European Master of Medical Technology and Healthcare Business (EMMaH)

Module Compendium

November 2018

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Module compendium

Master degree program

European Master of Medical Technology and Healthcare Business (EMMaH)

Hamburg University of Applied Sciences (HAW Hamburg),
Faculty of Life Sciences
Instituto Politécnico Do Porto - Escola Superior de Tecnologia da Saúde do Porto (IPP)
University of Lille, Faculté Ingénierie et Management de la Santé (ILIS)

November 2018

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Aims of the study program

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These module description is valid for the master programme Medical Technology and Healthcare Business (EMMaH). This Master Programme runs jointly with three institutions:

- Hamburg University of Applied Sciences (HAW Hamburg)
- Escola Superior de Saúde do Politécnico do Porto (ESS)
- Université de Lille – Faculté Ingénierie et Management de la Santé (ILIS)

The three Higher Education Institutions regulate the organization, execution of the studies and the examinations and are supplemented by the subject-related regulations for the specific master's programme at each institution.

Giving due regard to changes and requirements in the working world, the aim of the Master's Programme in EMMaH is to impart to students holding a relevant bachelor's degree the particular knowledge, skills and methods required in the medical technology and management field in a way that enables them to conduct scientific work, to critically assess and integrate scientific findings and knowledge, and to act responsibly. In order to achieve these objectives, the Master's programme in EMMaH strives to link research and instruction very closely with one another, inter alia through intensive lab courses conducted in collaboration with the three faculties in Hamburg, Lille and Porto.

Master degree programs are advanced courses and lead to a further and higher academic and vocational qualification. This module compendium describes the course of studies "European Master of Medical Technology and Healthcare Business (EMMaH)" of the three Higher Education Institutions.

Graduates have the ability to independently acquire new fields of knowledge and to solve complex problems, even above the current state of knowledge, using scientific methods. Graduates are capable to isolate problems in a new area of expertise or such an area in development and to encircle the most probable solution approach. They have the continuing ability of composing new technical solutions and new process strategies in the field of biomedical engineering and to transfer these solutions into clinical use or in industrial production. Although the course is designed for students interested in designing biomedical applications, graduates can not only work in research & development, but also in a company's production division or in technical functions in a hospital or research institutes. Graduates are qualified to join a doctorate program subsequently.

The full time study is designed for 4 semesters (2 years).

The graduate-level courses in Hamburg part cover scientific and engineering knowledge focused on the field of biomedical engineering with emphasis on the processing, control and imaging of biomedical signals and physiological control loops including virtual reality applications. The course is completed by regulatory and technology assessment aspects. Most lectures are complemented by associated practical courses with up-to date software tools and hardware, e.g. in research labs or at the hospital sites of collaboration partners. In a mandatory scientific project the students are engaged in autonomous scientific studies in small groups with one person of each country. Enhanced soft skills are acquired in the seminars and during the lectures by intense discussions and small projects like preparation of presentations, posters and papers. In the master thesis later, the students will demonstrate their ability for autonomous scientific work at graduate level. The courses are held in English language.

The graduate-level courses in Porto part cover the area of healthcare technologies. Real-life contextual learning is highly valued as can be seen in the weight given to credits awarded for such learning activities

- about one third - as well as in the community outreach policy, manifest both in the provision of actual healthcare services and the setting up of training labs.

The graduate-level courses at the ILIS faculty in Lille cover the area of healthcare business.

Master thesis

The Master thesis represents the written composition of a theoretical, empirical and/or experimental study. With the Master thesis students prove their capability to express a sound scientific study hypothesis, explore its relevant bibliographic background, select, adapt or develop appropriate scientific study methods to collect and analyze gathered data and discuss the results in relation to the study aims and relevant literature conclusively. The time-limit for delivery of the master thesis is six months. It is credited by 30 credit points.

Module and course structure

1. Semester: Modules at Hamburg University of Applied Sciences

Nr.	Module	CP	Semester*	Course	Course type	SHW	Achievment type	Exam type	Group size
1	Project Seminar in Engineering	5	W	Project Seminar in Engineering	PJ	4	PL	K, H, R, M	15
2	Data Acquisition and Processing	5	W	Data Acquisition	SeU	2	PL	K, H, R; M	20
			W	Data Acquisition, **Practical Work**	SeU	2			20
3	Advanced Biosignal Processing	5	W	Biosignal Processing	SeU	2	PL	K, H, R, M	20
			W	Advanced Filtering Techniques for Biosignals	SeU	2			
4	Modelling Medical Systems	5	W	Modelling Methods	SeU	2	PL	K, H, R, M	20
			W	Modelling Tools, **Practical Work**	SeU	2			
5	Simulation and Virtual Reality in Medicine	5	W	Simulation and Virtual Reality in Medicine	SeU	2	PL	H, K, R, M	20
			W	Simulation and Virtual Reality in Medicine, **Practical Work** (SimLab)	SeU	2			20
6	HTA /Regulatory Affairs	5	W	Regulatory Affairs	SeU	2	PL	H, K, R, M	20
			W	HTA	SeU	2			20
	Total	**30**				**24**			

2. Semester: Modules at Escola Superior de Tecnologia da Saúde do Porto

Nr.	Module	CP	Semester*	Course	Course type	SHW	Achievment type	Exam type	Group size
1	Project Seminar in Health	5	S	Project Seminar in Health	PJ	4	PL	K, H, R, M	15
2	Medical Imaging Technologies and Devices	5	S	Medical Imaging Technologies and Devices	SeU	4	PL	K, H, R; M	20
3	Medical Measurement Techniques	5	S	Medical Measurement Techniques	SeU	4	PL	K, H, R, M	20
4	Applied Clinical Imaging	5	S	Applied Clinical Imaging	SeU	4	PL	K, H, R, M	20
5	Applied Clinical Signals	5	S	Applied Clinical Signals	SeU	4	PL	H, K, R, M	20
6	Human-Technology Interaction on Clinical Environment	5	S	Human-Technology Interaction on Clinical Environment	SeU	4	PL	H, K, R, M	20
	Total	**30**				**24**			

