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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:**

Dr. Hamad F. Alharbi

Mechanical Engineering Department, Bldg. 3, Rm 2C 59

King Saud University

Tel: +966 11 467 6660, Fax: +966 11 467 6652

Email: harbihf@ksu.edu.sa (preferred contact)

**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, 2018February 18, 2018 | * **Elasticity (chapter 5)**
	+ Linear elasticity
	+ Generalized Hook’s law (3D)
	+ Isotropic and anisotropic elastic deformations
 | Homework-2 |
| 2 | January 28, 2018February 4, 2018 | * **Stress and strains (chapter 6)**
	+ Stress and strains
	+ Three-dimensional state of stress
	+ Principle stress and strain
	+ Hydrostatic and deviatoric stress parts
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| 5 | February 25, 2018March 4, 2018March 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, 2018March 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, 2018April 15, 2018 | * **Fatigue (chapters 9, 10, 11, & 14)**
	+ Stress life approach
	+ Strain life approach
	+ Fracture mechanics approach
	+ Crack propagation
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|  | **Major Exam-II** |
| 8 | April 22, 2018 | * **Fracture (chapter 8)**
	+ Introduction to linear elastic fracture mechanics
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***Prepared by*** *Dr. Hamad F. Alharbi [**harbihf@ksu.edu.sa**] January 21, 2018*