UCLouvain

lelec2350

2024

Electromagnetic waves

5.00 credits	30.0 h + 30.0 h	Q2

Teacher(s)	Craeye Christophe ;
Language :	English > French-friendly
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	
Evaluation methods	Open-book exam (solution of problems) for 14 points on 20. Short reports on Python codes, for 3 points on 20. 3 lab reports, for 3 points on 20. NB: bonus points can be obtained based on the realization of 1 or 2 extra Python codes.
Teaching methods	The teaching method is based on lectures, accompanied by exercices (some of which include programming of basic field representations) and by experiments in anechoic chamber. The 3 labs and 3 programming exercices are marked.
Content	1. Plane waves 2. Guided waves and advanced transmission lines 3. Pulse propagation in dispersive media (with computer exercices) 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, including lab 11. Laboratory on (anomalous) wave transmission 12. Laboratory on radar scattering cross-section
Other infos	6 first courses based on book of Orfanidis 7 next courses based on dedicated syllabus
Faculty or entity in charge	ELEC

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Electrical Engineering	ELEC2M	5		
Master [120] in Physical Engineering	FYAP2M	5		