ANNEX 2 – COURSE DESCRIPTION

Course Title	Rigid Body Mechanics				
Course Code	ME114				
Course Type	Compulsory				
Level	BSc (Level 1)				
Year / Semester	2nd (Spring)				
Teacher's Name	Dr. Theodoros Leontiou				
ECTS	5	Lectures / week	3	Laboratories/week	1
Course Purpose	The main objective of the course is to familiarize the students with the basic principles of statics and dynamics. Statics: Vectors and vector operations, force and moment systems, distributed loading, equilibrium of a Particle and of Rigid Bodies, support reactions, beams and simple truss structures. Dynamics: Motion of particles and rigid bodies including kinematics of particles, projectile motion, energy and momentum principles for systems of particles and rigid bodies, planar motion of rigid bodies, moment of inertia properties, rigid-body vibrations etc.				
Learning Outcomes	By the end of the course, students must be able to: • Define vectors and relate vectors to forces. Apply the properties of vector algebra in order to model and manipulate forces. • Define the different support types such as the free, the roller, the pin and the fixed support. Identify the physical meaning of each support and the reactions that are developed in each support. • Present Newton's laws, explain their physical meaning and how they are applied in engineering. Define particles and solve problems of equilibrium regarding particles using the equations for the summation of forces. • Define rigid bodies and explain the concept of moment. Then solve equilibrium problems with rigid bodies including the equation for the moments. • Present "beams" in terms of their behaviour, their response to the application of the loads and the presence of the supports. Show the different types of externally applied loads (concentrated loads, distributed loads) and relate to real scenarios. Calculate the reactions at the supports. • Present "trusses" in terms of their element behaviour and interconnection, their response to the application of the loads and the presence of the supports. Discuss the different truss configurations (simple truss, compound truss, complex truss). • Explain the importance of the connection between the elements and discuss tension and compression. Present the methods of truss analysis (method of joints and method of sections). Analyze trusses to calculate element forces and support reactions. • Formulate and solve engineering problems regarding rectilinear and Cartesian motion of particles. Become familiar with Polar, cylindrical				

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<tr><td></td><td colspan="3">and path coordinates. Analyze the motion of a projectile. Apply Cartesian, polar and path dynamics to problems of kinematics.
• Use the principles of force and acceleration, work and energy, and impulse and momentum to formulate and solve particles' engineering dynamic problems. Explain the concepts of work and kinetic energy. Explain the concept of potential energy, conservation, power.
• Apply the concepts of conservation of linear momentum and angular momentum for multi-particle systems.
• Apply Newton's second law of motion to formulate equations of motion of one-degree-of-freedom vibration systems. Use energy methods to solve vibration problems. Predict natural frequency of one-degree-of-freedom vibration systems of rigid bodies.</td></tr>
<tr><td>Prerequisites</td><td>AMAT111 (or concurrently)</td><td>Corequisites</td><td>None</td></tr>
<tr><td>Course Content</td><td colspan="3"><u>Introduction:</u>
➢ Forces as vectors. Vector components.
➢ Supports and their reactions: roller, pin and the fixed support.

<u>Equilibrium:</u>
➢ Newton's laws and equilibrium of particles.
➢ Rigid bodies and the concept of moment.
➢ Equilibrium problems with moments.

<u>Beams and Trusses:</u>
➢ Equilibrium of beams in the presence of external loads with various types of supports.
➢ Distributed loading.
➢ Introduction to trusses (simple truss, compound truss, complex truss).
➢ Methods of joints.
➢ Zero force Members.
➢ Method of sections.

<u>Kinematics and Kinetics of particles:</u>
➢ Rectilinear motion.
➢ Cartesian motion.
➢ Polar, cylindrical and path coordinates.
➢ Motion of a projectile.
➢ Circular Motion.
➢ Cartesian and polar dynamics, path dynamics.
➢ Linear and angular momentum, Impulse, Impact.

<u>Rigid-body kinematics and kinetics:</u>
➢ Mechanical Energy of a Rigid Body, Moment of Inertia.
➢ Fixed-point rotational motion and rolling motion.
➢ Systems of Rigid Bodies.</td></tr>
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	➢ General motion. Mechanical Energy and Conservation Laws: ➢ Work, kinetic energy. ➢ Potential energy, conservative and non-conservative forces. ➢ Multi-particle systems and conservation of linear momentum and angular momentum. ➢ Energy methods. Vibrations ➢ Revision of simple harmonic motion of particles. ➢ Undamped Rigid Body vibrations. ➢ Energy methods. ➢ Undamped forced vibration. ➢ Viscous damped free vibration. ➢ Viscous damped forced vibration.
Teaching Methodology	Students are taught the course through lectures (3 hours per week) in classrooms or lectures theatres, by means of computer presentations. The power point presentations are available for download at the course e-learning page. The notes are separated in distinct sections and each section includes the main lecture notes (in the same form as will be presented in the lectures) and in addition a collection of exercises/problems aiming in the understanding and application of the theory. These are either compiled by the students and answered, during the lecture or assigned as homework. Lectures are supplemented by laboratory exercises where the students get acquainted with the basic principles taught in the course.
Bibliography	(a) Textbook Russell Hibbeler, Engineering Mechanics: Statics and Dynamics, Prentice Hall, 12th edition, 2009. (b) References J. L. Meriam, L. G. Kraige, Engineering Mechanics: Dynamics, John Wiley & Sons, 5th edition, 2002. Anthony Bedford, Wallace T. Fowler, Engineering Mechanics: Dynamics, Prentice Hall, 3rd edition, 2001.
Assessment	The evaluation of the course is performed by: (a) Two written mid-term exam during the semester, which examines specific modules of the course, and they account for 20% of the overall grade, (b) Laboratory reports and during the semester. In the laboratory report students present the collected and analysed experimental data as well as their conclusions, derived from theory and experimental data, and they account for 20% of the overall grade. (c)Written final exam, which examines all modules of the course, and it accounts for 60% of the overall grade.

	• Two Written Mid-Term Exams: 20% • Laboratory Reports 10% • Assignments: 10% • Written Final Exam: 60% Students are prepared for the above written exams by presenting and solving selected problems in the class, so as the students to comprehend the method of solving these types of problems, understand in depth the concepts and place questions concerning these problems. In addition, problems are given to the students for further practice in form of assignments. Review sessions are also given to the students before each exam. In mid-term and final exams, the following are evaluated: (a) The comprehension of fundamental concepts / theory, (b) The capability of applying the theory, and equations, in solving simple problems, (c) The capability of applying the theory in solving problems, which require to use more than one concept or equation as well as investigation and/or quantification of equations. The means of evaluation are problems with elevated sub-questions, where all of the above three are examined, and they are weighted as follows: (a) 30%, (b) 30%, and (c) 40%, respectively.
Language	**English**