UCLouvain

lelec2350

2021

Electromagnetic waves

5.00 credits	30.0 h + 30.0 h	Q2

Teacher(s)	Craeye Christophe ;Lederer Dimitri ;
Language :	English
Place of the course	Louvain-la-Neuve
Prerequisites	Basic courses on physics and on engineering electromagnetics
Main themes	Wireless systems have become ubiquitous and new technologies exploiting higher frequencies, with wider bandwidths, are reinforcing this trend. This calls for a deeper understanding of high-frequency electromagnetic fields, as they occur in microwave circuits and propagation problems. Regarding microwave circuits, an advanced study of guided waves appears necessary, taking into account the quite diverse types of transmission lines and the study of their dispersion analysis. This may include dispersion-engineered materials, such as metamaterials. Regarding propagation, spatial selectivity is becoming more intensively used, since phased arrays now fully entered the civilian domain, in both communication and radar front-ends. This calls for spatial-spectrum representation of fields, in Cartesian, cylindrical and spherical systems of coordinates. Those will also be applied to propagation problems, including for instance surface waves. A link with optics will be made, through the analysis of partially coherent fields, which are more thoroughly studied in optics than in microwaves. An introduction the different types of numerical methods for field analysis, including commercially available software, will be provided as well. The exposed concepts will also be put in practice through different labs, devoted mainly to guided waves and radar experiments.
Learning outcomes	**At the end of this learning unit, the student is able to :** a. Contribution of the activity to the learning outcomes of the program 1.1, 1.2, 3.2, 3.3, 6.1 b. Learning outcomes **After this course, the students in electrical engineering should be able to:** . • Choose the most appropriate field representation for a given guided-wave or propagation problem. • Explain different electromagnetic-field phenomena based on those representations. • Be able to use some numerical tools to control wave propagation. • Have a practical experience with wave phenomena, through laboratory equipment.
Evaluation methods	Written exam and lab reports
Teaching methods	The teaching method is based on lectures, accompanied by exercices (some of which include programming of basic field representations), by use of commercial EM software and by experiments in anechoic chamber.
Content	1. Plane waves 2. Guided waves and advanced transmission lines 3. (with Comsol lab and study of dispersion), e.g. surface waves 4. Cylindrical and spherical waves 5. Green's functions 6. Spatial spectrum 7. Waves in periodic media 8. Numerical methods 9. Reciprocity and equivalence principles Physical and geometrical optics 10. Partially coherent fields 11. Radar 1, regarding hardware 12. Radar 2, with lab in anechoic chamber
Faculty or entity in charge	ELEC

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Physical Engineering	FYAP2M	5		
Master [120] in Electrical Engineering	ELEC2M	5		