UCLouvain

lfsab1103

2017

Mathematics 3

5 credits	30.0 h + 30.0 h	Q1

Teacher(s)	Keunings Roland ;Remacle Jean-François ;Winckelmans Grégoire ;
Language :	French
Place of the course	Louvain-la-Neuve
Prerequisites	*The prerequisite(s) for this Teaching Unit (Unité d'enseignement – UE) for the programmes/courses that offer this Teaching Unit are specified at the end of this sheet.*
Aims	*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	The students are evaluated individually and in writting. An short interrogation (typically 1 hour), covering the first 6 courses and APE, can also be organized by the Commission BTCI, so as to allow the students to evaluate, at mid term, their level of comprehension and acquisition of competences ; a reference solution is then also put on the Moodle site. The final exam is longer (3 to 4 hours). The note of the interrogation (in case there was one) participates to the final note only if the computation using both notes (and a formula defined by the BTCI) is in favor of the student. The APE (APE1 to APE12) are not graded, but solutions are put on the Moodel site. This too allows the students to continiously evaluate their level of comprehension and acquisition of competences
Teaching methods	The course is organized in 12 courses (CM1 to CM12), given in a large auditorium, and into 12 sessions of « learning through exercises » (APE1 to APE12) that are realized, in part, in tutored groups (with one assistant-tutor per group) and, for the rest, out of the tutored groups.
Content	**Partial differential equations (PDE) :** 1st and 2^{nd} order PDE: presentation, classification (hyperbolic, parabolic, elliptic) and links with physical phenomena (transport equation, wave equation, diffusion equation, Laplace's equation, Poisson's equation), Cauchy problem and method of characteristics for hyperbolic PDE, initial and/or boundary conditions (Dirichlet, Neumann, Robin), solutions in infinite domain (by Green's functions) for the diffusion equation, and for Poisson's equation. self-adjoint operators, eignevalues and eigenfunctions, orthogonality of eigenfunctions. Developpement of functions in series of eigenfunctions. Helmholtz problem. Bessel functions of the 1st and 2^{nd} kind. Method of separation of variables for problems in infinite domain: Laplace's equation in 2-D (rectangle, circle, annulus, sector of circle or annulus) ; wave equation in 1-D and in 2-D, diffison equation in 1-D and in 2-D. Similarity solutions for the diffusion equation in 1-D semi-infinite domain. **Functions of a complex variable, f(z) :** Recall the complex plane and the complex numbers. Definition of elementary functions: z^a, exp(z), log(z), a^z, sin(z), sinh(z), arcsin(z), etc. Branch point(s) and branch cut(s), Riemann surface(s). Limits and continuity, derivability, holomorphic (analytic) functions, entire functions, Cauchy-Riemann equations and links with Laplace's equation. Integration, Cauchy theorem and consequences: Cauchy integral formula, Taylor and Laurent series, poles, residue(s) theorem. Evaluation of definite integrals (also using Jordan's lemma). Introduction to conformal transformations and examples of applications.
Inline resources	https://www.moodleucl.uclouvain.be

Bibliography	**Partie EDP :** J.-F. Remacle et G. Winckelmans, syllabus « Partie EDP » (avec théorie et exemples d'exercices résolus) , notes complémentaires : « Modèle LWR du traffic routier », « Fonctions de Bessel de $1^{ère}$ et de $2^{ème}$ espèces », « Méthodes de résolution de l'équation de diffusion ». Ouvrage de références: Richard Haberman , « Elementary Applied Partial Differential Equations: with Fourier Series and Boundary Value Problems », Prentice Hall. **Partie f(z) :** G. Winckelmans et J.-F. Remacle : notes complémentaires : « Lemmes de Jordan ». Ouvrages de références : Stephen D. Fisher , « Complex Variables » , Dover (fortement recommandé) ; Georges F. Carrier, M. Krook, Carl E. Pearson, « Functions of a Complex Variable : Theory and Practice » , Hod Books. Les documents du cours (syllabus, notes complémentaires, énoncés et solutions des APE, énoncé et solution de l'évaluation intermédiaire (le cas échéant) sont mis à disposition sur le site Moodle du cours.
Faculty or entity in charge	BTCI

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Aims
Bachelor in Engineering	FSA1BA	5	LFSAB1101 AND LFSAB1102	🔍