3. Semester: Modules at Université de Lille II - Faculté Ingénierie et Management de la Santé, Lille

Nr.	Module	CP	Semester*	Course	Course type	SHW	Achievment type	Exam type	Group size
1	Project Seminar in Healthcare Business	5	W	Project Seminar in Healthcare Business	PJ	4	PL	K, H, R, M	15
2	Principles of Marketing in the Healthcare Business	5	W	Principles of Marketing in the Healthcare Business	SeU	4	PL	K, H, R; M	20
3	International Healthcare Marketing and Business	5	W	International Healthcare Marketing and Business	SeU	4	PL	K, H, R, M	20
4	Marketing for Innovative Medical Technology	5	W	Marketing for Innovative Medical Technology	SeU	4	PL	K, H, R, M	20
5	Legal and regulatory considerations in the HealthCare Industry	5	W	Legal and regulatory considerations in the HealthCare Industry	SeU	4	PL	H, K, R, M	20
6	Industrial Purchasing, Outsourcing in the Healthcare Industry	5	W	Industrial Purchasing, Outsourcing in the Healthcare Industry	SeU	4	PL	H, K, R, M	20
	Total	**30**				**24**			

4. Semester: Master thesis

Nr.	Module	CP	Semester*	Course	Course type	SHW	Achievment type	Exam type	Group size
	Master thesis	30	S	Master thesis			PL	MT	
	Total	**30**							

Legend:
SHW = Presence hours per week during semester
Course type: ST = seminaristic teaching, PJ. = Project, Sem. = Seminar (>80% presence obligatory)
Achievement type: SL = Test (not graded), PL = Exam (graded)
Exam type: K = written exam, M = oral exam / presentation, R = seminar paper, H = homework, P = Project documentation/poster

Module descriptions

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Project Seminar in Engineering – HAW Hamburg LS**	
Module number	1 HAW Hamburg
Module coordination/ responsibility	Prof. Dr. Bernd Flick
Duration/ term/ frequency	One semester / 1st semester / winter term
Credit Points (CP) /Presence hours per week (SHW)	5 CP / 4 SHW
Workload	150 h In-class Lecture: 4 SHW x 18 weeks = 72 h Self-study: = 78 h
Type of Module	Obligatory module
Preconditions /Required skills	Recommended: The projects must be individually supervised by a professor of the Biomedical Engineering department. The project regulations of the Department of Biomedical Engineering apply. Appropriate knowledge from previous academic studies in a professionally associated field, bachelor degree Required: none
Language	English
Competencies /Learning Outcome	**Professional Competence (Knowledge and Understanding)** • Analysis objectives and tasks; Finding and use of new knowledge in new situations; Problem solving, research and decision making • Innovation management; Project Management; Marketing and Distribution; Controlling The students are able to develop a biomedical component, device, software or study. Therefore, they are able to … • approach and handle complex problems, tasks and projects in the biomedical field. • find and understand appropriate literature, assess and understand complex informations and apply them to the project (E.g. literature data bases, specialized publications).

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Project Seminar in Engineering – HAW Hamburg LS**	
	• autonomously design, develop and implement laboratory experiments / software / hardware. • autonomously design, keep records and interpret measurements using appropriate mathematical and scientific methods. **Methodological Competence (Usage, Application and Generation of Knowledge)** Students are able to …: • understand and apply complex laboratory and biomedical equipment to solve the project tasks. • provide and track a project plan. • understand and define project goals and negotiate them with the project sponsors. • present the results to peers and sponsors. **Social Competence (Communication and Cooperation)** Students are able to …: • autonomously organize project groups, organize meetings and communication among the project participants and identify and solve all problems typical to scientific projects. • get in contact to experts, where necessary, discuss project and test plans with co-workers and project sponsors and defend their plans and results against critical objections. **Personal Competence (academic self-conception, professionalism)** Students are able to …: • handle projects responsible, with awareness to cost, risk and safety.
Content of Module	• project skills in practice • the scientific matters depend on the projects, which must be supervised / approved by a professor of the biomedical department • the projects should address scientific level problems from any aspect of biomedical engineering and biomedical sciences
Applicability of Module	
Requirements for the award of credit points / **Type of Assessment**	Regular form for the module examination: written project report with oral presentation The type of examination will be announced by the lecturer at the beginning of the course. The participation in at least 80% of the project seminar meetings is obligatory, presentations (1..2, not graded), writing of 1..2 seminar minutes and project poster required.

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Project Seminar in Engineering – HAW Hamburg LS**	
Related Courses	• none
Type of course and media	Typically: experimental laboratory work / hardware and software engineering / literature work / seminar / presentations / project meetings / project documentation / web based cooperation
Literature	Scientific literature, depending on the project

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Data Acquisition and Processing – HAW Hamburg LS**	
Module number	2 HAW Hamburg
Module coordination/ responsibility	Prof. Dr. Kay Förger
Duration/ term/ frequency	One semester / 1st semester / winter term
Credit Points (CP) /Presence hours per week (SHW)	5 CP / 4 SHW
Workload	150 h In-class Lecture: 4 SHW x 18 weeks = 72 h Self-study: = 78 h
Type of Module	Obligatory module
Preconditions /Required skills	Recommended: Basic skills in programming and mathematics (e.g. acquired in a bachelor degree program) Required: none
Language	English
Competencies /Learning Outcome	**Professional Competence (Knowledge and Understanding)** • Knowledge and Comprehension; Finding and use of new knowledge in new situations; Problem solving, research and decision making; Self-System • Implementation, maintenance and service The students are able to use the computer as universal tool to solve practical problems: • on the one hand complex simulations can be performed by LabVIEW with little effort and • on the other hand data can be acquired and processed with a computer easily. Data and signals are simulated to make the theoretical relations understandable and better applicable. The students are able … • to apply statistical methods and • to test the developed evaluation methods by simulation to get more reliable programs. Especially by such an approach subtle programming errors become obvious, which otherwise could be found hardly but distort the results much. That sensitizes students especially to such errors.

