1. MME 4316 Failure Analysis

2. Three credits and three contact hours per week

3. Stephen W. Stafford


5. Specific course information
   a. The mechanisms of materials failure, failure analysis techniques and non-destructive testing methods are discussed with emphasis on analysis and interpretation of case studies.
   b. MME 2434 w/C or better) and (MME 2303 w/C or better) and junior standing
   c. Required for MME majors; elective for other engineering students

6. Specific goals for the course
   a. Learning Outcomes
      • Work effectively individually and as a team to solve how and why an engineering structure, device or mechanism fails to meet its service potential (emphasized throughout the course)
      • Develop visual examination skills as they apply to failed components (Homework, in-class projects, Exam I, course project)
      • Understand what fracture toughness is and how it is determined via CVN testing, drop weight tear test, dynamic tear testing and fracture toughness testing (Homework, Exam I)
      • Understand and be able to apply a surface and volumetric nondestructive technique (Homework, Exam I)
      • Be able to distinguish ductile and brittle fracture (Homework, Exam I)
      • Identify the distinguishing features of classic and non-classic fatigue evidence (In-class project, homework, Exam II)
      • Identify the materials and processing responsible for embrittlement of engineering alloys (Exam II)
      • Develop a proficiency in the application of fracture mechanics to engineering product failures (Homework, Exam II)
      • Develop a proficiency in taking high quality macrophotographs of failed components (Course Project)
      • Classify the various categories of wear failures and recognize their various artifacts (Homework, Exam III)
      • Discriminate between the various forms of hydrogen damage (Homework, Exam III)
      • Recognize and describe various elevated temperature service conditions and their failures (Exam III)
      • Devise the sequence and procedures for conducting a failure investigation (Course project)
      • Hypothesize the possible failure causes and generate a plan to obtain the root cause of a failure and elimination/remediation of future failure (Course Project)
• Explain at least two theories offered for stress-corrosion cracking and be able to describe their physical attributes (Homework, Exam III)

b. Student outcomes addressed by the course

• Outcome 1: an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science & mathematics
• Outcome 2: an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety & welfare, as well as global, cultural, social, environmental, and economic factors
• Outcome 3: an ability to communicate effectively with a range of audiences
• Outcome 4: an ability to recognize ethical & professional responsibilities in engineering situations & make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental & societal contexts
• Outcome 5: an ability to function effectively on a team whose members together provide leadership, create a collaborative & inclusive environment, establish goals, plan tasks & meet objectives
• Outcome 6: an ability to develop & conduct appropriate experimentation, analyze & interpret data, and use engineering judgment to draw inclusions

7. Topics covered in this course: see 5(a) above