



Course Syllabus: Basic Principles of Mechanics - ME 100

Division	Physical Science and Engineering Division
Course Number	ME 100
Course Title	Basic Principles of Mechanics
Academic Semester	Fall
Academic Year	2018/2019
Semester Start Date	08/26/2018
Semester End Date	12/11/2018
Class Schedule (Days & Time)	09:00 AM - 10:30 AM Mon Wed

Instructor(s)				
Name	Email	Phone	Office Location	Office Hours
Christos Chatzichristidis	CHRISTOS.CHATZICHRISTIDIS@KAUST.EDU.SA	+966128087427	4348 (Level 4), 9, Engineering Science Hall (bldg. 9)	Available to students anytime I am in my office (8:00-18:00) or email for an appointment.

Teaching Assistant(s)	
Name	Email

Course Information

Comprehensive Course Description	<p>1. Solid Mechanics</p> <p>(a) Statics of rigid bodies: Principle of transmissibility. Equivalent forces. Moment of a force about a point. External and internal forces. Free-body diagram. Reactions at supports and connections for a two-dimensional structure. Equilibrium of a rigid body in two dimensions.</p> <p>(b) Moments of Inertia: Centroids and center of gravity. Moment of inertia of an area and a mass. Parallel axis theorem. Product of Inertia.</p> <p>(c) Concept of axial and shearing stress: Stress components under general loading conditions. Ultimate strength of a material. Allowable load and allowable stress. Factor of safety.</p> <p>(d) Axial loading: Normal stress and strain. Hooke's law. Modulus of elasticity. Stress-strain diagram. Elastic versus plastic behavior of a material. Repeated Loads. Fatigue. Deformation under axial loading. Poisson's ratio. Multiaxial loading. Generalized Hooke's law. Shearing strain. Modulus of rigidity.</p> <p>(e) Torsion of circular shafts: Elastic torsion formulas. Angle of twist.</p> <p>(f) Bending: Symmetric member in pure bending: stress, strain and deformation. Neutral surface and neutral axis. Elastic flexural formulas. Curvature. Eccentric axial loading applied in a plane of symmetry. Deformation of a beam under transverse loading. Elastic curve.</p> <p>(g) Analysis and design of beams for bending: Shear and bending moments diagrams. Design of prismatic beams for bending.</p> <p>(h) Transformation of plane stress: Principal stresses. Mohr's circle. Yield criteria for ductile materials under plane stress. Fracture criteria for brittle materials under plane stress.</p> <p>(i) Kinematics of particles: Rectilinear motion of a particle. Curvilinear motion of a particle.</p> <p>(j) Kinetics of particles: Newton's second law of motion. Linear momentum of a particle. Angular momentum of a particle.</p> <p>(k) Kinetics of particles: energy and momentum methods: Work of a force. Kinetic energy of a particle. Principle of work and energy. Potential energy. Conservative forces. Conservation of energy. Principle of impulse and momentum.</p> <p>(l) Planar kinematics of rigid bodies: Translation. Rotation about a fixed axis. General plane motion. Absolute and relative velocity. Absolute and relative acceleration.</p> <p>(m) Plane kinetics of rigid bodies: Angular momentum of a rigid body in plane motion. Equations of motion of a rigid body. Systems of rigid bodies.</p> <p>(n) Plane kinetics of rigid bodies. Principle of work and energy for a rigid body. Kinetic energy of a rigid body in plane motion. Systems of rigid bodies. Conservation of energy. Principle of impulse and momentum for a rigid body in plane motion. Conservation of angular momentum. System of rigid bodies.</p> <p>2. Fluid Mechanics</p> <p>(a) Fluid kinematics: Descriptions of a fluid field: Lagrangian, Eulerian and augmented Lagrangian-Eulerian. The material or substantial derivative. Streamlines, trajectories and streaklines.</p> <p>(b) Fluid forces: Body forces. Surface forces. The concept of pressure.</p> <p>(c) Fluid statics: The basic equation in fluid statics. Hydrostatics.</p> <p>(d) Integral conservation principles. Mass conservation. Linear momentum equation. Angular momentum equation. Total energy conservation. The Bernoulli equation. Initial and boundary conditions.</p> <p>(e) Dimensional analysis: Dimensional homogeneity. Buckingham's theorem. Reynold's number. Similarity. Dimensionless equations.</p> <p>(f) Internal incompressible viscous flow: Fully developed laminar flow. Flow in pipes and channels. Shear stress distribution. Turbulent velocity profiles. Moody chart. Head loss.</p> <p>(g) Compressible flow: Basic equations for one-dimensional compressive flow.</p>
Course Description from Program Guide	
Goals and Objectives	<p>The goal of the course is to organize and review the fundamentals of static and dynamics of rigid bodies, mechanics of materials and fluid mechanics.</p>
Required Knowledge	<p>Undergraduate Calculus.</p>
Reference Texts	<ol style="list-style-type: none"> 1. Mechanics of Materials, Ferdinand Beer, Jr., E. Russell Johnston, John DeWolf, David Mazurek, McGraw-Hill Science, 2011 (any other edition is ok). 2. Vector Mechanics for Engineers: Statics and Dynamics, Ferdinand Beer, Jr., E. Russell Johnston, David Mazurek, McGraw-Hill Science, 2012 (any other edition is ok). 3. Fluid Mechanics Fundamentals and Applications, by Yunus Cengel and John Cimbala, McGraw-Hill Education; 3rd edition (January 30, 2013).
Method of evaluation	<p>45.00% - Final exam 15.00% - Quiz(zes) 20.00% - Exam 2 20.00% - Exam 1</p>

