Erasmus Mundus Joint Master GREENANO

SYLLABUS

Semester 1

COURSE NAME:	**Solid State Physics**		
HOSTING UNIVERSITY:	University of Lorraine – Science and technology Faculty (Vandoeurve-les-Nancy)		
SEMESTER:	**NUMBER OF ECTS:**	**PILLAR:**	
1	6 ECTS	1	
DISTRIBUTION OF HOURS			
Lectures	*Seminars*	*Lab work*	*Individual student work*
60 h	6 h	NO	60 h
PROFESSOR:	Prof. Y. Fagot-Revurat, Prof Stéphane Andrieu and Prof. Hervé Rinnert (University of Lorraine/Institut Jean Lamour)		
LEARNING AND TEACHING METHODS:	Formal lectures and stimulating work in small groups for exercises and applications to GREENNANO materials thematics, seminars		
PREREQUISITES:	Basic knowledge of quantum physics and solid state physics		
OBJECTIVES OF THE COURSE:	Basic understanding of solid state physics and electronic properties of metallic/semiconducting materials and nanomaterials		
CONTENT OF THE COURSE :	**Part-I : Basic theory of solid state physics (40h)** I-1 Bonding in crystals (metallic, covalent, iono-covalent, ionic materials) I-2 Periodic lattices : direct versus reciprocal space, Brillouin zone. I-3 Sommerfeld theory of metals I-4 Bloch theorem and electronic band structure: -Nearly free electron (s metal) versus tight-binding (p, d metals and semiconductors) I-5 Density of states and Fermi surface of metals I-6 Introduction to physics of semiconductor: hole concept – effective mass– intrinsic vs extrinsic semiconductor– carrier concentration – effect of doping – pn junction I-7 Vibrationnal properties: band structure of phonons Applications: list of typical problems in solid state physics related to the GreenNanomaterials thematics **Part-II : Electronic properties of materials/nanomaterials (20 h)** II-1: Electric, thermal and thermoelectric properties of metals/semiconductors II-2: Introduction to dia, para, ferro, ferri, and antiferromagnetism - itinerant versus localized electrons – Stoner criterion II-3: Toward nanomaterials: quantum confinement, occurrence of surface/interface states		

	Applications: list of novel/recently discovered properties related to the GreenNanomaterials thematics **TOTAL = 60 h** Seminar 1 (1h30) : Introduction to DFT theory Seminar 2 (1h30) : Surface/interface states in nanostructures Seminar 3 (1h30) : Spin-dependent transport properties Seminar 4 (1h30) : Introduction to transistor physics
INTENDED LEARNING OUTCOMES:	Background in solid state physics and electronic/vibrational properties of materials
FORM OF ASSESSMENT:	Quiz (self-evaluation) Individual written and oral assessment, evaluation of small group projects