	Additionally the students are enabled by computer simulations to analyze measurement and processing techniques (signal sampling, averaging, statistical tests etc.) if some restrictive mathematical prerequisites (e.g. sampling theorem, normal distribution of random variables) are not exactly met in practical problems. Methods which provide reliable results in such cases are highlighted as robust procedures. • The students are able to look for robust procedures / techniques. In practical applications the parallel acquisition and processing of measurands and the simultaneous reaction on user input is an essential requirement, which is difficult to understand and implement in text based programming languages. On the contrary the graphical programming environment of LabVIEW enables the students to • design programs with parallel execution and synchronization which are easy to implement and understand. • acquire and process data from real experiments correctly and scientifically founded. **Methodological Competence (Usage, Application and Generation of Knowledge)** Students are able to …: • **Social Competence (Communication and Cooperation)** Students are able to …: • recognize the must of software tests using simulations with results which are known in advance to assess the extent of tests for methods and procedures more precisely. • develop solutions for a given data acquisition project using the methods presented. **Personal Competence (academic self-conception, professionalism)** Students are able to …: • keep one's distance to their results and especially to their own programs.
Content of Module	Introduction to LabVIEW programming, statistical evaluation of measured data • basic statistical quantities (mean, variance and standard error, median etc.) • hypothesis tests • parameter estimation acquisition and processing • Fourier Transform und series: basics, examples and discretization

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Data Acquisition and Processing – HAW Hamburg LS**	
	• Sampling Theorem: Aliasing, smoothing Windows etc. • Digital Filters: linear filters (FIR and IIR)
Applicability of Module	• Knowledge and Comprehension; Finding and use of new knowledge in new situations; Problem solving, research and decision making; Self-System • Implementation, maintenance and service
Requirements for the award of credit points / **Type of Assessment**	Regular form for the module examination: written exam Further possible examinations: oral examination, presentation, homework reports The type of examination will be announced by the lecturer at the beginning of the course.
Related Courses	• Data Acquisition • Data Acquisition, Practical Work
Type of course and media	The course is split into a lecture part and a practical part which last approximately the same amount of time. Lecture part: Mainly presented in form of a seminaristic lectures, i.e. with student interaction to discuss and present different solutions, results and programming approaches by demonstrating the usage of software tools directly. Additional exercises are to be solved by the students to improve their comprehension. Lab (practical) part: Solution of prepared exercises during the attendance. To difficulties and misunderstood issues is responded by mentoring individually. Selected solutions were presented to the study group.
Literature	Press, W. H. et al (1998). Numerical recipes in C. New York: Cambridge University Press. Bronstein, I.N., Semendyayev, K.A. et al. (2004). Handbook of Mathematics, 4th Ed. Berlin Heidelberg: Springer. Jamal, R., Pichlik, H. (1998). LabVIEW Applications. München: Prentice Hall. LabView User Manual, National Instruments, January 1998 Hamming, R.W. (1983). Digital Filters. New Jersey: Englewood Cliffs.

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Advanced Biosignal Processing – HAW Hamburg LS**	
Module number	3 HAW Hamburg
Module coordination/ responsibility	Prof. Dr. Friedrich Ueberle
Duration/ term/ frequency	One semester / 1st semester / winter term
Credit Points (CP) /Presence hours per week (SHW)	5 CP / 4 SHW
Workload	150 h In-class Lecture: 4 SHW x 18 weeks = 72 h Self-study: = 78 h
Type of Module	Obligatory module
Preconditions /Required skills	Appropriate knowledge from previous academic studies in a professionally associated field, bachelor degree: mathematics, informatics, electronics, physics, mechanics, signals and systems, human biology Required: none
Language	English
Competencies /Learning Outcome	**Professional Competence (Knowledge and Understanding)** • are able to solve demanding scientific and engineering problems. • know and apply advanced concepts of biomedical signals and systems and the processing of biomedical signals (e.g. EEG, ECG, phonocardiogram, EMG, EOG). • understand relevant literature and implement the knowledge in biomedical problems solving. • are able to develop solutions for biomedical signals processing tasks. **Methodological Competence (Usage, Application and Generation of Knowledge)** Students know and are able to …: • apply advanced mathematical methods in technology, e.g. linear systems analysis and synthesis of medical sound fields, application of finite element methods for biomedical problems etc. • apply advanced algorithms for the extraction of functional parameters from biomedical signals, (e.g independent

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Advanced Biosignal Processing – HAW Hamburg LS**	
	component analysis – ICA, statistical parameter mapping – SPM). **Social Competence (Communication and Cooperation)** Students are able to …: • are able to present and discuss their concepts in a peer group and with experts **Personal Competence (academic self-conception, professionalism)** Students are able to …: • are able to critically read, understand and review original articles and working documents.
Content of Module	Biosignal Processing Methods -1: • Signal analysis in phonocardiography • ECG signal processing • EEG signal processing Biosignal Processing Methods -2: • z-Transformation, FIR and IIR Filter design, adaptive filters • ICA, fourier methods, wavelets • Linear systems approach for field mapping (e.g. Ultrasound: Field-II, Dream) • Finite element methods
Applicability of Module	
Requirements for the award of credit points / **Type of Assessment**	Regular form for the module examination: written exam Further possible examinations: oral examination, presentation, homework reports The type of examination will be announced by the lecturer at the beginning of the course.
Related Courses	• Biosignal Processing • Advanced Filtering Techniques for Biosignals
Type of course and media	Seminaristic lectures, labs, expert puzzle, teamwork, distance learning elements, web-based cooperation, autonomous studies / Power Point, blackboard, overhead projection, multimedia, software
Literature	To be advised by the lecturers

