GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Under Graduate

Branch: Plastics Engineering

Subject Code: BE05053041

Subject Name: Plastic Waste Management Techniques

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

Prerequisite:	• Basic understanding of polymer chemistry, polymer types (thermoplastics, thermosets) and their properties. • Knowledge of polymer processing techniques and material behaviour during manufacturing. • Awareness of environmental issues related to plastics, including degradation, recycling and sustainability concepts.
Rationale:	The rapid growth of plastic consumption in industries and daily life has led to significant environmental challenges, including landfill accumulation, pollution and resource depletion. Effective management of plastic waste is therefore essential for sustainable development and environmental protection. This course equips students with a comprehensive understanding of the strategies, technologies and regulatory frameworks used in the collection, segregation, recycling and disposal of plastic waste. It covers mechanical, chemical and energy recovery methods, along with emerging techniques for biodegradable and environmentally friendly polymers.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes
01	Remember the types of plastics, their properties and the environmental issues associated with plastic waste.
02	Understand the principles of plastic degradation, recycling methods and regulatory frameworks for waste management.
03	Apply mechanical, chemical and thermal recycling techniques to process and manage plastic waste efficiently.
04	Analyze the composition of plastic waste streams and assess the suitability of different management techniques for specific plastic types.
05	Evaluate various plastic waste management strategies based on environmental, economic and sustainability criteria.
06	Create innovative solutions for reducing plastic waste, improving recycling processes, and designing sustainable materials or products for a circular economy.

Teaching and Examination Scheme:

Teaching - Learning Scheme (in Hours per Semester)					Total Credits = TH / 30	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	TW / SL	TH		ESE (E)	PA (M)	PA (I)	TW / SL (I)	ESE (V)	
45	00	30	15	90	03	70	30	10	10	30	150

Where L = Lecture, T = Tutorial, P = Practical, TW/SL = Term-Work / Self-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:** Overview of plastics and their environmental impact; types of plastic waste (thermoplastics, thermosets, composites); sources and generation of plastic waste; global and local waste statistics; challenges in plastic waste management.	6	13
2.	**Plastic Degradation and Environmental Impact:** Mechanisms of plastic degradation (thermal, photo, chemical and microbial); biodegradation of polymers; impact on soil, water, and marine ecosystems; microplastics and health concerns; sustainability considerations.	7	15
3.	**Mechanical Recycling Techniques:** Collection, segregation and sorting of plastic waste; size reduction, cleaning and reprocessing; extrusion, pelletizing and remolding; limitations and practical considerations in mechanical recycling.	8	18
4.	**Chemical and Thermal Recycling:** Pyrolysis, depolymerization, gasification and hydrolysis methods; conversion of plastics to monomers, fuels or chemicals; advantages, limitations and industrial applications; energy recovery from plastics.	8	18
5.	**Waste Management Strategies and Regulations:** Integrated waste management approaches: reduce, reuse, recycle (3R) principles; circular economy in plastics; policies, legislation and standards (national and international); extended producer responsibility (EPR).	8	18
6.	**Emerging Techniques and Applications:** Biodegradable polymers and compostable plastics; innovative recycling technologies; upcycling and	8	18

	value-added products; case studies on industrial applications and successful plastic waste management projects.		
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20	25	10	5	5	5

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) Plastic Waste Management – Methods and Applications by K. Deshmukh and J. Parameswaranpillai.
2) Plastic Waste Management: Processing and Disposal by M. N. Subramanian.
3) Plastics Waste Management by N. Mustafa.
4) Plastic Waste Pollution and Mitigation Strategies by B. Rani, A. Sharma, R. K. Yadav, L. Mohan and R. K. Maheshwari.
5) Plastic Recycling and Waste Management by A. Szeberényi, B. Y. Adam, H. Sharma and A. Dhivya.
6) Efficient and Enhanced Management of Plastic Waste in India: Case Studies from Vapi and Surat by P. Chakraborty, G.K. Bharat, E. H. Steindal, S. Mohanty, R. Hurley, M. Olsen and S. Pandey.
7) Rural Plastic Waste Management: Strategies and Practices by S. Raj.

(b) Open source software and website:

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

Suggested Course Practical List:

Practical based on above topics.

List of suggested activities for Term-Work / Self-Learning:

S. No.	Activity	No. of Hours	Total Hours Claimed	Evaluation Criteria
1	Industry / Research laboratory visit	Visit = 5 h, Report preparation = 5 h	10	Based on report submitted
2	Poster / chart / power point preparation on technical topics	Duration = 10 h	10	Based on Poster / Chart / PPT preparation and presentation skills
3	Assignment writing	5 assignments of 2 h each	10	Based on the assignment

				submitted
4	Technical Video based learning related to the subject	Duration of video = 5 h Report preparation = 5 h	10	Report / presentation based on the video learning outcomes
5	Group Discussion on emerging / trending technical topics based on subject	Duration = 1 h each	-	Based on performance in group discussion, technical depth, knowledge, etc.
6	Attending Expert Lecture / Webinar / Seminar	Duration = 1 h each	-	Based on Short report
7	Self-learning on-line course	Minimum duration of the course should be 10 h	10	Examination based assessment at the end of course. Based on the certificate produced
8	Exhibition / Conference / Trade Fair / Industrial exposure for 2-3 days	Visit = 15 h, Report preparation = 5 h	20	Based on learning, observations and short report
9	Working model on technical topics	Working = 15 h	15	Based on design, understanding & presentation of the model
10	Non-working model on technical topics	Non-working = 5 h	5	Based on design, understanding & presentation of the model
11	Videos on Industrial safety aspects based on subject	Duration of video = 5 h Report preparation = 5 h	10	Based on report submitted

- Above activities are suggestive, faculty can choose any of these activities and cover up the rest of the 15 Self 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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