

COMPOSITES FABRICATION AND MACHINING

VIII Semester: AE								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE522	Elective	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil			Total Classes: 60			
<p>OBJECTIVES: Students will try to learn:</p> <ol style="list-style-type: none"> I. The definition of composite materials, various constituents of a composite material and different classifications of composite materials based on their constituents. II. The types of fibers and matrix used as constituents of composite materials and various processing methods of these fibers and matrix. III. Various conventional and non-conventional methods of composite fabrication. IV. The pros and cons of various techniques implemented in manufacturing of composites. <p>COURSE OUTCOMES: Upon the successful completion of this course, the students will be able to:</p> <ol style="list-style-type: none"> CO 1 Compare the characteristic features of conventional metals and composites for understanding the general advantage and disadvantages associate with composites over conventional metals. CO 2 Outline the primary physical differences and performance differences between thermoplastics and thermoset plastics for making better decisions in material selection and improve the product designs. CO 3 List common types of fibers used in composites construction and their mechanical properties for deciding the applications of composite fibers based on the constituents. CO 4 Summarize different types of bonds used in composites, their physical and chemical properties and different tests carried out for interpretation of the interfacial strength. CO5 Outline various techniques and processes like hand layup, filament winding etc for understanding the pros and cons of these manufacturing methods. CO 6 List the mechanical properties of various metal, ceramic matrix materials constituted in composites for studying characteristic changes in the properties of composites based on their constituents. CO 7 List different metals used in construction of metal matrices of composites for choosing appropriate matrix composite fabrication technique. CO 8 Classify different types of polymers used in thermoset plastics based on their characteristic properties for choosing applications of thermosetting resins. CO 9 Recall various manufacturing processes for understanding the difference between the conventional and non-conventional manufacturing methods. CO 10 List the advantages and disadvantages of the conventional and non-conventional machining processes for understanding the factors that influence the selection of the process. CO 11 Choose suitable composite manufacturing method keeping in mind the wide design flexibility composites afford for selecting the appropriate manufacturing method that suits the requirement. 								

UNIT-I	OVERVIEW AND INTRODUCTION	Classes: 08
<p>Definition of composite material, classification based on matrix and topology, classification and characteristics of composites, conventional vs. composite materials, advantages and limitations, salient applications in various fields constituents of composites, interfaces and interphases, distribution of constituents, Nano-composites; Classification of polymers properties of thermo plastics properties of thermosetting plastics, prepare layup and autoclave processing.</p>		
UNIT-II	FIBERS AND MATRIX MATERIALS	Classes: 10
<p>fibers fabrication, structure, properties and applications glass fiber, boron fiber, carbon fiber, organic fiber, ceramic and metallic fibers whiskers fabrication of matrix materials polymers, metals and ceramics and their properties interfaces wettability types of bonding at the interface tests for measuring interfacial strength physical and chemical properties.</p>		
UNIT-III	PROCESSING OF POLYMER MATRIX COMPOSITES, METAL MATRIX COMPOSITES AND CERAMIC MATRIX COMPOSITES	Classes: 10
<p>Thermoset matrix composites: hand layup, spray, filament winding, pultrusion, resin transfer moulding, autoclave moulding bag moulding, compression moulding with bulk moulding compound and sheet Moulding Compound thermoplastic matrix composites film stacking, diaphragm forming, thermoplastic tape laying, injection moulding interfaces in PMCs structure, properties and application of PMCs recycling of PMCs.</p> <p>Metallic matrices: aluminum, titanium, magnesium; Copper alloys processing of MMCs: Liquid state, solid state, in situ fabrication techniques diffusion bonding powder metallurgy techniques interfaces in MMCs; Processing of CMCs: cold pressing, sintering, reaction bonding, liquid infiltration; Lanxide process in situ chemical reaction techniques: Chemical vapour deposition, chemical vapours impregnation, SOLGEL interfaces in CMCs..</p>		
UNIT-IV	FABRICATION OF COMPOSITES	Classes: 09
<p>Fabrication Composites: Fabrication of metal matrix composites: Commonly used matrices, basic requirements in selection of constituents, solidification processing of composites - XD process, spray processes; Osprey process, rapid solidification processing, dispersion processes; Stir-casting and</p>		
UNIT-V	NONTRADITIONAL MACHINING OF FRPs AND HEALTH AND SAFETY ASPECTS IN MACHINING FRPS	Classes: 08
<p>Abrasive water jet machining, laser machining, electric discharge machining; Hazard sources and route exposure, dust generation in dry machining, aerosol emission in laser machining, work place control.</p>		
Text Books:		
<ol style="list-style-type: none"> 1. Krishnan KChawla, -Composite Materials: Science and Engineering , Springer, International Edition,2012. 2. Jamal Y.Sheikhahmad,-Machining of Polymer Composites , Springer, International Edition,2009. 3. Autar.K.Kaw,-Mechanics of Composite Materials , Taylor & Francis Group, LLC,2006. 		
Reference Books:		
<ol style="list-style-type: none"> 1. J.N.Reddy,-Mechanics of laminated composite plates and shell theory and Analysis , CRC Press LLC, 2nd Edition,2004. 2. P. K. Mallick, -Fiber Reinforced Composites: Materials, Manufacturing and Design , CRC press, 3. 1st Edition, 2010. 		
Web References:		
<ol style="list-style-type: none"> 1. https://link.springer.com/book/10.1007%2F978-0-387-74365-3. 2. https://www.hydrojet.com/capabilities/composites/ 3. https://www.me.iitb.ac.in/~ramesh/courses/ME338/comp.pdf 		

E-Text Books:

1. <https://www.cantab.net/users/bryanharris/Engineering%20Composites.pdf>
2. <https://www.sciencedirect.com/science/article/pii/B9781856174152500034>
3. <https://www.sciencedirect.com/science/article/pii/B9781856174152500022>