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Modelling Medical Systems – HAW Hamburg LS**	
Module number	4 HAW Hamburg
Module coordination/ responsibility	Prof. Dr. Nicholas Bishop
Duration/ term/ frequency	One semester / 1st semester / winter term
Credit Points (CP) /Presence hours per week (SHW)	5 CP / 4 SHW
Workload	150 h In-class Lecture: 4 SHW x 18 weeks = 72 h Self-study: = 78 h
Type of Module	Obligatory module
Preconditions /Required skills	Students should have knowledge in electronics, biomedical engineering, computer science (especially programming) and human biology. Required: none
Language	English
Competencies /Learning Outcome	**Professional Competence (Knowledge and Understanding)** Students are able to … • understand model-based simulation methods • understand basics of engineering tools. • describe biological feed-back systems (e.g. heart rate variability) using mathematical analysis in time- and frequency domain and using non-linear methods • describe biological system interactions by appropriate methods **Methodological Competence (Usage, Application and Generation of Knowledge)** Students know and are able to …: • model dynamical systems • structured, by first principles (white box) • unstructured, from measurement data (black box) • semi-structured, by adapting model parameters (gray box) • model continuum mechanics problems • discretisation of continuum problems • solution by numerical methods

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Modelling Medical Systems – HAW Hamburg LS**	
	• use simulation tools, e.g. MATLAB / Simulink to… • build a model from physical differential-algebraic equations (white box) • identify parameters from measurement data (black box / gray box) • validate a model • simulate dynamic behavior • use finite element analysis software o model mechanical structures • design and conduct experiments with biosignal recording • use Matlab-based analysis software for biological signals (e.g. Kubios-HRV) **Social Competence (Communication and Cooperation)** Students are able to …: • discuss modelling concepts in a team. • decide which concepts are applicable. • guide the parameter identification process. • present and discuss their concepts in a peer group. **Personal Competence (academic self-conception, professionalism)** Students are able to …: • critically read, understand and review original articles and working documents.
Content of Module	Numerical Modelling of Structures Methods: Finite element analysis will be used to approximate solutions to distributed parameter models, described by partial differential equations. Discretisation of a problem into simpler elements allows efficient analysis of complex problems using numerical techniques. Particular attention will be paid to modelling elastic structures. A solid model must be generated, with appropriate boundary conditions, discretised, solved and assessed. Errors Involved in such modelling methods will be discussed. Practical Work: Finite element software will be used to design a structure. Models will be developed based on verifiable steps. Accuracy of solutions will be achieved according to convergence analysis. Solution efficiency will be addressed by simulating symmetry planes using boundary conditions.
Applicability of Module	
Requirements for the award of credit points / **Type of Assessment**	Regular form for the module examination: written exams (one per course) Further possible examinations: oral examination, presentation, homework reports

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Modelling Medical Systems – HAW Hamburg LS**	
	The type of examination will be announced by the lecturer at the beginning of the course
Related Courses	• Modelling Methods • Modelling Tools, Practical Work
Type of course and media	Seminaristic lectures, practical courses, expert-puzzle, team-work PowerPoint-presentation, tutorials, private study blackboard, projector, software-demonstration e-Learning
Literature	Lee, H (2015) Finite Element Simulations with ANSYS Workbench 16: Theory, Applications, Case Studies. SDC Publishers. Chen, X & Liu Y (2014). Finite Element Modeling and Simulation with ANSYS Workbench. CRC Press. Bathe, K. (2007). Finite Element Procedures. New Jersey: Prentice Hall. Scientific Journals and papers depending on the project

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Simulation and Virtual Reality in Medicine – HAW Hamburg LS**	
Module number	5 HAW Hamburg
Module coordination/ responsibility	Prof. Dr. Boris Tolg
Duration/ term/ frequency	One semester / 1st semester / winter term
Credit Points (CP) /Presence hours per week (SHW)	5 CP / 4 SHW
Workload	150 h In-class Lecture: 4 SHW x 18 weeks = 72 h Self-study: = 78 h
Type of Module	Obligatory module
Preconditions /Required skills	Required: none
Language	English
Competencies /Learning Outcome	**Professional Competence (Knowledge and Understanding)** The courses of this module enables the students to… • decide based on a given scenario which simulation technique fits best. • develop training scenarios for given situations. **Methodological Competence (Usage, Application and Generation of Knowledge)** Students know and are able to …: • evaluate and analyze training results. **Social Competence (Communication and Cooperation)** The students are able to… • present and discuss their concepts in a peer group. • develop solutions for simulation tasks. **Personal Competence (academic self-conception, professionalism)** Students are able to …: • critically read, understand and review original articles and working documents.

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Simulation and Virtual Reality in Medicine – HAW Hamburg LS**	

Content of Module	3D Simulation
	• Mathematical Background
	  • Transformation matrices
	  • Quaternions
	  • Kinematics
	  • Propagation Models
	  • …
	• Computer Graphics Background
	  • Lighting
	  • Data Structures
	  • …
	• Simulation Background
	  • Main Loop
	  • Events
	  • Storing results with MySQL
	  • …
	Other Simulation methods
	• Simulation Patients
	• Mass Casualty Incidents (MCI)
	• CAVE
	• 3D-Visual systems
	Evaluation
	• Mathematical Background
	  • Statistics
	  • …
	• Methodical Background
	  • Questionnaires
	  • Physiological data
	• Psychological Background

Applicability of Module	
Requirements for the award of credit points / **Type of Assessment**	Regular form for the module examination: written project report Further possible examinations: written exam, oral examination, oral presentation, homework reports The type of examination will be announced by the lecturer at the beginning of the course. The participation in at least 80% of the project seminar meetings is obligatory, presentations (1..2, not graded) required.

