Birla Institute of Technology & Science, Pilani
Hyderabad Campus

**INSTRUCTION DIVISION**
**SECOND SEMESTER 2020-2021**
Course Handout Part II

Date: 01-01-2021

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.* : MEF452
*Course Title* : Composite materials and design
*Instructor-in-Charge* : Faizan Mohammad Rashid

**Scope and Objective of the Course:**
Composite Materials have gained considerable importance over the years due to their outstanding mechanical properties, less weight, flexibility, ease of fabrication, corrosion resistance, impact strength and fatigue resistance. Introduction to composites, concepts of reinforcement, strengthening mechanisms, fibrous reinforcements, matrix materials, micro-mechanical aspects of composites, manufacturing methods, composite production design methods, design of tensile members, pressure vessels, storage tanks, and other chemical process equipment made of FRP, design of joints, damage of composites by impact, FRP grids, recent development in manufacturing of composites and technologies.

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

**Reference books**
1. Analysis and Performance of Fiber Composites - BD Agarwal, L J Broutman and K Chandrashekhara, Wiley, 3rd Edition, 2006
2. Mechanics of composite materials, Robert Jones, Taylor & Francis (2nd Edition).

**Course Plan:**

| Lecture No. | Learning objectives | Topics to be covered | Chapter in the Text Book |
|---|---|---|---|
| 1-2 | Definition and constituents of composites | Introduction, applications and classification of composites fibers and matrices, distribution of constituents, | Ch1-T1,R1 |
| 3-5 | Types of reinforcements | Reinforcements; Glass, Carbon, Aramid , metallic and non-metallic fibers, Manufacturing of fibers | Ch2-T1,R1 |
| 6-7 | Types of matrix materials; | Polymers, metals and ceramics | Ch3-T1, Ch2-R1 |

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|---|---|---|---|
| 8-9** | Effect of interface on composite behaviour | Interfaces, Wettability, Interactions and bonding at interfaces, Tests to measure interfacial strength | Ch4-T1, |
| 10-12 | Processing methods of various composites | Manufacturing of composites: Hand layup, Bag molding and RTM, Pultrusion and preformed molding composites | Ch6&Ch7-T1, Ch2-R1 |
| 13-16 | Strength and modulus of a unidirectional composite | Micromechanics of composites; Behavior of unidirectional lamina, Predictive models: Longitudinal modulus and longitudinal strength and other properties | Ch10-T1, Ch3-R1 |
| 17-22 | Application of basic stress-strain relations to different class of materials | Important terminologies in composites: 3D stress-strain relations; Isotropic, transversely isotropic, orthotropic materials, analysis of orthotropic lamina | Ch11-T1, Ch5-R1 |
| 23-25 | Failure of orthotropic lamina | Transformation of stresses and strains Maximum stress, Maximum strain and Maximum work (Tsai-Hill) criteria | Ch11-T1, Ch5-R1 |
| 26-32 | Analysis of multi-layer composite | Strain field in a laminate Resultant forces and moments in a laminated composite Stiffness matrix of laminate, Special laminate sequences: | Ch11-T1, Ch6-R1 |
| 33-36 | Failure criteria | Failure of composites due to longitudinal tension and compression and out of plane loading | Ch12-T1, Ch9-R1 |
| 37-41 | Design of composites for various loads | Strengthening mechanisms in composite Design procedures, design of tensile members, Design of pressure vessels and storage tanks | Ch14-T1, Ch9-R1 |

**Evaluation Scheme:**

| Component | Duration | Weightage (%) | Date & Time | Nature of Component |
|---|---|---|---|---|
| Mid Exam | 90 min | 25 | | Closed book |
| Surprise quiz/Hands on experiments | | 10+10 | | |
| Assignments/Project | | 15 | | Open book |
| Comprehensive Examination | 3 hr | 40 | | Closed book |

**Chamber Consultation Hour:**
To be announced in the class, Chamber: NAB 6020E

**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).

**INSTRUCTOR-IN-CHARGE**