1. MME 4316 Failure Analysis

2. Three credits and three contact hours per week

3. Stephen W. Stafford

4. *Metals Handbook, Volume 11. Failure Analysis & Prevention (9th ed.) ASM International 2002(optional).* Supplemental materials are posted on-line on Blackboard

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