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Simulation and Virtual Reality in Medicine – HAW Hamburg LS**	
Related Courses	• Simulation and Virtual Reality in Medicine • Simulation and Virtual Reality in Medicine, Practical work (SimLab)
Type of course and media	Typically: experimental laboratory work / hardware and software engineering / literature work / seminar / presentations / project meetings / project documentation / web based cooperation
Literature	Scientific literature, depending on the project

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: HTA / Regulatory Affairs – HAW Hamburg LS**	
Module number	6 HAW Hamburg
Module coordination/ responsibility	Prof. Dr. Marc Schütte
Duration/ term/ frequency	One semester / 1st semester / winter term
Credit Points (CP) /Presence hours per week (SHW)	5 CP / 4 SHW
Workload	150 h In-class Lecture: 4 SHW x 18 weeks = 72 h Self-study: = 78 h
Type of Module	Obligatory module
Preconditions /Required skills	Appropriate knowledge from previous academic studies in a professionally associated field, bachelor degree Required: none
Language	English
Competencies /Learning Outcome	**Professional Competence (Knowledge and Understanding)** The courses of this module enables the students to… • describe the basic strategy and procedures of Health Technology Assessment (HTA) based on the general concept of evidence-based medicine. • identify quality criteria of scientific publications (ethics, study design, statistical methods, outcome measures, publication bias, journal impact etc.). **Methodological Competence (Usage, Application and Generation of Knowledge)** Students know and are able to …: • apply HTA both as a prospective and retrospective tool of quality assurance in the development and evaluation of medical technologies. • retrieve and evaluate relevant information using internet-based data bases (PubMed, Medline, Cochrane library etc.). • apply economical evaluation methods (cost/benefit-analysis) to healthy technologies.**Social Competence (Communication and Cooperation)** The students are able to…

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: HTA / Regulatory Affairs – HAW Hamburg LS**	
	• present and discuss their critique on a paper in a group ("journal club presentation"). • write a "peer review"-like evaluation report of a published paper. • write and revise an own text contribution ("workpackage") to a review paper prepared by the group **Personal Competence (academic self-conception, professionalism)** Students are able to …: • critically read and review original articles. •
Content of Module	Health Technology Assessment: • basis and methodologies of evidence based medicine • National and international health technology assessment organizations Process of peer-reviewed scientific publication Regulatory Affairs: • Principal routes to marketing medical devices: premarket approval, investigational device exemption, product development protocol, premarket notification (FDA process) • Medical device regulation in Europe • Role of the biomedical engineer in premarket reviews and postmarket controls of medical devices
Applicability of Module	
Requirements for the award of credit points / **Type of Assessment**	Regular form for the module examination: oral presentation Further possible examinations: oral examination, presentation, homework reports The type of examination will be announced by the lecturer at the beginning of the course.
Related Courses	• Regulatory Affairs • Health Technology Assessment (HTA)
Type of course and media	• Powerpoint presentations • Group work (internet retrieval, discussions) • Excursions ("expert interviews")
Literature	Introduction to health technology assessment. CS Goodmann. HTA 101, 2004. Sterne JA, Egger M, Smith GD. Systematic reviews in health care: investigating and dealing with publication and other biases in metaanalysis. BMJ. 2001; 323:101-5. Steinberg EP. Cost-effectiveness analyses. N Engl J Med. 1995; 332:123.

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: HTA / Regulatory Affairs – HAW Hamburg LS**	
	Oxman AD, Sackett DL, Guyatt GH. Users' guides to the medical literature. I. How to get started. JAMA. 1993; 270(17): 2093-5. Guyatt GH, Haynes RB, Jaeschke RZ, et al. Users' guide to the medical literature, XXV: Evidence-based medicine: principles for applying the users' guides to patient care. Evidence-Based Medicine Working Group. JAMA. 2000; 284:1290-6.

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Project Seminar in Engineering - IPP**	
Module number	1 IPP
Module coordination/ responsibility	Prof. Dr. Sandra Moreira Rua Ventura (The projects must be individually supervised by a professor of the department)
Duration/ term/ frequency	One semester / 2st semester / summer term
Credit Points (CP) /Presence hours per week (SHW)	5 CP / 2 SHW
Workload	140 h In-class Lecture: 2 SHW x 15 weeks = 30 h Self-study: Autonomous Work (hours) = 110 h
Type of Module	Obligatory module
Preconditions /Required skills	Recommended: Appropriate knowledge from previous academic studies in a professionally associated field, bachelor degree Required: none
Language	English
Competencies /Learning Outcome	**Professional Competence (Knowledge and Understanding)** Students are able to …: • approach and handle complex problems, tasks and projects in the biomedical field • autonomously design, develop and implement laboratory experiments • solve all problems typical to scientific projects **Methodological Competence (Usage, Application and Generation of Knowledge)** Students are able to …: • autonomously design, keep records and interpret measurements using appropriate mathematical and scientific methods

	• find and understand appropriate literature, assess and understand complex informations and apply them to the project • understand and apply complex laboratory and biomedical equipment to solve the project tasks. • provide and track a project plan. **Social Competence (Communication and Cooperation)** Students are able to …: • autonomously organize project groups, organize meetings and communication among the project participants and identify and solve all problems typical to scientific projects. • get in contact to experts, where necessary, discuss project and test plans with co-workers and project sponsors and defend their plans and results against critical objections. **Personal Competence (academic self-conception, professionalism)** Students are able to …: handle projects responsible, with awareness to cost, risk and safety.
Content of Module	• Project skills in practice: step-by-step • The scientific matters depend on the projects, which must be supervised / approved by a professor • The projects should address scientific level problems from any aspect of biomedical engineering and healthcare sciences and business
Applicability of Module	This module will serve as linkage along the curriculum between partners of the Master Program. This course will promote a better preparation, integration and share of knowledge in healthcare field. Thus, it is intended that students develop a working group to solve a common problem, promoting self-study and critical analysis. The groups include a student from each partner country (HAW + ILIS + IPP), enabling the integration of the colleagues in the institution and the country's culture. The contents are adjustable and can address any aspect linked to health, under the supervision of a teacher. In this course is intended that students develop their learning in an innovative way, shared and in close guidance with a teacher. Since this course takes place separately from the other curricular units, and along the full semester, will allow students to develop a small project in their areas of interest, promoting self-learning, work group and knowledge integration.
Requirements for the award of credit points / **Type of Assessment**	Types of Evaluation: Distributed Assessment or Final assessment (according to students choice). It is required that students achieved a minimum score at 47,5% at each assessment task. The distributed assessment includes two tasks: - short paper (SP) and poster presentation, each task is weighted at 50% of the final mark.

