

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Plastic Engineering (23)
SUBJECT NAME: FRP Technology and Composites
SUBJECT CODE: 2172307

B.E. 7TH SEMESTER

Type of course:

Prerequisite: IPMS, Chemistry of Plastic Materials

Rationale:

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		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 enable learning of resins, fibers, FRP and composite product manufacturing processes

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	<p>General introduction.</p> <p>Introduction- Composites- Advantages of FRP –Role of resin and reinforcements -Applications of FRP.</p> <p>Designing in FRP – Selection criteria - material and process selection</p>	3	10
2	<p>Molds for FRP.</p> <p>Introduction – Plaster mold, wooden Mold - GRP molds- Epoxide molds- Steel molds- Aluminum alloy molds- Nickel shell molds.</p>	4	10
3	<p>Polyester resins.</p> <p>Introduction-polyester resins – glycols - unsaturated acids - saturated acids-monomers- inhibitors - Commercial resins - Gelcoat/top coat resins- General purpose resins - Chemical resistant resins- Reduced flammability resins - Low styrene emission resins – Low shrinkage /low profile resins- Special purpose resin.</p>	7	15

4	Catalyst/Accelerators and Inhibitors for unsaturated polyester resins. Introduction – Curing reactions - Catalyst -diacyl peroxides-ketone peroxides-hydro peroxides-dialkyl and diaralkyl peroxide -peroxy esters-perketals. Accelerators or promoters-metal compounds-totality amine - accelerators-mixed motel salts-t-amine accelerators,-inhibitors.	2	10
5	Epoxide Resins: Introduction- Bisphenol A based resins- Glycidyl ester resins- Glycidyl amine resins- Glycidyl ethers of novolac resins- Brominated resins- Diluents- Reactive diluents- Non-reactive diluents. Curing Agents for Epoxide Resins.	6	10
6	Reinforcements: Introduction - Surfacing tissue –Glass fiber - Continuous filament rovings- Chopped strands- Chopped strand mats- Continuous strand mat- Woven glass fabrics- Carbon fiber- Aromatic polyamide (aramid) fibers - Polyester fibers- Polyacrylonitrile fibers - Nylon - PVC and PVDC Cotton – Sisal - Asbestos– Jute- Boron fibers.	6	15
7	Molding Processes. Introduction - Contact molding -hand lay up - Spray lay-up- Vacuum bag molding - Pressure bag molding – Resin transfer or resin injection molding-pressure injection- Vacuum impregnation and injection - Hot press/matched metal molding - Filament winding- Centrifugul molding - Continuous sheet manufacture – Pultrusion - Sandwich construction.	12	20
8	Bulk, Dough and Sheet molding Compounds and Prepregs. Introduction- Dough and bulk molding compounds - Sheet mould compounds- manufacture of SMC- Prepregs - Commercial products	2	10

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks							
Remembrance R Level	Understanding Level	U	Application Level	A	Analyze N Level	Evaluate Level	E
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

Textbooks:

1. FRP TECHNOLOGY by Weatherhead.
2. FIBERREINFORCED COMPOSITES- Materials, Manufacturing, and Design by P.K. Mallick
3. COMPOSITES MANUFACTURING- Materials, Product, and Process Engineering by Sanjay K. Mazumdar
4. Hand book of Reinforcement for plastics – Milewski
5. M O W Richardson “Polymer Engineering Composite” – Applied Science.

References:

1. Reinforced Plastics Handbook by Donald Rosato, Dominick Rosato, Elsevier Science & Technology Books, 2004

Course Outcome:

After learning the course the students should be able to:

1. Know various applications of FRP
2. Identify resins suitable for specific applications
3. Identify reinforcements suitable for particular applications.
4. Design new applications for FRP products

List of Experiments:

1. To manufacture tray using hand layup technique.
2. To manufacture pen stand in FRP using spray up technique.
3. To study RTM process
4. To study pultrusion process
5. To study filament winding process and learn various winding techniques.
6. To prepare FRP articles using centrifugal casting
7. To prepare composites using epoxy resins
8. To fabricate composites using multiple fibers and study effects by testing them.
9. To make composites using fibers and fly ash.
10. To make composites for marine applications.

Design based Problems (DP)/Open Ended Problem:

1. Design and Fabricate Pultrusion machine.
2. Design and fabricate filament winding machine
3. Design and fabricate moulds for hand layup.

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.