

## DESIGN ANALYSIS OF COMPOSITE STRUCTURES

<b>I Semester: AE</b>																																						
Course Code	Category	Hours / Week			Credits	Maximum Marks																																
BAEB07	Elective	L	T	P	C	CIA	SEE	Total																														
		3	-	-	3	30	70	100																														
<b>Contact Classes: 45</b>		<b>Tutorial Classes: Nil</b>		<b>Practical Classes: Nil</b>		<b>Total Classes: 45</b>																																
<p><b>I. COURSE OVERVIEW:</b>            The course focuses on properties of constituent materials and composite laminates, and also provides insight into different analysis approaches of composite materials. It imparts knowledge about different theories of analysis of laminated beams and plates. The course is aimed to obtain knowledge also in different failure theories and concepts of composite materials.</p> <p><b>II. COURSE OBJECTIVES:</b>  <b>The course should enable the students to:</b>            I. Develop advance research and development projects on composite materials and its fabrication.            II. Classify the composite materials based on matrix and fibres.            III. Understand the methods for analysis the composite materials</p> <p><b>III. COURSE OUTCOMES:</b>  <b>After successful completion of the course, students will be able to:</b></p> <table border="1"> <tr> <td>CO 1</td> <td>Apply the knowledge of properties of constituent materials to analyse the composite materials</td> <td>Apply</td> </tr> <tr> <td>CO 2</td> <td>Develop stress-strain relations of isotropic, orthotropic, and anisotropic composite materials to design the composite laminates</td> <td>Apply</td> </tr> <tr> <td>CO 3</td> <td>Apply the knowledge of classical lamination theory for analysing various composite materials</td> <td>Apply</td> </tr> <tr> <td>CO 4</td> <td>Explain the mechanical behavior of layered composites compared to isotropic materials</td> <td>Understand</td> </tr> <tr> <td>CO 5</td> <td>Develop relationships of mechanical loads applied to a laminate to analyze the strains and stresses in each lamina</td> <td>Apply</td> </tr> <tr> <td>CO 6</td> <td>Identify the failure of individual lamina in a laminate to analyze the failure criteria of composite laminates</td> <td>Apply</td> </tr> </table> <p><b>IV. SYLLABUS:</b></p> <table border="1"> <tr> <td><b>UNIT-I</b></td> <td><b>PROPERTIES OF CONSTITUENT MATERIALS &amp; COMPOSITE LAMINATES</b></td> <td><b>Classes: 09</b></td> </tr> <tr> <td colspan="3">Introduction to laminated composite plates- mechanical properties of constituent materials such as matrices and filaments of different types. Netting analysis of composite materials, determination of properties of laminates with fibers and matrices.</td> </tr> <tr> <td><b>UNIT-II</b></td> <td><b>ELASTIC PROPERTIES</b></td> <td><b>Classes: 09</b></td> </tr> <tr> <td colspan="3">Stress-strain relations of isotropic, orthotropic and anisotropic materials, transformation of material properties for arbitrary orientation of fibers.</td> </tr> </table>									CO 1	Apply the knowledge of properties of constituent materials to analyse the composite materials	Apply	CO 2	Develop stress-strain relations of isotropic, orthotropic, and anisotropic composite materials to design the composite laminates	Apply	CO 3	Apply the knowledge of classical lamination theory for analysing various composite materials	Apply	CO 4	Explain the mechanical behavior of layered composites compared to isotropic materials	Understand	CO 5	Develop relationships of mechanical loads applied to a laminate to analyze the strains and stresses in each lamina	Apply	CO 6	Identify the failure of individual lamina in a laminate to analyze the failure criteria of composite laminates	Apply	<b>UNIT-I</b>	<b>PROPERTIES OF CONSTITUENT MATERIALS &amp; COMPOSITE LAMINATES</b>	<b>Classes: 09</b>	Introduction to laminated composite plates- mechanical properties of constituent materials such as matrices and filaments of different types. Netting analysis of composite materials, determination of properties of laminates with fibers and matrices.			<b>UNIT-II</b>	<b>ELASTIC PROPERTIES</b>	<b>Classes: 09</b>	Stress-strain relations of isotropic, orthotropic and anisotropic materials, transformation of material properties for arbitrary orientation of fibers.		
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<b>UNIT-III</b>	<b>METHODS OF ANALYSIS- I &amp; METHODS OF ANALYSIS- II</b>	<b>Classes: 09</b>
<p>Mechanics of materials approach to determine Young's modulus, shear modulus and Poisson's ratio. Brief mention of elasticity approach and macro mechanics of laminates.</p> <p>Anisotropic elasticity, stress –strain relations in material coordinates - Transformation of geometric axes, strength concepts, biaxial strength theories, maximum stress and maximum strain.</p>		
<b>UNIT-IV</b>	<b>ANALYSIS OF LAMINATED BEAMS AND PLATES</b>	<b>Classes: 09</b>
<p>Classical plate theory, Classical lamination theory – Special cases of single layer, symmetric, antisymmetric &amp; unsymmetric composites with cross ply, angle ply layup. Deflection analysis of laminated plates, Analysis of laminated beams and plates.</p>		
<b>UNIT-V</b>	<b>SHEAR DEFORMATION ANALYSIS &amp; BUCKLING ANALYSIS</b>	<b>Classes: 09</b>
<p>Shear deformation theories for composite laminated beams, plates- first, second and third order theories. nth order theory. Buckling analysis of laminated composite plates with different orientation of fibers, Tsai-wu criteria and Tsai – Hill Criteria.</p>		
<b>Text Books:</b>		
<ol style="list-style-type: none"> <li>1. Agarwal.B.D, Broutman.L.J, “Analysis and Performance of Fibre Composites”, John Wiley and sons, New York,1980.</li> <li>2. Lubin.G, Von. Nostrand, “Advanced Plastics and Fibre Glass”, Reinhold Co.Newyork, 1989.</li> </ol>		
<b>Reference Books:</b>		
<ol style="list-style-type: none"> <li>1. Gupta.L, Advanced Composite Materials, Himalayan Books, New Delhi, 1998.</li> <li>2. Jones.R.M, Mechanics of Composite Materials, McGraw Hill Kogakusha ltd. Tokyo.</li> <li>3. Reddy. J.N, Mechanics of Composite Materials.</li> </ol>		
<b>Web References:</b>		
<ol style="list-style-type: none"> <li>1. <a href="http://onlinelibrary.wiley.com/book">http://onlinelibrary.wiley.com/book</a>.</li> <li>2. <a href="https://www.asme.org/products/courses/design-analysis-fabrication-composite-structures">https://www.asme.org/products/courses/design-analysis-fabrication-composite-structures</a>.</li> <li>3. <a href="http://as.wiley.com/WileyCDA/WileyTitle/productCd-1118401603.html">http://as.wiley.com/WileyCDA/WileyTitle/productCd-1118401603.html</a></li> </ol>		
<b>E-Text Books:</b>		
<ol style="list-style-type: none"> <li>1. <a href="https://www.bookshout.com/ebooks/design-and-analysis-of-composite-structures">https://www.bookshout.com/ebooks/design-and-analysis-of-composite-structures</a></li> <li>2. <a href="https://www.overdrive.com/media/1303069/design-and-analysis-of-composite-structures">https://www.overdrive.com/media/1303069/design-and-analysis-of-composite-structures</a></li> <li>3. <a href="http://www.lehmanns.de/technik/25035754-9781119957065-design-and-analysis-of-composite-structures">http://www.lehmanns.de/technik/25035754-9781119957065-design-and-analysis-of-composite-structures</a></li> </ol>		