	The final assessment includes the presentation of an individual written report - WR (50%) and a written examination - WE (50%). **Calculation of final grade:** Distributed Assessment: Final grade = 60% SP+ 40% Poster Final Assessment: Final grade: 50% WR + 50% WE
Related Courses	• none
Type of course and media	Experimental laboratory work meetings will be promoted (hardware and engineering software, related literature), tutorials, explanation sessions remotely via e-learning platforms.
Literature	Axson, D. (2010). Best Pratices in plannig and performence managment. Hoboken: John Wiley & Sons. Cohen, L., Manion, L., & Morrison, K. (2011). Research methods in education. London: Routledge. Other Scientific literature, depending on the project. Walliman, N. (2011). Your Research Project: Designing and Planning Your Work. SAGE Study Skills Series. SAGE Publications.

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Medical Imaging Technologies and Devices- IPP**	
Module number	2 IPP
Module coordination/ responsibility	Dr. Paula Maria da Costa Lopes
Duration/ term/ frequency	One semester / 2st semester / summer term
Credit Points (CP) /Presence hours per week (SHW)	5 CP / 3 SHW
Workload	140 h In-class Lecture: 3 SHW x 15 weeks = 45 h Self-study: Autonomous Work (hours) = 95 h
Type of Module	Obligatory module
Preconditions /Required skills	Recommended: Appropriate knowledge from previous academic studies in a professionally associated field, bachelor degree Required: none
Language	English
Competencies /Learning Outcome	This curricular unit covers advanced healthcare technology systems and devices for diagnostic and therapeutics. Focus will be given in imaging, radiation therapy and other clinical equipment. For each technology, principles, applications, patient safety, common problems and solutions are included. **Professional Competence (Knowledge and Understanding)** Students are able to …: • identify and distinguish the principles and applications for each diagnostic technology and therapeutic areas • understand the underlying scientific basis of each medical imaging technology • identify and describe the monitoring physiological signals devices • identify and describe the hearing assistive devices • understand and distinguish the theoretical and clinical applications of implants

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Medical Imaging Technologies and Devices- IPP**	
	• recognize the safety standards of different equipment and medical instruments • to understand the functional link between the different components of the equipment and monitoring, sensing, and emergency devices **Methodological Competence (Usage, Application and Generation of Knowledge)** Students are able to …: • solve problems and analyse the main results • improve knowledge in the most advanced medical imaging technologies • recognize the equipment technological evolution of and instrumentation used for medical imaging **Social Competence (Communication and Cooperation)** Students are able to …: • Discuss concepts to technology and medical instrumentation in a team **Personal Competence (academic self-conception, professionalism)** Students are able to …: **dealing with medical terminology associated with each imaging technology**
Content of Module	1. Diagnostic and Therapeutic Equipment 1.1. Physical principles and patient safety 1.2. Newest theories, methods and techniques 1.3. Common problems and solutions 2. Clinical applications for each technology 2.1. Related-terminology 3. Implants and clinical devices in audiology 3.1. Principles and clinical applications, patient safety 3.2. Common problems and solutions
Applicability of Module	The proposed programme focuses on each of the objectives proposed creating a line of logic and gradual learning, allowing students to obtain knowledge in the area of medical equipment's and instrumentation for medical imaging, in order to create a theoretical and practical (TP) knowledge base.
Requirements for the award of credit points / **Type of Assessment**	The evaluation includes one written exams (60%) and oral presentation of a clinical case (40%).
Related Courses	• none

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Medical Imaging Technologies and Devices- IPP**	
Type of course and media	This module develops integrating knowledge of the several medical imaging technology and related instrumentation using the following methodologies: • expository teaching methodology with teaching knowledge of theoretical characteristics, describing the various techniques, clinical applications e patient safety of each diagnostic and therapeutic equipment. solving of real problems of clinical practice making the connection between the theoretical and practical knowledge, and case report demonstrations
Literature	Baim, D.S. (2005). Cardiac Catheterization, Angiography, and Intervention. Lippincott Williams & Wilkins. Cooper, E.R., Binnie, C.D., Billings, R. (2005). Techniques in Clinical Neurophysiology: a practical manual. Amsterdam: Elsevier Churchill Livingstone. Dillon, H. (2012). Hearing aids (2ªed.). Australia: Boomerang Press. Haidekker, M.A. (2013). Medical Imaging Technology. New York: Springer-Verlag. Kenny, T. (2008). Nuts and Bolts of Cardiac Pacing. Wiley Blackwell. Lemoigne, Y., Caner, A., Rahal, GCN-WW. (2007). Physics for medical imaging applications. Nato science series II. Dordrecht, Netherlands: Springer. Moore, D. (2010). The Oxford handbook of auditory science. Oxford: Oxford: University Press. Murgatroyd, F.D. (2002). Handbook of Cardiac Electrophysiology: A Practical Guide to Invasive EP Studies and Catheter Ablation. Remedica. Washington, C.M., Leaver, D.C.N. (2010). Principles and practice of radiation oncology. St.Louis: Mosby.

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Medical Measurement Techniques- IPP**	
Module number	3 IPP
Module coordination/ responsibility	Dr. Diana Patrícia Leal Tavares
Duration/ term/ frequency	One semester / 2st semester / summer term
Credit Points (CP) /Presence hours per week (SHW)	5 CP / 3 SHW
Workload	140 h In-class Lecture: 3 SHW x 15 weeks = 45 h Self-study: Autonomous Work (hours) = 95 h
Type of Module	Obligatory module
Preconditions /Required skills	Recommended: Appropriate knowledge from previous academic studies in a professionally associated field, bachelor degree Required: none
Language	English
Competencies /Learning Outcome	This module presents an introduction to physiological measurement of bioelectric phenomena and neurostimulation. In addition, students should understand various measurement devices and approaches including the underlying biological process that generates the quantity to be measured or controlled. The medical instrumentation used clinically to perform these functions is also examined. **Professional Competence (Knowledge and Understanding)** Students are able to …: • identify and distinguish the principles and applications of each measuring method of physiological signals • to understand the underlying scientific basis for each medical measurement technique • identify and describe the monitoring devices of physiological signals • to understand the biosensors working • understand the radiobiology concepts and their practical applications

