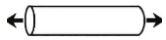
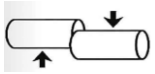
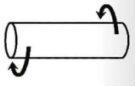
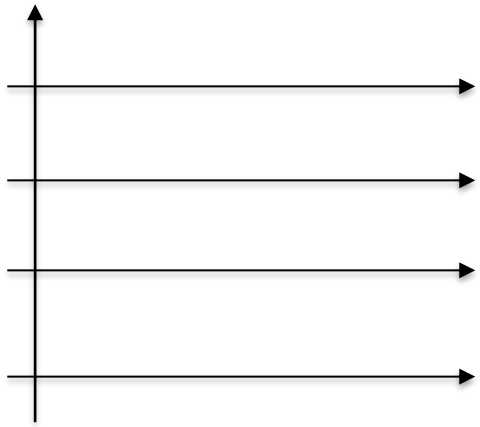
In this course, recognizing and analyzing critical elements within machine components is essential to ensuring the reliability and safety of your designs. This worksheet provides a step-by-step framework to systematically identify these critical elements.

Step	Description	Sketch/Calculate
1. Draw the Free-Body Diagram	Sketch the component and clearly label all applied forces, moments, and support reactions.	
2. Solve for all reaction forces & moments	Use static equilibrium equations to determine unknown reactions.	
3. Determine & sketch internal loads for each segment.	Identify and illustrate the following internal loads throughout the component: - Axial (*N*)  - Transverse shear (*V*)  - Bending moment (*M*)  - Torsion (*T*) 	
4. Identify critical cross-section(s)	Locate the section(s) where internal loads reach their extreme values.	
5. Analyze stress distribution at critical cross-section(s)	Calculate and sketch the stress distribution for each internal load at the identified cross-sections. Consider the following load distributions: - **Axial:** Uniform throughout cross-section. - **Bending:** Zero at the neutral axis, maximum at the farthest location from the neutral axis.	

	- **Shear (transverse):** Parabolic distribution, maximum at the neutral axis, zero at outer fibers. - **Torsion:** Zero at the center, maximum at the outer radius.	
6. Identify critical elements	Compute stress components at each potential location for the critical element(s) (e.g. top, bottom, left, right, and center). - Axial Stress: $\sigma = \frac{P}{A}$ - Shear Stress: $\tau = \frac{VQ}{Ib}$ (or look up maximum in a table/equation sheet) - Bending Stress: $\sigma = \frac{My}{I}$ - Torsional Shear Stress: $\tau = \frac{T\rho}{J}$	
7. Represent the state of stress	Draw a stress element at each critical location to visualize the state of stress.