GUJARAT TECHNOLOGICAL UNIVERSITY

PLASTIC TECHNOLOGY (23)
BIOPOLYMERS
SUBJECT CODE: 2162311
B.E. 6th SEMESTER

Type of course: Elective

Prerequisite: NA

Rationale: NA

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	3	6	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Introduction: Definition of Biopolymers and types of biopolymers, definition of bioplastics, Types of bioplastics, such as starch based, cellulose based plastics and some aliphatic polyesters (PLA, PHB), polyamides, Bio-Based Composites from Soybean Oil and Chicken Feathers, bio-derived polyethylene and genetically modified bioplastics. Environmental impact such as Bioplastics and biodegradation.	07	15
2	Polymer biodegradation: Biodegradable polymer classes, Natural biodegradable polymer, Synthetic biodegradable polymer and modified naturally biodegradable polymer. Non-biological and biological degradable polymer. Measuring of biodegradation of polymers- Enzyme assays, Plate test, Respiratory test, Natural environment, Field trial, Gas evolution test (CO2 & CH4) Composite implant materials: Mechanics of improvement of properties by incorporating different elements. Composite theory of fiber reinforcement (short and long fibers, fibers pull out). Polymers filled with estrogenic fillers (e.g. hydroxyapatite). Host tissue reactions.	08	15
3	Bioplastics and Biocomposites processing and their applications: Introduction of bioplastics and biocomposites, processing of bioplastics and biocomposites, applications of bioplastics and their composites- civil engineering, biomedical, automotives applications.	10	15

4	Biomaterials in Medical and Dental Devices and Prostheses: Introduction of biomaterials, Material choice implications based on device design. General biomaterial evaluation procedures. Replacement of skeletal hard tissues. Polymer used as cosmetic implants, controlled drug delivery system artificial heart valves, bone replacement, artificial organs, dental applications.	07	15
5.	Surface Modification of Biomaterials for Improved Functionality: Enhancement of biocompatibility by the use of Corona discharge and plasma processes. Surface coatings Silver/silver oxide silicone hydrogels UV curable systems PC coatings Heparin loaded systems	05	10
6.	Characterization and Testing of Biomaterials: Bulk analysis methods applied to the study of Biomaterials (XRD, FTIR, DSC, TGA, etc.) Surface analysis methods applied to the study of biomaterials (SEM, TEM, AFM, etc.) Mechanical test: wear, friction, flexibility, fatigue, etc.	10	15
7.	Applications and manufacture of Bio Plastics Use of Bio materials for manufacture of plastic films, various types of films and applications; usage of biological friendly plastics in homes, industry, etc. with specific applications. Mixing of biomaterials with plastics: equipment details, process details etc.	10	15

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**15**	**20**	**15**	**10**	**0**

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. Biomaterials –novel materials from biological sources D. Byrom - Stockton press
2. hand Book of Biodegradable polymers Catia Bastioli, - Rapra Tech
3. Surface modification of biomaterials: Methods analysis and applications R Williams - University of Liverpool, UK
4. Biopolymers**,**R.M. Johnson, L.Y. Mwaikambo and N. Tucker
5. Hand Book of Bioplastics & Biocomposites for Engineering Applications Srikanth Pillai
6. Biopolymers **,** Steinbuechel

Course Outcome:

After learning the course the students should be able to:

1. Understand the theory behind Bio Polymers
2. Understand the importance and applications of Bio Polymers

List of Experiments:

1. To synthesize Bio Polymer from Soyabean oil
2. Preparation of Starch based plastic materials in laboratory
3. Processing of Bio Plastics
4. Processing of Bio Composites
5. To carry out tests for measuring bio degradation in Polymers.
6. To Carry out the DSC test for Bio Plastics
7. Surface Analysis of Bio Plastics and Composites using SEM.
8. Surface Analysis using TEM
9. FTIR Test for Bio Plastics
10. Manufacture of Bio Degradabale Plastic Films

Design based Problems (DP)/Open Ended Problem:

1. To Manufacture artificial Heart Valves in BIO PLASTICS
2. To manufacture artificial organs in Bio Plastics
3. To design and build knee replacements in Bio plastics

Major Equipment: DSC, FTIR, SEM, TEM, SINGLE SCREW AND TWIN SCREW EXTRUDERS, COMPRESSION MOULDING PRESS,ETC

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.