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Medical Measurement Techniques- IPP**	
	• identify and distinguish the effects arising from exposure to radiation of biological tissues • to understand the processes and mechanisms of response of tumours and normal tissues to radiation **Methodological Competence (Usage, Application and Generation of Knowledge)** Students are able to …: • evaluate and interpret the physiological signal measurements from medical devices • solve problems and analyse the main results • improve knowledge about the most advanced measurement techniques **Social Competence (Communication and Cooperation)** Students are able to …: • Discuss concepts to technology and medical instrumentation in a team **Personal Competence (academic self-conception, professionalism)** Students are able to …: dealing with medical terminology associated with each monitoring system and measurement of physiological signals
Content of Module	1. Basic Medical Laboratory Techniques 2. Biosensors 3. Applied Radiobiology 4. Medical dosimetry 5. Neurophysiological measurements: Advanced methods and techniques 6. Cardiac, respiratory and vascular physiological measurements: Advanced methods and techniques 7. Auditory and vestibular measurements: Advanced methods and techniques 7.1. Balance, dizziness and vestibular system 7.2. Static and computorized dynamic posturography (CDP) 7.3. Sensory organization test
Applicability of Module	The proposed programme focuses on each of the objectives proposed creating a line of logic and gradual learning, allowing students to obtain knowledge in the area of medical equipments and instrumentation for physiological signal (neurophysiological, cardiovascular, respiratory auditory and vestibular), in order to create a theoretical and practical (TP) knowledge base. In addition, the effects of irradiation of biological systems and monitoring will be focused.
Requirements for the award of credit points / **Type of Assessment**	The evaluation includes a written test (TT) corresponding to 60% of the evaluation (referring to the 4 topics of the programmatic contents).

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Medical Measurement Techniques- IPP**	
	Presentation of a scientific article (AAC), corresponding to 40% of the grade, being selected by teachers of the curricular unit. The minimum grade for each element of assessment is 9.5 points (O to 20 scale). Final grade = TT*0,60 + AAC*0,40
Related Courses	• none
Type of course and media	This UC develops integrating knowledge of the several medical imaging technology and related instrumentation using the following methodologies: • expository teaching methodology with teaching knowledge of theoretical characteristics, describing the various techniques and clinical applications of each advanced measurement method. • solving of real problems of clinical practice making the connection between the theoretical and practical knowledge, and case report demonstrations
Literature	Adamec, J., Adamec, R. (2008). ECG-Holter-Guide to Electrocardiographic Interpretation. Springer. Claudio Bassetti, et al. (2014). ESRS European Sleep Medicine Texbook. ERRS. Desmond, A. (2011). Vestibular function: clinical and practice function (2ª ed.). New York: Thieme. Dowd, S.B., Tilson, E.R. (2009). Radiobiology and Radiation Protection. 2 edition. Mosby. Hughes, J.M.B. (1999). Lung Function Tests: Physiological Principles and Clinical Applications. WB Saunders. Katz, J et al (2009). Handbook of Clinical Audiology. Philadelphia: Wolters Kluwer - Lippincott Williams & Wilkins. Kropotov, JD (2009). Quantitative EEG, Event-related Potentials and Neurotherapy. Amsterdam: Elsevier. Luna, AB (2007). Basic Electrocardiography: Normal and Abnormal Patterns. Wiley-Blackwell. Wasserman, K et al (2004). Principles of Exercise Testing and Interpretation. Lippincott Williams & Wilkins.

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Applied Clinical Imaging- IPP**	
Module number	4 IPP
Module coordination/ responsibility	Prof. Dr. Brígida da Costa Ferreira
Duration/ term/ frequency	One semester / 2st semester / summer term
Credit Points (CP) /Presence hours per week (SHW)	5 CP / 3 SHW
Workload	140 h In-class Lecture: Theoretical work (hours): 1 SHW x 15 weeks = 15 h Lab and practical work hours: 2 SHW x 15 weeks = 30 h Self-study: Autonomous Work (hours) = 95 h
Type of Module	Obligatory module
Preconditions /Required skills	Recommended: Appropriate knowledge from previous academic studies in a professionally associated field, bachelor degree Required: none
Language	English
Competencies /Learning Outcome	This module introduces topics related with imaging and radiation therapy practice, and integrates students to realistic situations of clinical setting. **Professional Competence (Knowledge and Understanding)** Students are able to …: • observe, identify and compare the most common technologies used in hospitals and research laboratories to make measurements of biomedical variables of clinical significance • In depth knowledge regarding the most advanced techniques in medical imaging • in depth knowledge regarding the most advanced techniques in clinical dosimetry • identify and discuss the importance of the various techniques used in medical visualization and image processing

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Applied Clinical Imaging- IPP**	
	• compare the advantages and limitations of different image processing systems **Methodological Competence (Usage, Application and Generation of Knowledge)** Students are able to …: • apply and test medical imaging processing and radiation therapy software • develop solutions for medical imaging processing tasks **Social Competence (Communication and Cooperation)** Students are able to …: • get in contact to experts, where necessary, discuss projects and test plans with co-workers. **Personal Competence (academic self-conception, professionalism)** Students are able to …: understand the terminology associated with the clinical imaging systems
Content of Module	**Theorical contents:** 1. Practical issues in clinical imaging and radiation therapy 2. Advanced imaging applied to radiotherapy: basic concepts of Intensity Modulated Radiation Therapy (IMRT) 3. Advanced diagnostic imaging procedures: a multimodality approach 4. Future trends in clinical imaging **Practical contents:** Demonstrations with radiology advanced workstations and treatment planning system ISOGRAY (Imaging module, Registration/Fusion, Atlas, Segmentation, Simulation e Dosimetry).
Applicability of Module	The proposed programme focuses on each of the objectives proposed creating a line of logic and gradual learning, allowing students to obtain knowledge in the area of medical imaging processing and clinical dosimetry, in order to create a theoretical (T) and practical (P) knowledge base.
Requirements for the award of credit points / **Type of Assessment**	Continuous evaluation: One written exam (weight of 50%), a work group (20%) and a group written report (30%) at the end of the semester. Final evaluation: Graded examinations: written exam (70%) and a group written report (30%) at the end of the semester. Appeal: the student must repeat the evaluation element that has failed