<p>Nature of the assignments</p>	<p>There are three components to the final grade: 3 quizzes, 2 tests and a final exam. The contribution of each component to the course grade is as follows:</p> <ol style="list-style-type: none"> 1. Quizzes (x3) -- 5% each 2. Tests (x2) -- 20% each 3. Final Exam -- 45% <p>The three quizzes have a duration of 30 minutes and will be held at the beginning of the following Wednesday lectures: Sept 26; Oct 17; Nov 14.</p> <p>The two 80-minute tests will be held during lecture time on the following Wednesdays October, 3 and November, 21.</p> <p>The final exam is on December, 5, during lecture.</p> <p>Problem sets will be given as ungraded homework. The quizzes will be based on these sets.</p> <p>To pass the course, the final grade should be at least 70%. The grading system is S(Satisfactory)/U(Unsatisfactory).</p>
<p>Course Policies</p>	<p>If a student is absent more than 15% of the classes, he/she will be disqualified for the final exam.</p> <p>The students are required to attend all lectures and to take notes. The students will read the corresponding material in advance, and the instructor will present a summary of the topics and work out appropriate examples.</p> <p>Students that do not show up for a quiz, a test or the exam should expect a zero in that assessment.</p> <p>All quizzes, tests and final exam are closed-book and closed-notes. The student may use one A4 sheet with formulae and a calculator.</p>
<p>Additional Information</p>	

Tentative Course Schedule

(Time, topic/emphasis & resources)

Week	Lectures	Topic
1	Mon 08/27/2018 Wed 08/29/2018	Course and lecturer introduction. Statics.
2	Mon 09/03/2018 Wed 09/05/2018	Centroids. Moments and products of inertia. Concept of axial and shearing stress.
3	Mon 09/10/2018 Wed 09/12/2018	Axial loading. Torsion of circular shafts.
4	Mon 09/17/2018 Wed 09/19/2018	Bending. Analysis and design of beams for bending. Transformation of plane stress.
5	Mon 09/24/2018 Wed 09/26/2018	Kinetics of particles I. Quiz 1. Kinematics.
6	Mon 10/01/2018 Wed 10/03/2018	Kinetics of particles II. Test 1.
7	Mon 10/08/2018 Wed 10/10/2018	Planar kinematics of rigid bodies. Planar kinetics of rigid bodies.
8	Mon 10/15/2018 Wed 10/17/2018	Planar kinetics of rigid bodies. Quiz 2. Fluid kinematics.
9	Mon 10/22/2018 Wed 10/24/2018	Fluid forces. Fluid statics. Integral conservation principles.
10	Mon 10/29/2018 Wed 10/31/2018	Mid-term break - No Class Integral conservation principles
11	Mon 11/05/2018 Wed 11/07/2018	The Bernoulli equation.
12	Mon 11/12/2018 Wed 11/14/2018	Dimensional analysis. Quiz 3
13	Mon 11/19/2018 Wed 11/21/2018	Internal incompressible viscous flow. Test 2.
14	Mon 11/26/2018 Wed 11/28/2018	Internal incompressible viscous flow. Basic equations for one-dimensional compressive flow.
15	Mon 12/03/2018 Wed 12/05/2018	Review. Final Exam
16	Mon 12/10/2018	

Note

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