Course unit title:	Rigid Body Mechanics
Course unit code:	ME 114
Type of course unit:	Compulsory
Level of course unit:	Bachelor (1st Cycle)
Year of study:	1
Semester when the unit is delivered:	2 (Spring)
Number of ECTS credits allocated :	5
Name of lecturer(s):	Dr. Theodoros Leontious
Learning outcomes of the course unit:	1. Understand vectors and define the relation of vectors to forces. Comprehend that the properties of vector algebra can be used to model and manipulate forces. 2. Define the different support types such as the free, the roller, the pin and the fixed support. Understand the physical meaning of each support and therefore reason the development of the reactions that are developed in each support. 3. 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. 4. Define rigid bodies and explain the concept of moment. Then solve equilibrium problems with rigid bodies including the equation for the moments. 5. 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. 6. 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. 7. Formulate and solve engineering problems regarding rectilinear and Cartesian motion of particles. Become familiar with Polar, cylindrical and path coordinates. Analyze the motion of a projectile. Understand Cartesian, polar and path dynamics. 8. 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. Understand the concepts of conservation of linear momentum and angular momentum for multi-particle systems. 9. 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. 10. Model stiffness and damping characteristics.

<table>
<tr><td>Mode of delivery:</td><td colspan="3">Face-to-face</td></tr>
<tr><td>Prerequisites:</td><td>APHY 111</td><td>Co-requisites:</td><td>AMAT 111</td></tr>
<tr><td>Recommended optional program components:</td><td colspan="3">None</td></tr>
<tr><td>Course contents:</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.
➢ General motion.

<u>Mechanical Energy and Conservation Laws:</u>

➢ Work, kinetic energy.
➢ Potential energy, conservative and non-conservative forces.
➢ Multi-particle systems and conservation of linear momentum and angular momentum.
➢ Energy methods.
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	<u>Vibrations</u> ➢ Revision of simple harmonic motion of particles. ➢ Undamped Rigid Body vibrations. ➢ Energy methods. ➢ Undamped forced vibration. ➢ Viscous damped free vibration. ➢ Viscous damped forced vibration.
Recommended and/or required reading:	
Textbooks:	Russell Hibbeler, Engineering Mechanics: Statics and Dynamics, Prentice Hall, 12th edition, 2009.
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. A. Biran, Moshe Breiner, Matlab for Engineers, Prentice Hall, 2002.
Planned learning activities and teaching methods:	➢ Lectures for learning the theory and fundamentals in dynamics ➢ Explaining with specific examples different aspects of dynamics and solve specific problems ➢ Assignments in order to enforce the “every day” studying and prepare the students to readily attend the next class lecture ➢ Tutorials, where the students ask further questions on the lectures for better comprehension ➢ Frequent reviews and discussions **Laboratory Work:** Individual or small group experiments performed where the students get acquainted with the basic principles taught in the course.
Assessment methods and criteria:	• Tests: 30% • Laboratory Work/Assignments: 10% • Final Exam: 60%
Language of instruction:	English
Work placement(s):	No