Instructions:

* Replace the highlighted areas in yellow above with your own name, section and group numbers and correct dates,
* Review related materials in lecture notes, lab manual and other related documents (note that there is no demo video for this lab),
* Provide your best answers to the following questions. Add pages as needed,
* Convert this Word answer sheet into pdf format and submit to Canvas.

1. (20 pts) Provide a concise account of composite materials: what they are in general and what type of composites are commonly used in aerostructures.
2. (3 pts) What does the subscript ‘s’ mean in the laminate code [0,(45,-45)2]s? (5 pts) How many plies in total this code indicates?
3. (3 pts) For the fiber-reinforced composite focused in this lab, what type of material property they possess? (4 pts) How many independent elastic constants are required to describe this material property?
4. (5 pts) In the theory learned in lecture notes, what kind of loads are considered/susceptible?
5. (10 pts) What are the objectives of this lab? (5 pts) What is the single strain component of particular interest? (15 pts) What steps are involved in the design process?

Total 70 points

Answers

1. Composites are materials formed by merging two or more different materials with different characteristics, developing a new material which have properties that are better than those of the original materials for specific applications. They are composed of matrices and fibers. Composites that are commonly used in aerostructures are: reinforced plastics such as fiber-reinforced polymer, metal composites with e.g. stitches, ceramic composites using composite ceramic and metal matrices.
2. The subscript ‘s’ denotes symmetry. 10 plies.
3. Transversely isotropic. 5 -> 4.
4. Normal forces and bending moments.
5. To design the layup of an 8-ply fiber-reinforced laminate sheet so that a strip cut off from the laminate sheet will produce maximum twist at the end of the strip when subjected to a bending moment. Twist curvature κxy. (1) Review the classical laminate theory; (2) Access the online Laminate Calculator; (3) Modify layer thickness to 150 microm and zero out any applied stress in x-direction; (4) Apply a nominal bending moment and calculate the curvatures/twists; (5) Play with the layup design and see how it affects the curvatures, and try to maximize the twist at the end of the strip.