GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Plastic Engineering (23)
SUBJECT NAME: Additives and Compounding of Plastics
SUBJECT CODE: 2172303

B.E. 7TH SEMESTER

Type of course:
Prerequisite: IPMS, Chemistry of Plastic Materials, BPP, Advance Plastic Processing.
Rationale:

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment; OEP-Open Ended problem; AL-Active learning;

Learning Objectives: To study the additives and compounds that can be used with plastic materials and design newer applications.

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Introduction** – Technological Requirements – Classification – Chemistry and Mechanism – Selection Criteria – General effect on Properties – Evaluation and functions of additives.	5	5
2	**Fillers – Reinforcements** – Thermal Stabilizers- Antioxidants (Heat & UV) – Plasticizers - Impact Modifiers – Lubricants - Processing aids – Blowing agents – Flame Retardants – Anti-static agents – Anti blocking agent- Slip and anti slip agent- processing aids- Mould releasing agents. Conductive additives- Toughening agents – Nucleating agents – Colorants – Additives for Recycling – aids – mould releasing agents, coupling agents, antislip, etc. Commercially available fillers and additives	15	20
3	**Selection of Polymers and Compounding ingredients** – General objectives – possibilities and limitations of mixing and compounding – Methods of incorporation of additives into polymer materials, Mixing	10	15

	and mixing equipments.		
4	**Mixing and mixing equipments. Principles** – Operating characteristics – Machine construction – Specifications – Process control systems and working details of Batch mixers and continuous mixers – High speed mixer – Two roll mill – Banbury Mixer – Ribbon blender – Planetary mixers –Twin screw extruders [co rotating / counter rotating].	10	20
5	Mixing Methodologies : Types of Mixing, Dispersive/Distributive, Agglomerates, mixing of solid additives, mixing of liquid additives, Difference between mixing and compounding, etc.	8	20
6	**End Use Market for Plastics** Principles of Material selection including consideration of conventional materials competitive with plastics – Case studies on material suitability (e.g., Plastic Gears, Feeding Bottle, Bowels for micro wave ovens). Survey and uses of plastics additives with reasons for their importance in major industries like, Agriculture, Packaging, Building, Transport, Electrical, Electronics and Telecommunications, Medical and Furniture.	3	20

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
Remembrance **R Level**	**Understanding U Level**	**Application A Level**	**Analyze** **N Level**	**Evaluate E Level**
10	**15**	**20**	**15**	**10**

Legends: R : Remembrance ; U = Understanding; A = Application 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

Text Book:

1. J. A. Brydson, Plastics Materials, Butterworth Heinemann, Oxford, 1999.
2. John Murphy, The Additives for Plastics Hand Book, Elsevier Advanced Technology, Oxford, 1996.
3. Mixing and compounding of polymers Theory and Practice, Author: Manas-Zloczower, Ica

Reference Books:

1. R. Gachter and H. Muller, Plastics Additives Hand Book, Hanser Publishers, Munich, 1993.
2. Jesse Edenbaum, Plastics Additives and Modifiers Hand Book, Chapman & Hall, London, 1996.
3. Ica Manas – Zloczower and Zehev Tadmor, Mixing and Compounding of Polymers, Hanser Publications, Munich, 1995.
4. Nicholas P. Cheremisionoff, Polymer Mixing and Extrusion Technology, Marcel Dekker Inc., New York, 1995.

Course Outcome:

After learning the course the students should be able to:

1. Identify additives and compounds suitable for specific applications.
2. Suggest suitable fillers/reinforcements/additives for new applications.
3. Develop new compounds for specific applications.

List of Experiments:

1. To carry out compounding of PP with various additives for specific applications.
2. To do PVC compounding using high speed mixer.
3. To carry out mixing of thermoplastics with rubber materials on two roll mill.To analyse mixing time v/s. Speed of rolls, study effects using microscope on morphology.
4. To study effects of additives on properties of LDPE
5. To study effects of additives on properties of PP
6. To study effects of additives on properties of PVC
7. To study effects of additives on properties of ABS
8. To carry out compounding using twin screw extruder.
9. To prepare compounds of plastic materials with additives suitable for medical applications
10. To prepare compounds of plastic materials with additives suitable for automotive applications.

Design based Problems (DP)/Open Ended Problem:

1. Design and manufacture of compounds of plastic materials for machinery applications.
2. Design and Manufacture of compounds of plastic materials for high impact applications.

Major Equipment:

List of Open Source Software/learning website:

1. **www.wikipedia.org**
2. **www.sciencedirect.com**
3. **www.mit.edu**

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.