# MECH4010 Materials Failure in Mechanical Applications

<table>
<thead>
<tr>
<th><strong>Course Code:</strong></th>
<th>MECH4010</th>
<th><strong>Course Title:</strong></th>
<th>Materials Failure in Mechanical Applications</th>
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<tr>
<td><strong>Required Course Or Elective Course:</strong></td>
<td>elective</td>
<td><strong>Terms Offered (Credits):</strong></td>
<td>Spring (3 credits)</td>
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<td><strong>Faculty In Charge:</strong></td>
<td>Xi SHEN</td>
<td><strong>Pre-Requisites:</strong></td>
<td>MECH 2410</td>
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<tr>
<td><strong>Course Structure:</strong></td>
<td>two lectures (80 min each) and one tutorial (50 min) per week</td>
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## Bulletin Course Description:
1. This is an elective course for the BEng in Mechanical Engineering with Option in Solid mechanics and materials.
2. Failure analysis, brittle and ductile fracture, linear elastic fracture mechanics, fatigue cracking, environmental degradation of materials, damage tolerance design and life predication of engineering components.

## Course Topics:
1. Introduction & Review
2. Linear Elastic Fracture Mechanics and Fracture Mechanics beyond elasticity
3. Fatigue of Materials
   a) Fatigue of Materials: Introduction and Stress-Based Approach
   b) Stress-Based Approach to Fatigue: Notched Members
   c) Fatigue Crack Growth
4. Time-Dependent Behavior: Creep and Damping

## Course Objectives:
1. To provide comprehensive understanding of principles of fracture mechanics, failure mechanisms of engineering materials of various nature and applications, including brittle and ductile fracture, creep rupture, cyclic stress/strain fatigue, fatigue crack propagation, environmental degradation and microstructural aspects of fracture toughness. [1] (P-O1 – P-O5)
2. To study damage tolerance design and life prediction of engineering components. [2] (P-O1 – P-O5)

## Course Outcomes:
A. The students will have the fundamental knowledge of material damage and failures. [1, 2] (POC3, POC4, POC6, POC8, POC10, POC11).
B. The students will have a thorough understanding of the fundamental failure mechanisms of engineering materials [1, 2] (POC1, POC6, POC7, POC8, POC9, POC10, POC11).
C. The students will be able to conduct simple failure analysis for industrial practice [1], and moreover the students will be able to estimate the service life of an engineering component. [2] (POC1,
| Assessment Tools: (correlated course outcomes) | Six Assignments (A, B, C, D) Mid-term and Final exams (A, B, C, D) |
| D. The students will enhance the self-learning ability (POC8, POC10, POC11) |

**BEng in Mechanical Engineering (4-year program)**

**Program Objectives:**

P-O1. Be able to communicate and perform as an effective engineering professional in both individual and team-based project environments,

P-O2. Have an international outlook with clear perspectives on the Pearl river Delta and Greater China,

P-O3. Be able to research, design, develop, test, evaluate and implement engineering solutions to problems that are of complexity encountered in professional practice and leadership,

P-O4. Clearly Consider the ethical implications and societal impacts of engineering solutions,

P-O5. Continuously improve through lifelong learning.

**Program Outcomes:**

POC1. ability to identify and formulate problems in multidisciplinary environment with an understanding of engineering issues and constraints;

POC2. ability to design and conduct experiments as well as analyze and interpret data;

POC3. ability to apply knowledge of mathematics, science, and engineering for problem solving in mechanical engineering and related sectors or for further education in a research career;

POC4. ability to develop specification and to design system, component, or process to meet needs;

POC5. ability to understand the manufacturability, maintainability, and recyclability of engineering system and components;

POC6. ability to use modern engineering tools, techniques, and skills in engineering practice;

POC7. ability to communicate effectively;

POC8. ability to function in multi-disciplinary teams and provide leadership;

POC9. broadly educated with an understanding of the impact of engineering solutions on issues such as economics, business, politics, environment, health and safety, sustainability, and societal context;

POC10. clear understanding of professional and ethical responsibilities;

POC11. recognition of the need for life-long learning and continuing education;

POC12. international outlook with knowledge of contemporary issues.