lfsab1202

2017

Physics 2

6 credits	30.0 h + 30.0 h	Q2

Teacher(s)	Fisette Paul ;Francis Laurent ;Oestges Claude ;
Language :	French
Place of the course	Louvain-la-Neuve
Main themes	Two themes are considered : • The first theme deals with electromagnetism, in particular in materials, it is the continuation of LFSAB1201. • The second theme introduces the dynamic of the rigid body in 3D.
Aims	1 **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: • 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 • 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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The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled “Programmes/courses offering this Teaching Unit”.

Evaluation methods

A mid-semester interrogation is organized for this course. It may consist of a multiple choice quiz, or of small problems to solve. The reports of assignements may be taken into account too. The standard rules of EPL are followed regarding the notes and their inclusion in the final result of the student.

In addition, students are evaluated individually in a written exam, on the basis of the learning outcomes mentioned above. The exam essentially focuses on solving small problems close to the ones solved during the course. Examples of previous exams are available on the course website.

Students are also evaluated in groups during the lectures by the teachers, when they present orally their problem-solving work. This evaluation is not graded, unless students fail to deliver a decent presentation, in which case a certificative evaluation is organised for them.

Teaching methods

The course is organized

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

During the first week, a training for the preparation of efficient slides is organised

Content

- Electromagnetism (continued)

Electrostatics in materials

Magnetostatics in vacuum and materials

Magnetic induction

- Rigid body mechanics

Vector geometry and 3C kinematics

Dynamics characterization of a rigid body

Dynamics of rigid bodies

Static of rigid bodies

Inline resources

http://icampus.uclouvain.be/claroline/course/index.php?cid=LFSAB1202

Bibliography

Les livres de référence sont :

- une version récente du livre de H. D. Young et R. A. Freedman, University Physics with Modern Physics, Addison Wesley: San Francisco. Avec ce livre, les étudiants ont droit à une licence leur permettant également un accès en ligne (sur www.masteringphysics.com) à des exercices supplémentaires, des tests et des questions à choix multiples gérés par l'enseignant.
- Symbolic Modeling of Multibody Systems, Jean-Claude Samin et Paul Fisette, Kluwer Academic Publisher, 2003.

Les énoncés des problèmes, exercices et laboratoires, ainsi que la solution de certains d'entre eux, ainsi que les questionnaires des évaluations passées, avec leur corrigé, sont disponibles sur le site web du cours.

Des polycopiés des transparents des cours de restructuration sont disponibles.

Faculty or entity in charge	BTCI

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Aims
Bachelor in Engineering	FSA1BA	6		🔍
Bachelor in Engineering : Architecture	ARCH1BA	6		🔍