Birla Institute of Technology & Science, Pilani
Hyderabad Campus

INSTRUCTION DIVISION
SECOND SEMESTER 2023-2024
Course Handout Part II

Date: 25-12-2023

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. : MST G522
Course Title : Advanced Composites
Instructor-in-Charge : Prof. Pavan Kumar P

Scope and Objective of the Course:

Composite Materials have gained considerable importance due to their outstanding mechanical properties. They find extensive applications in automobile and aerospace industries. The topics that are to be covered : Definition of composite materials; classification; particulates and dispersion hardened composites, continuous and discontinuous fiber reinforced composites, metal-matrix composites, carbon-carbon composites, molecular composites, micro and multilayer composites, theory of reinforcement; reinforcement by continuous and discontinuous fibers, concept of microfibril; effect of orientation and adhesion; mechanical behaviour of composites, stress-strain relationship, strength, fracture toughness and fatigue; properties of fiber reinforcement and production technology of composites.

Textbooks :

Composite materials, K.K. Chawala, 2nd ed., (1987) Springer-Verlag, New York.

Reference books :

Analysis and Performance of Fiber Composites - BD Agarwal, L J Broutman and K Chandrashekhara, Wiley, 3rd Edition, 2006

Prerequisites :

Courses – Materials science and mechanics of solids

Course Plan:

Lecture No.	Learning objectives	Topics to be covered	Chapter in the Text Book
1-4	Definition and constituents of composites	Introduction to composites, Reinforcements, Matrices , Interfaces,	Ch1-T1,R1
5-6	How to manufacture composite materials	Manufacturing methods of composites:	Ch2-T1,R1

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7-10	Mathematical analysis of tensorial stress and strain	Introduction to tensor algebra. Stress and strain tensor, Stress-strain relations for composite materials	Ch3-T1, Ch2-R1
11-16	Effect of interface on composite behaviour	Micro and macro mechanics	Ch4-T1,
17-20	Stress and strain field in a laminate	Analysis of laminates	Ch6&Ch7-T1, Ch2-R1
21-24	Design of composites for various loads	Design and performance of fiber composites: Fatigue, Impact Design of pressure vessels and storage tanks	Ch10-T1, Ch3-R1
25-30	Application of basic stress-strain relations to different class of materials	Advanced topics: Inter laminar stresses, Fracture mechanics of composites Advanced composites	Ch11-T1, Ch5-R1
31-35	Analysis of advanced composites	Metal-matrix composites, carbon-carbon composites, molecular composites, concept of micro fibril;	Ch10-R1
36-38	Characterization of composite strength	Experimental methods	Ch11-T1, Ch5-R1
39-42	Numerical analysis of composites	FE analysis of composites using ABAQUS	

This course also contains a lab component along with theory classes. The lab component will cover both numerical simulations and lab experiments.

List of experiments:

S. No	Name of the experiment
1	Introduction to stress analysis in ABAQUS/COMSOL/ANSYS
2	Analysis of unidirectional lamina in ABAQUS/COMSOL/ANSYS
3	Analysis of composite laminate in ABAQUS/COMSOL/ANSYS
4	Analysis of hybrid laminate in ABAQUS/COMSOL/ANSYS
5	Making of short fiber carbon composites (Carbon + Polypropylene)
6	Making of carbon epoxy composite
7	Hand-layup technique
8	Wetting studies between fiber and matrix
9	Mechanical testing of fiber and matrix
10	Tensile testing of composite
11	Composites processing by Pultrusion technique
12	Processing of metal-matrix composites

The numerical simulation studies will be carried out in CAD Laboratory. Processing studies of composites will be carried out in chemical engineering department laboratory and mechanical testing and machining will be carried out in mechanical engineering department laboratory.

Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Nature of Component
Mid semester test	90 min	25		Closed book
Literature Survey / Presentation		10		Open book
Research Seminar/Project		15		Open book
Lab exam		15		Open book
Comprehensive Examination	3 hr	35		Closed book

Research seminar:

Each student/batch of students is assigned a task of processing and testing of composites using various reinforcements and matrix materials. The students/batch have to prepare a plan through proper literature survey. After the composite perpetration and testing, numerical studies have to be carried out using ABAQUS or ANSYS or COMSOL. The progress of the project will be monitored through three time evaluation in the form of project plan proposal, mid-semester and end-semester presentations.

Chamber Consultation Hour:
To be announced in the class. Chamber: E-217

Notices: All notices related to this course will be put on CMS only.

Make-up Policy:
Make-up will be granted **ONLY** in genuine cases with *prior permission*. The request application for make-up test must be reached to the Instructor-in-charge before commencement of the scheduled test (documentary proof is essential).

Academic Integrity Policy:
It is expected that in compliance with institute rules and regulations, academic integrity should be adhered to in all the evaluation components. Any type of academic dishonesty is NOT acceptable and malpractice in any form will have serious implications.

Prof. Pavan Kumar P

INSTRUCTOR-IN-CHARGE