lepl1202

2023

Physics II

5.00 credits	30.0 h + 30.0 h	Q2

Teacher(s)	. SOMEBODY ;Fisette Paul ;Oestges Claude ;
Language :	French
Place of the course	Louvain-la-Neuve
Prerequisites	This course supposes acquired the notions of physics and mathematics such as taught in **LEPL1201, LEPL1101 and LEPL1102.**

Main themes

Two themes are considered :

- The first theme deals with electromagnetism, in particular in materials, it is the continuation of LEPL1201.
- The second theme introduces the dynamic of the rigid body in 3D.

Learning outcomes

At the end of this learning unit, the student is able to :

Contribution of the course to the program objectives:

Regarding the learning outcomes of the program of Bachelor in Engineering Sciences, this course contributes to the development and the acquisition of the following learning outcomes:

- LO 1.1, 1.2
- LO 3.2
- LO 4.1, 4.4, 4.5

Specific learning outcomes of the course:

The learning outcomes marked by (*) are initiated in LFSAB1202 and applied for FSA11BA students, in the framework of the project LFSAB1502.

At the end of the course, he student will be able :

1. for the part on electricity:

LO 1.1, LO 1.2: to use basic law of electromagnetism to solve simple problems in electromagnetism or electromechanics

and more specifically, will be able to:

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- Use vector formalism to express interaction forces, in vacuum, between a magnetic field and moving particles or a current, or between currents.
- Use Biot-Savart and Ampere laws in vacuum to calculate the magnetic field produced by currents travelling in geometrically simple structures. (*)
- Calculate the trajectory of a charged particle through a uniform and constant magnetic field
- Distinguish the magnetic properties of various materials (dia-,para-,ferro-magnetic) based on their magnetic permeability. (*)
- Explain and interpret the effect on a coil inductance when a ferromagnetic core is introduced(*)
- Explain the hysteresis phenomenon of magnetic materials, and use the magnetic permeability in the derivation of inductances or simple magnetic circuits containing linear or non-linear magnetic materials. (*)
- Explain the origin of energy losses in a conducting or ferromagnetic material for AC regime
- Explain and justify the boundary conditions for B and H at the interface between two different media
- Define the inductance and mutual inductance of simple structures with and without a ferromagnetic core(*)
- Explain the Lenz-Faraday law expressing the e.f.m induced by a variable magnetic flux and use it for the calculation of AC generators with geometrically simple structures(*)
- Calculate the magnetic energy stored in simple circuits or structures
- Explain how simple electromechanical systems like a DC motor, a AC generator, an ideal transformer, an electromagnet work by exploiting the notion of magnetic flux
- Write and explain Maxwell equations for the EM field in their integral formulation limited to the static case

2. for the part on mechanics of the rigid body:

LO 1.1, LO 1.2 to express in vector form the equations of motion of one or several interconnected rigid bodies; to derive the equations describing the dynamics of a single rigid body (Newton-Euler equations); to manipulate generalized coordinates to model multiple rigid bodies dynamics (by means of) and to derive their equations of motion as well as the constraint forces via the Virtual Power Principle.

and more specifically, will be able to:

- use the tools associated to the geometrical space allowing to manipulate vectors in the 3D space

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Use the systematic procedure to calculate, in a general frame, the successive temporal derivatives of a vector in a mobile base.
Describe in the 3D space, the instantaneous configurations of one or several interconnected rigid bodies
Specify the variables describing the dynamic behavior of a body modeled as a continuous medium (mass center, momentum, angular momentum, kinetic energy) with an application to the rigid body case
Use and manipulate the concept of the inertial matrix of a rigid body to mathematically express its angular momentum and kinetic energy
Exploit various properties (symmetry, planes figures, ') to easily derive the mass center position as well as the inertial matrix of a geometrically simple body or combination of various geometrically simple bodies
express the vector motion equations of a rigid body submitted to various forces (Newton-Euler equations)
For a rigid body first, then for a system of interconnected rigid bodies, make a justified choice of a set of generalized coordinates allowing an optimized description of the configurations of the system (in 3D /2D space)
For a rigid body first, then for a system of interconnected rigid bodies, express the constraints ' holonomic and non-holonomic ' involving the generalized coordinates (or velocities), and verify their independence
Determine the number of degrees of freedom of a mechanical system
Make the inventory of forces (and torques) influencing the dynamic behavior of such a system
Write the motion equations for such a system as a function of generalized coordinates and their derivatives
Make use of the virtual power principle to derive the differential equations describing the behavior of rigid systems, avoiding the calculation of link forces
Explain the various kinds of links or static supports, and related degrees of freedom and constraints

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<tr><td>Evaluation methods</td><td>
Students are evaluated individually (writing exam during the session):

the "electromagnetism" part counts for 40% of the final grade;
the "rigid body mechanics" part counts for 60% of the final grade,

unless one part is graded below 10/20 (for grading details in this case, see the French version of this note)
An optional test on the "electromagnetism" part is (normally) organized during the semester, and counts for 30% of the grade of the "electromagnetism" part, if it is to the advantage of the student.
For the the written examination, only an unannotated form, provided to the students at the beginning of the year, is allowed.
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<tr><td>Teaching methods</td><td>
The course is organized

around problem-based learning sessions, or experimental laboratory work, which predate the lectures;
around exercise-based learning sessions, that follow lectures;
around lectures including from time to time 'live' experiments' in physics.

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<tr><td>Content</td><td>
Electromagnetism

Magnetostatics in vacuum and materials
Magnetic induction
Inductance and magnetic circuits

Rigid body mechanics

Vector geometry and 3C kinematics
Dynamics characterization of a rigid body
Dynamics of rigid bodies
Static of rigid bodies

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<tr><td>Inline resources</td><td>https://moodleucl.uclouvain.be/course/view.php?id=8756</td></tr>
<tr><td>Faculty or entity in charge</td><td>BTCI</td></tr>
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Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Bachelor in Engineering	FSA1BA	5		🔍
Bachelor in Engineering : Architecture	ARCH1BA	5		🔍