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

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

Division	Physical Science and Engineering Division
Course Number	ME 211A
Course Title	Mechanics of Structures and Solids
Academic Semester	Fall
Academic Year	2019/2020
Semester Start Date	08/25/2019
Semester End Date	12/10/2019
Class Schedule (Days & Time)	09:00 AM - 10:30 AM | Sun Tue

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
Gilles Henn Lubineau	gilles.lubineau@kaust.edu.sa	+966128082983	2216, 4, Al-Jazri (bldg. 4)	Sun 4.00PM/5.00PM You are welcome to come at my office for class related questions at any time within these office hours. To make sure we optimize the usage of the office hours, please sign up on the appointment list (available on my door) in the morning for the afternoon.

Teaching Assistant(s)

Name	Email
Not applicable	Not applicable

Course Information

Comprehensive Course Description	**Prerequisite:** Undergraduate strength of materials and stress analysis, ME 211b requires ME211a. This class intends to provide all key fundamentals needed by Solid mechanics Enginneers and researchers for mastering 3D continuum mechanics and its applications to simple structures. The class is a balanced between mathematical concepts (only the one that are strictly needed), theoritical developments in Solid Mechanics and application either using dedicated softwares or in house coding. **We will go through the following topics:** Kinematics of deformable continua. Description of stress tensors. Two-and three-dimensional theory of stressed elastic solids. Theory of Elasticity. Analysis of structural elements with applications in a variety of fields. Strong form solving of partial differential equations in Elasticity. Weak forms. Variational theorems and approximate solutions, introduction to finite elements. Energy based solutions. Introduction to fracture mechanics, damage mechanics and plasticity.

Course Description from Program Guide	Static and dynamic stress analysis. Two- and three-dimensional theory of stressed elastic solids. Analysis of structural elements with applications 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	-To provide our students with the needed background to be operational in advanced mechanics classes. - To review a variety of classical techniques in Solid Mechanics and insist on parralels betwen these and very similar concept in other fields. -To make the students aware of the classical solutions to academic problems in Solid Mechanics.At the end of the class, the student will be able to : (1) Clearly build/criticize and discuss a modeling approach for a real application that is predefined: chosing the boundary conditions, the PDEs to be solved, etc.. (2) Solving this set of PDEs from an analytical point of view if a strong form solution exists (3) Finding an approximate solution using a variety of techniques: Ritz techniques, finite elements, stationarity of various forms of energy
Required Knowledge	-Undergraduate strength of materials and stress analysis, ME 211b requires ME211a. -Fundamentals of Elasticity in 1D
Reference Texts	- Introduction to Continuum Mechanics by W. Michael Lai - Continuum Mechanics by G.E. Mase, Schaum's outlines -Mechanics of Solids and Structures, by D.W.A. Rees, -Mechanics of Solids and Structures, by R.T. Fenner and J.N.Reddy -**Applied Mechanics of Solids, by A.F. Bower, CRC Press**
Method of evaluation	**40.00**% - Final exam **20.00**% - Homework /Assignments **20.00**% - Midterm exam **20.00**% - Presentation
Nature of the assignments	-HOMEWORKS: (20% of total grade): Some homework swill be collected (ONLY IN CLASS). Students may work in groups of no more than 3 and turn in one Group Homework for grading. Homework turned in late will not be taken into account for grading (without exception). Homework answers may come from sources other than the required or reference books and you are strongly advised to extend your skills by reading other sources. -EXAMS: One mid-term exam (20% of total grade). Date will be announced during the first month. Final exam is 40% of total grade. Exam questions are mostly taken from homework with modification and/or extensions. You should do well if you have done the homework (seriously, not copied) and understand concepts through individual efforts. -REVIEW PRESENTATIONS: (20% of total grade): a presentation about a pre designed part of the semester content. This is usually done just before the final exams to ensure a complete review of the material and to help sharing informations between students.
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!
Additional Information	

Tentative Course Schedule *(Time, topic/emphasis & resources)*		
Week	**Lectures**	**Topic**
1	Sun 08/25/2019	Introduction and evaluation session
1	Tue 08/27/2019	Tensors: mathematical aspects and applications
2	Sun 09/01/2019	Description of stresses. Part 1.
2	Tue 09/03/2019	Description of stresses. Part 2.
3	Sun 09/08/2019	Concept of transformation
3	Tue 09/10/2019	Strains, Invariants and non linear transformations
4	Sun 09/15/2019	Linearized transformations
4	Tue 09/17/2019	Elasticity Part 1.
5	Sun 09/22/2019	University holiday
5	Tue 09/24/2019	Elasticity Part 2
6	Sun 09/29/2019	Practice session on Elasticity of Strong Form solving
6	Tue 10/01/2019	Energy theorems. Part 1.
7	Sun 10/06/2019	Energy theorems. Part 2.
7	Tue 10/08/2019	Practice session on energy theorems
8	Sun 10/13/2019	Practice session on energy theorems
8	Tue 10/15/2019	Mid term exam.
9	Sun 10/20/2019	Fracture mechanics Part 1
9	Tue 10/22/2019	Fracture mechanics Part 2
10	Sun 10/27/2019	Break
10	Tue 10/29/2019	Fracture mechanics Part 3
11	Sun 11/03/2019	Fracture mechanics Part 4
11	Tue 11/05/2019	Fracture mechanics Part 5
12	Sun 11/10/2019	Practice on Fracture Mechanics
12	Tue 11/12/2019	Damage mechanics Part 1
13	Sun 11/17/2019	Damage mechanics Part 2
13	Tue 11/19/2019	Plasticity Part 1
14	Sun 11/24/2019	Plasticity Part 2
14	Tue 11/26/2019	Practice on plasticity and damage mechanics
15	Sun 12/01/2019	Students presentations Part 1
15	Tue 12/03/2019	Students presentations Part 2
16	Sun 12/08/2019	Exams
16	Tue 12/10/2019	Exams

Note

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