جامعة الملك عبدالله
للعلوم والتقنية
King Abdullah University of
Science and Technology

Course Syllabus: Mechanics of Structures and Solids - ME 211B

Division	Physical Science and Engineering Division
Course Number	ME 211B
Course Title	Mechanics of Structures and Solids
Academic Semester	Spring
Academic Year	2016/2017
Semester Start Date	01/22/2017
Semester End Date	05/18/2017
Class Schedule (Days & Time)	09:00 AM - 10:30 AM | Sun Tue

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
Gilles Henn Fernard Lubineau	gilles.lubineau@kaust.edu.sa	+966128082983		By appointment. The instructor considers that office hours are a very important part of the educational strategy in this class. As much support as needed will be provided until you fully understand the concept. But make sure you randow random shiw-up and send a simple email before to book for appointment. An appointment sheet is also available on the instructor door.

Teaching Assistant(s)

Name	Email

Course Information

Comprehensive Course Description	This class aims to explore the relation between scales of description in solid mechanics. Most of materials and structures can be studied at very different scales, depending on the pursued objective. At the law scale, a very fine description of the microstructure of materials can help understanding how they behave. At the scale of the structure, such a refined description might not be possible anymore due to the subsequent computational cost. We then have to define "effective macroscopic properties", which represent some average properties at larger scale. This class will focus on some aspects of upscaling and scale changing in mechanics of materials and structures. Among other topics, we will explore: 1. Fundamentals of composites 2. Homogenization technique: from microstructures to effective properties. 3. Beam and laminated structures theory: from 3D continuum to 1D and 2D approximations. 4. Micromechanics of cracked structures and damage mechanics: from discontinuities to damage. 5. Fundamental of identification of material properties using Full-Field measurements.
Course Description from Program Guide	Static and dynamic stress analysis. Two-and threedimensional theory of stressed elastic solids. Analysis of structural elements withapplications in a variety of fields. Variational theorems and approximate solutions, introduction to finite elements. A variety of special topics will be discussed in the second term such as, but not limited to, elastic stability, wave propagation, and introductory fracture mechanics.
Goals and Objectives	At the end of the class, the student will be able to: 1) use a known microstructure to predict the effective properties of the material 2) calculate mechanical fields in beams and laminated structures 3) define equivalent damaged domtinua to cracked continua 4) write consistent and efficient damage mechanics models
Required Knowledge	Students should have a solid basis in Solid Mechanics and Continuum Mechanics. ME 211A and ME 212A are excellent preparations to this class. A complete understanding of the description of stresses, strains, constitutive equatiosn in linear elasticity, energy theorems is required.
Reference Texts	Zohdi and Wriggers, *An Introduction to Computational Micromechanics, Lecture Notes in Applied and Computational Mechanics*, **Springer,** ISBN 978-3-540-32360-0 Herakovich, *Mechanics of Fibrous Composites,* **Wiley,** ISBN-13: 978-0471106364, ISBN-10: 0471106364 Bornert, Bretheau and Gilormini, *Homogenization in Mechanics of Materials*, **ISTE USA**, ISBN 1905209177, 9781905209170 Lemaitre. *A Course on Damage Mechanics*, **Springer**, ISBN: 978-3-540-60980-3 (Print) 978-3-642-18255-6 (Online) Torquato. Random Heterogeneous Materials: Microstructure and Macroscopic Properties. Springer, ISBN 0387951679, 9780387951676
Method of evaluation	**20.00**% - Quiz(zes) **10.00**% - Presentation **20.00**% - Midterm exam **20.00**% - Homework /Assignments **25.00**% - Final exam **5.00**% - Active participation
Nature of the assignments	1) Homeworks about fundamental concepts and applications 2) Short projects using commercial softwares 3) Assigned reading and presentations
Course Policies	Lecture notes will be provided on very specific key points and should summarize the entire basis concept you have to acquire. I do expect your active participation during classes. Two sessions per week. You can expect two thirds for lecture (100 min.) and one third for recitation (50 min). Asking questions in class or office hours is a key point for your success. In case you don't understand something, it is likely you are not the only one. So do not hesitate, stupid questions do not exist! Attendance to lectures is mandatory. Homework should be submitted during the class of the day of submission. Late homework submissions will not be accepted. Exams will be close book and close notes.
Additional Information	

Tentative Course Schedule *(Time, topic/emphasis & resources)*		
Week	**Lectures**	**Topic**
1	Sun 01/22/2017 Tue 01/24/2017	Introduction to upscaling in Solid Mechanics. General introduction of the class and organization of the semester. Framework of Composite Materials Engineering.
2	Sun 01/29/2017 Tue 01/31/2017	A refresh about fundamental concepts in Solid Mechanics - Some Application Examples about Strong Forms, Weak Forms and Energy theorems
3	Sun 02/05/2017 Tue 02/07/2017	Homogenization: from microstructure of materials to their effective macroscopic behavior. Part A [Mean fields, Voigt and Reuss, Hill assumption, Hill Mandel Techniques]
4	Sun 02/12/2017 Tue 02/14/2017	Homogenization: from microstructure of materials to their effective macroscopic behavior. Part B. [Hill Mandel Techniques Applications and Asymptotic techniques]
5	Sun 02/19/2017 Tue 02/21/2017	Homogenization: from microstructure of materials to their effective macroscopic behavior. Part C.
6	Sun 02/26/2017 Tue 02/28/2017	A refresh on Beam Theory: cross section, 1D equilibrium, internal force tensors, flexion, torsion
7	Sun 03/05/2017 Tue 03/07/2017	Theory of laminated structures
8	Sun 03/12/2017 Tue 03/14/2017	Theory of laminated structures and MID TERM EXAM
9	Sun 03/19/2017 Tue 03/21/2017	Micromechanics of degraded structure: From Crack to Equivalent Continua. Application to transverse cracking in laminated composites.
10	Sun 03/26/2017 Tue 03/28/2017	Damage Mechanics: Part A. Concept of internal damage variable. Isotropic scalar damage and relations to localization
11	Sun 04/02/2017 Tue 04/04/2017	BREAK
12	Sun 04/09/2017 Tue 04/11/2017	Damage Mechanics: Part B
13	Sun 04/16/2017 Tue 04/18/2017	Identification and Full-field measurements
14	Sun 04/23/2017 Tue 04/25/2017	Peridynamics: from local to non local continuum mechanics. About 3D coupling of models
15	Sun 04/30/2017 Tue 05/02/2017	Presentation of Research projects and Class Summary
16	Sun 05/07/2017 Tue 05/09/2017	Practices
17	Sun 05/14/2017 Tue 05/16/2017	FINAL EXAM
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Note

The instructor reserves the right to make changes to this syllabus as necessary.