Principles of Failure Analysis combines lectures and readings from online resources and class handouts and textbook assignments and a series of hands-on sessions where students work individually and in groups to analyze failures in structural materials. The course will focus on fracture of components but also will include some corrosion and wear failures.

Part 1
How Structural Materials Fail**

A. Mechanics of Materials and Fracture Mechanics
A review of stress analysis and fracture mechanics will be presented, and common background knowledge needed for these analyses will be reviewed.

B. Structural Degradation of Materials and Structures
Fundamentals of brittle fracture, ductile fracture, environmental degradation, fatigue and high temperature failures will be explored.

Part 2
Conducting a Successful Failure Analysis--Tools, Techniques and Protocols

A. General Principles and Procedures for Failure Analysis
An overview of the general methodologies used to plan and complete an accurate analysis of the failure of components or systems will be explored.

B. Forensic Tools in Failure Analysis
Details of fractographic analysis (from macro to micro) will be covered in sufficient detail to allow proficient “reading” of fracture surfaces for the critical information they can provide about how and why fracture occurred.

Part 3
Failure Analysis Projects

Short Project: Students will work in groups to provide a preliminary investigation of a failure, including macroscopic inspection and photographic documentation. A report detailing the initial findings and development of a proposal for a more detailed analysis will be required.

Major Project: Teams will be given a failed component to investigate during the second half of the term. Each team will document the failure, research the service expectations (history, stresses, temperatures, environments) and materials of the component, prepare a
plan of investigation, request resources for further study (SEM time, specimen prep, photography equipment), conduct the approved plan and prepare a report and presentation of the findings.

*Materials for Part 1 of this course, in particular, will come from two textbooks and from instructor notes. The texts are (1) *Mechanical Behavior of Materials*, Third Edition, by Norman E. Dowling and (2) *Deformation and Fracture Mechanics of Engineering Materials*, by Hertzberg, Vinci and Hertzberg. It is recommended that you own a copy of at least one book, but purchase is not required.

** Case studies of failed components will be used throughout the course to integrate knowledge and skills required for failure analysis and to demonstrate the methods used in accurate determination of the causes of failure.

How will performance be assessed?

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Homework</td>
<td>15%</td>
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<tr>
<td>Short Failure Analysis Projects</td>
<td>15%</td>
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<tr>
<td>Midterm Exam</td>
<td>15%</td>
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<tr>
<td>Major Failure Analysis Project</td>
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<tr>
<td>Final Examination</td>
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