Course code	Course Name	L-T-P-Credits	Year of Introduction
CH466	COMPOSITE MATERIALS	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

- To impart the basic concepts of composite materials

Syllabus

General Characteristics of Composites, Basic Materials, Processing/Manufacturing, Composite Micromechanics, Composite Mechanics Theory, Failure And Strength Design, Composite Behaviour And Applications

Expected Outcome

At the end of the course the students will be able to

i. Demonstrate understanding of fundamentals in materials, manufacturing, mechanics, design, and repair of composites;
ii. Identify advantages and disadvantages of composites with respect to metals; and
iii. Apply the knowledge acquired to the design and manufacturing of high-performance composite structures.

References:

1. G. Piatti, Advances in composite materials, , (1978), Applied Science Publishers Ltd., London.
2. D. Hull, An Introduction to Composite Materials, Cambridge University Press, Cambridge.
3. G.Lubin, Handbook of composites, Van Nostrand, New York, 1982.
4. K.K. Chawala, Ceramic matrix composites, , 1st ed., (1993) Chapman & Hall, London.
5. K.K.Chawla, Composite Materials, 2nd ed., (1987) Springer-Verlag, New York
6. Katz.H.S. & J.V. Milewski, Handbook of Fillers and Reinforcement for plastics- Van Nostrand, New York.
7. M.O.W. Richardson (Ed)Polymer Engineering Composites. Applied Science Publishers, London.
8. Mohr.J.G.et al, SPI handbook of Technology and Engineering of reinforced Plastics/Composites, Van Nostrand, New York.
9. P. M. Ajayan, L. S. Schadler, P. V. Braun , Nanocomposite Science and Technology, , (2003), Wiley-VCH Verlag GmbH Co. KGaA, Weinheim.
10. V.V. Vasiliev and E.V. Morozov, Mechanics and Analysis of Composite Materials, , (2001), Elsevier Science Ltd, The Boulevard, Langford Lane, Kidlington, Oxford OX5 lGB, UK.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	General characteristics of composites, advantages and disadvantages, advantages of using composites in high performance structures application trends. Composite applications in aircraft, space, transportation, energy,	7	15%

	electronics, sports and medical industries. Characteristics of fibers, matrices, interface bonding, adhesives microstructure of composites, the function of the fiber and matrix in a composite. Thermoplastic and thermoset matrix composites. Composite products and their unique properties. The strengthening mechanism that makes composites stronger. Environmental effects to design of composite structures.		
II	**Processing/Manufacturing:** Traditional and novel approaches process fundamentals. Fundamental physics in composite manufacturing, manufacturing processes for polymeric composites. Typical defects introduced in manufacturing and the methods utilized to minimize these defects. Common terminology in composites manufacturing. Special tooling considerations required for composite manufacturing.	7	15%
FIRST INTERNAL EXAMINATION			
III	**Composite Micromechanics** Basic concepts, stiffness, strength, thermal and moisture expansion. Anisotropic and isotropic materials, tailored specific strengths. The cause of discontinuous stresses in composites and how it differs from metals.	7	15%
IV.	**Composite Mechanics Theory** Laminate theory; macromechanical behavior of a ply, out-of-plane effects. Hooke's Law to unidirectional composites. The stress-strainrelations of a unidirectional composite subjected to mechanical, thermal and moisture loads. Stress/strain/curvature of a laminate under constant axial forces and bending moments. The unusual behaviors which may occur in laminates such as bending/stretching coupling and stretching-shear coupling. The use of a specific layup orientation based on the loading conditions and CLT. The role of lamina and their arrangement in a laminate.	7	15%
SECOND INTERNAL EXAMINATION			
V	**Failure and Strength Design:** Failure criteria, Laminate Strength, Stress Concentrations. The service life (fatigue) and environmental (damage/corrosion) effects on metallic vs. composite structures. Key damage mode for composites and composite damage tolerance capabilities.	7	20%
VI	**Composite Behavior and Applications:** How do actual composites for aerospace, automotive, sporting goods, high temperature applications behave? Problem areas, long-term performance, influence of structural geometries the Advantages and disadvantages of composites with respect to Product Lifecycle Management. General considerations and	7	20%

	process involved in composite structural design. Typical in-service damage types for composites. Non-destructive inspection techniques for detecting damage in composites. Basic types of composite repair and their benefits.		
END SEMESTEREXAMINATION			

Question Paper Pattern

Maximum Marks: 100 Exam Duration: 3 Hours

Part A: There shall be **Three questions** uniformly covering Modules 1 and 2, each carrying 15 marks, of which the student has to answer any **Two questions**. At the most 4 subdivisions can be there in one main question with a total of 15 marks for all the subdivisions put together.
(2 x15= 30 Marks)

Part B: There shall be **Three questions** uniformly covering Modules 3 and 4, each carrying 15 marks, of which the student has to answer any **Two questions**. At the most 4 subdivisions can be there in one main question with a total of 15 marks for all the subdivisions put together.
(2 x15= 30 Marks)

Part C: There shall be **Three questions** uniformly covering Modules 5 and 6, each carrying 20 marks, of which the student has to answer any **Two questions**. At the most 4 subdivisions can be there in one main question with a total of 20 marks for all the subdivisions put together.
(2 x20= 40 Marks)