FMEA Homework
Due per the course syllabus

Fill in the FMEA analysis Chart below using a subsystem or part of your Senior Design Project. Use a part or subsystem with at least three functions, determine at least two failure modes and follow those failure modes through the rest of the chart. Turn the assignment in to your Senior Design instructor and include the FMEA analysis in your end of semester proposal. Special Note: The lecture will walk the class through a similar FMEA process. The following homework assignment is intended as a simplified version to be done for your project.

Part & Function	Potential Failure Mode	Potential Effect(s) Of Failure	Δ	S E V	Potential Cause(s)/ Mechanism(s) Of Failure	O C C	Detection Method & Quality Controls	D E T	RPN	Recommended Actions

1. Three key questions to be answered by the FMEA process:
   - What could fail in each component of my product or design?
   - To what extent might it fail and what are the potential hazards produced by the failure?

- What steps should be implemented to prevent failures?

2. Design FMEA Analysis

Delta = Critical characteristic which may effect safety, compliance with Gov. regulations, or require special controls.
SEV = Severity rating (1 to 10)
OCC = Occurrence frequency (1 to 10)
DET = Detection Rating (1 to 10)
RPN = Risk Priority Number (1 to 1000)

Item and Function	Potential Failure Mode	Potential Effects of Failure	∇	SEV	Potential Cause(s) of Failure	OCC	Detection Method & Quality Controls	DET	RPN	Recommended Actions
List Part Name, Number and Function	List the possible modes of failure	List the consequences of failure on part function and on the next higher assembly			List those such as: inadequate design, improper materials, etc.		List these measures available to detect failures before they reach the customer			List them for each of the failure modes identified as being significant by the RPN

3. Let's go through a simple column-by-column example using a rifle bolt.

Item and Function

Rifle Bolt

- Chambers bullet
- Locks into receiver
- Fires a round
- Sustains firing pressure on lugs
- Provides extraction of spent case

Potential Failure Modes

- Fracture
- Jamming

List of Example Failure Modes		
Corrosion	Ingress	Delamination
Fracture	Vibrations	Erosion
Material Yield	Whirl	Thermal shock
Electrical Short	Sagging	Thermal relaxation
Open Circuit	Cracking	Bonding failure
Buckling	Stall	Starved for lubrication
Resonance	Creep	Staining
Fatigue	Thermal expansion	Inefficient
Deflections or deformations	Oxidation	Fretting
Seizure	UV deterioration	Thermal fatigue
Burning	Acoustic noise	Sticking
Misalignment	Scratching and hardness	Intermittent system operation
Stripping	Unstable	Egress
Wear	Loose fittings	Surge
Binding	Unbalanced	
Overshooting (Control)	Embrittlement	
Ringing	Loosening	
Loose	Scoring	
Leaking	Radiation damage	

		The product requires repair.
6	Significant	Product performance is degraded. Comfort or convenience functions may not operate.
7	Major	Product performance is severely affected but functions. The system may not be operable.
8	Extreme	Product is inoperable with loss of primary function. The system is inoperable.
9	Serious	Failure involves hazardous outcomes and / or noncompliance with govt. regulations or standards.
10	Hazardous	Failure is hazardous, and occurs without warning. It suspends operation of the system an/or involves noncompliance with govt. regulations

Potential Effects of Failure	**Delta**	**SEV**
Catastrophic failure with destruction of weapon and injury to personnel------>	yes	10
Failure of weapon to function---------->	no	1

Likelihood of Occurrence (OCC) - Estimate the potential occurrence of failure

7	$4 \times 10^{-}$	High
8	0.2	Repeated Failures
9	0.33	Very High
10	≥ 0.55	Extremely High: Failure Almost Inevitable

Detection Method & Quality Controls

Incoming Part Inspection
Dye penetrate testing
Measure patterns
Confirm finished casting dimensions

Ranking	Detection Probability
1	Almost Certain Detection
2	Very High Chance of Detection
3	High Probability of Detection
4	Moderately High Chance of Detection
5	Moderate Chance of Detection
6	Low Probability of Detection
7	Very Low Probability of Detection
8	Remote Chance of Detection
9	Very Remote Chance of Detection
10	Absolute Uncertainty – No Control

Calculate the RPN number RPN = (SEV) x (OCC) x (DET)

A 1000 rating implies a certain failure that is hazardous and harmful
A 1 rating is a failure that is highly unlikely and unimportant

Ratings above 100 will occur
Rating below 30 are reasonable for typical applications

Final Column - Based on your RPN number, develop recommended actions to solve failure modes
Assign responsibilities
Outline corrective actions
Revise test plans, material specifications
These actions should be specific, not general action items

Part and Function	Potential Failure Mode	Potential Effects of Failure	DELTA	SEV	Potential Cause (s) of Failure	OCC	Detection Method & Quality Controls	DET
Rifle Bolt §Chambers bullet §Locks into receiver §Fires Round §Sustains firing pressure on lugs §Provides extraction of spent case	Fracture	Catastrophic failure with destruction of weapon and injury to personnel	yes	10	§Shrinkage §Porosity caused by improper feed	6	§Incoming Part Inspection §Dye penetrate testing	5
	Jamming	Failure of weapon to function		8	§Out of spec. Dimension §Change in shell refractory	5	§Measure patterns §Confirm finished casting dimensions	3