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|  | **ME 451 Mechanical Behavior of Materials**  **3(3,0,0)**  **Hamad F. Alharbi, PhD** | **https://lh6.googleusercontent.com/Ye9htheWMEkSS0qNonInxiaD7RhpuSoiat-qpPdMO5uvnf8TlACQ332W-C4Sw156g2XMZEMPmpXz2uw3j2qHDTdhUwTl3XncMQndj19KIJlcwM97ukZQkCp82SKMnaNACw** |

**Instructor Contact Information:**

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**Office Hours:**

Monday: 12:00 pm-2:00 pm

Wednesday: 12:00 pm-2:00 pm

(Also by appointment)

**Prerequisites:**

Mechanics of Materials and Materials Engineering

**Course Description:**

ME 451 Mechanical Behavior of Materials: Fundamentals of elastic, viscoelastic and plastic deformation of materials; the elementary theory of static and dynamic dislocations; fracture, fatigue, creep; strengthening mechanisms.

**Course Topics:**

* Elastic deformation
* Viscoelastic deformation
* Plastic deformation
* Creep
* Fatigue
* Fracture

**Course Meeting Times and Duration:**

Meeting twice a week for 3 hours.

**Course Outcomes**

By the end of this course, students should be able to

* Differentiate between different types of deformation including elastic, viscoelastic, plastic, and creep deformation.
* Apply appropriate constitutive equations to describe the material behaviour under elastic, viscoelastic, and plastic deformation
* Estimate fatigue life using stress, strain, and fracture mechanics approach

**Reference Texts:**

* Norman E. Dowling, Mechanical Behavior of Materials, 4th edition, Pearson.
* William F. Hosford, Mechanical Behavior of Materials, 2nd edition, Cambridge University Press.
* Thomas H. Courtney, Mechanical Behavior of Materials, 2nd edition, Waveland Pr Inc.

**Grading Policy**

Homework (5 problem sets) ----------------------------------------------------------------- 20

Two Major Exams ---------------------------------------------------------------------------- 30

Project ------------------------------------------------------------------------------------------ 10

Final Exam ------------------------------------------------------------------------------------- 40

**Course Schedule**

The table below shows a tentative schedule for the topics, homework, and examinations in this course.

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| **Part** | **Date** | **Topics** | **Assignment** |
| 1 | January 21, 2018 | * **Review of Structure and Deformation in Materials (chapters 2, 3 & 4)**   + Structure in crystalline materials   + Elastic deformation and theoretical strength   + Mechanisms of plastic deformation   + Deformation behavior under mechanical testing | Homework-1 |
| 3 | February 11, 2018  February 18, 2018 | * **Elasticity (chapter 5)**   + Linear elasticity   + Generalized Hook’s law (3D)   + Isotropic and anisotropic elastic deformations | Homework-2 |
| 2 | January 28, 2018  February 4, 2018 | * **Stress and strains (chapter 6)**   + Stress and strains   + Three-dimensional state of stress   + Principle stress and strain   + Hydrostatic and deviatoric stress parts |
| 5 | February 25, 2018  March 4, 2018  March 11, 2018 | * **Inelastic Deformation (chapter 7)**   + Yield criteria: Tresca and Von-Mises   + Effective stress (Von-Mises)   + Strain hardening: Isotropic and kinematic   + Plastic potential theory   + Deformation theory of plasticity   + Rate-independent and rate-dependent plasticity | Homework-3 |
|  | **Major Exam-I** | | |
| 4 | March 18, 2018  March 25, 2018 | * **Viscoelasticity**   + Time dependent deformation   + Viscoelastic models: Maxwell, Kelvin, Zener, and standard linear models   + Creep and Stress relaxation in viscoelastic materials | Homework-4 |
| 6 | April 1, 2018 | * **Creep (chapter 15)**   + Time-dependent plastic deformation   + Temperature dependence of creep   + Idealization of creep (1D) | Homework-5 |
| 7 | April 8, 2018  April 15, 2018 | * **Fatigue (chapters 9, 10, 11, & 14)**   + Stress life approach   + Strain life approach   + Fracture mechanics approach   + Crack propagation |
|  | **Major Exam-II** | | |
| 8 | April 22, 2018 | * **Fracture (chapter 8)**   + Introduction to linear elastic fracture mechanics |  |

***Prepared by*** *Dr. Hamad F. Alharbi [*[*harbihf@ksu.edu.sa*](mailto:harbihf@ksu.edu.sa)*] January 21, 2018*