GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Under Graduate

Branch: Plastics Engineering

Subject Code: BE05053031

Subject Name: Plastic Blends and Composites

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

Prerequisite :	□ Fundamental knowledge of polymer chemistry, including polymerization mechanisms, molecular structure and morphology. □ Understanding of thermoplastics and thermosetting polymers, along with basic polymer processing methods. □ Introductory knowledge of reinforcements, fillers and fiber-reinforced plastic (FRP) systems.
Rationale:	Polymer blends and composites enable the development of materials with tailored mechanical, thermal and electrical properties to meet the evolving demands of modern engineering applications. A clear understanding of blend miscibility, phase morphology, compatibilization techniques and rheological behavior is essential for the effective design and optimization of advanced polymer systems. This course also imparts knowledge of composite fabrication methods and emerging high-performance applications across industries. It equips students with the technical competence required for careers in polymer modification, compounding, fiber-reinforced plastics (FRP) manufacturing and advanced materials development.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes
01	Remember the fundamental concepts of polymer blends, composites, miscibility, morphology, fillers and reinforcements.
02	Understand the principles of compatibilization, interfacial adhesion and phase behaviour in multi-component polymer systems.
03	Apply rheological and thermodynamic principles to processing and performance evaluation of plastic blends and composite materials.
04	Analyze the effect of composition, reinforcement type and processing parameters on the mechanical, thermal and electrical properties of blends and composites.
05	Evaluate appropriate material combinations and manufacturing techniques for specific engineering applications based on performance, cost and sustainability criteria.
06	Create optimized polymer blend formulations or composite designs to meet targeted industrial requirements and standards.

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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	PBL	TH		ESE (E)	PA (M)	PA (I)	PBL (I)	ESE (V)	
45	00	30	15	90	03	70	30	20	30	50	200

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 Polymer Blends and Composites:** Definition and classification of polymer blends and composites; criteria for selection of polymers; thermodynamics of miscibility; phase morphology and phase separation behavior; determination of blend morphology; mechanical compatibility; characterization using electron microscopy; introduction to composites; advantages and applications of FRP; role of resin and reinforcements.	8	18
2.	**Compatibilization and Reactive Blending:** Introduction to compatibilization; mechanisms and methods of compatibilization; compatibilization by addition of copolymers; reactive blending techniques; recent advances and future trends in compatibilization of polymer blends.	7	15
3.	**Rheology of Polymer Blends:** Introduction to rheology of blends; miscibility and flow behavior of polymer blends; rheology of immiscible and miscible blends; complex flow behavior during processing; flow through contraction and its significance in processing operations.	7	15
4.	**Preparation and Types of Polymer Blends and Alloys:** Principles and methods of preparation of polymer blends and alloys; interpenetrating polymer networks (IPN): synthesis, morphology, properties and applications; enhancement of polymer miscibility; utilization of miscible polymers; liquid crystalline polymer blends; ternary polymer blends; elastomeric blends; blends containing block copolymers; biodegradable and recycled polymer blends.	9	20
5.	**Composite Manufacturing Processes:** Introduction to composite processing; contact molding methods – hand lay-up and spray lay-up;	8	20

	vacuum bag and pressure bag molding; resin transfer molding (RTM) and resin injection techniques; vacuum impregnation and injection; hot press / matched metal molding; filament winding; centrifugal molding; continuous sheet manufacturing; pultrusion; sandwich construction.		
6.	**Applications of Polymer Blends and Composites:** Applications of polymer blends in emerging technologies, like solar energy systems (photovoltaic devices), light-emitting diodes (LEDs), electrochromic and smart devices, electrically conductive blends and EMI shielding, lithium-ion batteries, and fuel cells.	6	12
	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**
25	20	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:

Text Books:

1) Polymer Blends: A Comprehensive Review by Lloyd M. Robeson.
2) Polymer Blends Vol. 1 & 2 by D. R. Paul and S. Newman.

Reference Books:

1) Polymer-Polymer Miscibility by O. Olabis, L. M. Robeson and M. T. Shaw.
2) Polymer Alloys and Blends by L. A. Utracki.
3) Handbook of Composites by G. Lubin.
4) Dictionary of Composite Materials Technology by S. M. Lee.
5) Manufacturing of Polymer Composites by B. T. Åström.

(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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