspects based on subject	Duration of video = 5h Report preparation = 5h	10	Based on report submitted

Above activities are suggestive, faculty can choose any of these activities and cover up the Problem based learning hours.. The number of hours is suggestive. Faculty can sub-divide the number of hours based on the activity. However, the total number of hours is fixed.

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