

MAE/CEE 5060 Homework Assignment #6
(60 Points)
Due 5:00PM, Friday, Mar 26, 2021
Please follow HW Guidelines 😊

****Use composite material properties listed on pages 105/225 of the notes****

(IMPORTANT)

- DO NOT hand in any printed output from your CLT code that will lead NO credits.
- Turn in a summary page showing important values with comments ONLY.

1) **(20 Points)** Determine i) the total number of plies, ii) the number of plies in each ply group, and iii) factor of safety (FS) for each given stress resultant for a AS/3501 carbon/epoxy laminate. The laminate must be designed to satisfy the following requirements:

- a. The laminate should be able to carry $N_{xx} = 4000$ lb/in and $N_{xy} = 800$ lb/in
- b. The laminate should not exceed strains of $\epsilon_{xx} = 0.004$ in/in and $\gamma_{xy} = 0.005$ in/in.
- c. The ply thickness is $t_p = 0.006$ in.
- d. The final layup should be balanced and symmetric.
- e. The laminate consist of 0° , $\pm 45^\circ$, and 90° plies.
- f. There must be at least 10% of the plies in each of the three major directions.

2) **(20 Points)** Determine the critical value of the normal strain for each of the following cases. Draw a conclusion about the results (meaning that you **MUST** comment on your results). The following are design requirements:

- a. Using Scotchply uni-tape with a ply thickness of 0.005 inches
- b. Use first-ply-failure and the Tsai-Wu failure criterion for strength ratio (R) calculation.

Lay-up	[0/45/90]%	Nxx (lb/in)	ϵ_{xx}	R	ϵ_{xxC}
[0 ₁₆ /45/-45/90 ₂] _s		1000			
[0 ₁₂ /[45/-45] ₃ /90 ₂] _s		1000			
[0 ₁₀ /[45/-45] ₄ /90 ₂] _s		1000			
[0 ₈ /[45/-45] ₅ /90 ₂] _s		1000			
[0 ₆ /[45/-45] ₅ /90 ₄] _s		1000			
[0 ₂ /[45/-45] ₈ /90 ₂] _s		1000			

- 3) **(20 Points)** A balanced and symmetric laminate must carry $N_{xx} = 5000$ lb/in and $N_{xy} = 900$ lb/in. The material is carbon/epoxy uni-tape. Refer to the carpet plots shown below. The allowable strains are $\epsilon_{xx} = 0.003$ in/in and $\gamma_{xy} = 0.005$ in/in. The laminate consists of 0° , $\pm 45^\circ$, and 90° plies. There must be at least 8% of the plies in each of the three major directions. Determine the least number of plies (and the best distribution of 0° 's, 45° 's, and 90° 's) needed for the laminate to carry the given loads without exceeding the allowable strains. The ply thickness is 0.005 inches.

