1.	**Field of study**	**Biophysics**
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2022/2023 (winter term), 2023/2024 (winter term), 2024/2025 (winter term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Large Facilities: Synchrotron and Neutron Sources

Module code: W4-2BF-MB-21-11

1. Number of the ECTS credits: 5

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
MB_11_1	students will be able to explain the basic functioning of a synchrotron radiation source and a spallation source, as well as the different properties that synchrotron light or neutrons can possess and how they can be tuned	KBF_W02	4
MB_11_2	students will be able to describe how synchrotron light and neutrons can be used to investigate the condensed matter, how collected data should be analyzed, and what information can be extracted from the data	KBF_U09 KBF_W04 KBF_W10	4 4 5
MB_11_3	students will be able to identify the advantages of using a large facility to perform experiments, and the most suitable technique to tackle a given experimental problem	KBF_K06 KBF_U11 KBF_U13	3 3 3

3. Module description

Description	The purpose of this unit is to learn the basics of facilities such as synchrotrons and spallation sources, and the kind of characterization techniques that they allow. Program: (1) Particle accelerators, synchrotron radiation, and neutron sources. (Basics of particle accelerators: general introduction, types of accelerators, methods of acceleration; circular accelerators, magnetic systems; main accelerator systems: RF, diagnostics; Beam characteristics. Generation of e.m. radiation: Bremsstrahlung, synchrotron radiation, characteristics and generation, insertion devices; beamlines and experiments: the Alba synchrotron; ion accelerators; spallation sources. (2) Data analysis and elementary scattering theory (Frequentist data analysis; data and errors: a statistical view; classical fitting methods; statistical distributions; hypothesis testing; Bayesian data analysis: Bayesian statistics and probability distribution functions; Bayes theorem, measurement, fitting functions; Markov Chain Montecarlo method; Model selection in Bayesian statistics; basics of X-ray and neutron scattering (Bragg Law; the phase problem; reflectometry and small-angle scattering; diffraction of liquids and amorphous materials; inelastic scattering: coherent and incoherent scattering,

	Van –Hoff functions. (3) Some synchrotron and Neutron applications (XRD and powder diffraction; EXAFS – XANES; hard X-ray synchrotron imaging Techniques; Neutron applications: inelastic neutrons scattering methods: Time of flight, Spin Echo, Backscattering; magnetism using neutrons; imaging using neutrons; specialized seminars by ALBA staff; practices at ALBA in the accelerators group: magnetic measurements, RF measurements, vacuum system
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
MB_11_w_1	exam	The evaluation will consist of a mark for small homework projects and exercises of each module (25%), and one for the final project (75%). The latter will consist of two marks, one for the written report and one for the oral presentation.	MB_11_1, MB_11_2, MB_11_3

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
MB_11_fs_1	lecture	Detailed discussion by the lecturer of the issues listed in the table "module description" using the table and/or multimedia presentations	45	Supplementary reading, working with the textbook, doing homework projects and exercises. Final project preparation	80	MB_11_w_1