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Applied Clinical Imaging- IPP**	
	Continuous evaluation: FINAL GRADE = 50% Exam + 20% Work group + 30% Report Final evaluation: FINAL GRADE= 70% Exam + 30% Report
Related Courses	• none
Type of course and media	This UC develops seamlessly and continuously by connecting the theoretical component with the practical component using the following methodologies: • expository teaching methodology with teaching knowledge of theoretical characteristics, describing the various techniques of medical image processing and planning systems in radiation therapy. • solving of real problems of clinical practice • presentation and discussion addressing the practical problems
Literature	Chao, K.S.C., Perez, C.A., Brady, L.W. (2012). Radiation Oncology: Management Decisions. Lippincott Williams and Wilkins. Faiz M.Khan, Bruce J.Gerbi. (2016) Treatment planning in Radiation Oncology, Fourth edition. Philadelphia: Walters Kluwer. Feigenbaum, H., Armstrong, W., Ryan, T. (2007). Ecocardiography Editor Guanabara Koopan. Grainger, R.G., Allison, D.J., Adam, A., Dixon, A.K.C.N. (2002). Grainger & Allison's diagnostic radiology. Edinburgh: Churchill Livingstone. Kumar, A., Chowdhury, V. (2013). Diagnostic Radiology: Recent Advances and Applied Physics in Imaging. 2nd Ed. Jaypee Brothers Medical Pub. Pellerito, J.S., Polak, J.F. (2012). Introduction to vascular ultrasonography. Philadelphia: Elsevier Saunders. Rumack, C.M. (2011). Diagnostic ultrasound. Philadelphia: Elsevier. Torres, L.S., Norcutt, TL-W., Dutton, A.G.C.N. (2003). Basic Medical Techniques and patient care in Imaging Technology. Philadelphia: Lippincott Williams & Wilkins. Other references: Wolfgang Schlegel, Thomas Bortfeld, Anca-Ligia Grosu ; contribs. J. R. Adler... [et al.]. (2006) New technologies in radiation oncology, eds. Berlin: Springer. Leonard L.Gunderson, Joel E.Tepper. Clinical Radiation Oncology, (2012) third edition. Philadelphia: Saunders.

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Applied Clinical Imaging- IPP**	
	Robert Timmerman; Lei Xing. Image-guided and adaptive radiation therapy, (2010) Philadelphia: Wolters Kluwer, Lippincott Williams & Wilkins. Scientific articles available in the Moodle platform.

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Applied Clinical Signals- IPP**	
Module number	5 IPP
Module coordination/ responsibility	Prof. Dr. David Tomé Bartolomeu Simões
Duration/ term/ frequency	One semester / 2st semester / summer term
Credit Points (CP) /Presence hours per week (SHW)	5 CP / 3 SHW
Workload	140 h In-class Lecture: Theoretical work (hours): 1 SHW x 15 weeks = 15 h Lab and practical work hours: 2 SHW x 15 weeks = 30 h Self-study: Autonomous Work (hours) = 95 h
Type of Module	Obligatory module
Preconditions /Required skills	Recommended: Appropriate knowledge from previous academic studies in a professionally associated field, bachelor degree Required: none
Language	English
Competencies /Learning Outcome	This curricular unit introduces topics related with bio signals monitoring and therapeutics practice, and integrate students to realistic situations of clinical setting. **Professional Competence (Knowledge and Understanding)** Students are able to …: • in depth knowledge regarding the most advanced techniques for physiological signals measurements • in depth knowledge regarding the most advanced techniques in audiology • interpret the medical results (outputs) **Methodological Competence (Usage, Application and Generation of Knowledge)** Students are able to …:

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Applied Clinical Signals- IPP**	
	• apply and test medical transducers and electro medical equipment in common use in hospitals and research laboratories • make measurements of biomedical variables of clinical significance • develop solutions for biomedical signals measurement tasks **Social Competence (Communication and Cooperation)** Students are able to …: • get in contact to experts, where necessary, discuss projects and test plans with co-workers. **Personal Competence (academic self-conception, professionalism)** Students are able to …: understand the terminology associated with the monitoring and measurement systems
Content of Module	**Theoretical contents:** 1. Levels of care 2. Practical issues in clinical signals 3. Advanced clinical signals approaches: a multimodality approach 4. Trends in clinical signals monitoring and therapeutics **Practical contents:** Demonstrations wiht BIODEX platform, MADSEN Astera 2 Audiometer, Interacoustics Eclipse and Affinity, TRUSCAN, SOMNOSCREEN and others neurophysiological equipment's, implants dummies, cardiac and respiratory functional systems.
Applicability of Module	The proposed programme focuses on each of the objectives proposed creating a line of logic and gradual learning, allowing students to obtain knowledge in the area of medical imaging bio signals monitoring and therapeutics, in order to create a theoretical (T) and practical (P) knowledge base.
Requirements for the award of credit points / **Type of Assessment**	Graded examinations: written exam (50%) and a group written report (50%) at the end of the semester.
Related Courses	• none
Type of course and media	This UC develops seamlessly and continuously by connecting the theoretical component with the practical component using the following methodologies: • expository teaching methodology with teaching knowledge of theoretical characteristics, describing the various techniques of bio signals monitoring and therapeutics practice • solving of real problems of clinical practice

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Applied Clinical Signals- IPP**	
	presentation and discussion addressing the practical problems
Literature	Crawford, M. (2013). Current Diagnosis and Treatment Cardiology, McGraw-Hill Professional. Decker, N., Carrel, T. (2004). Instrumentation: An Introduction for the students in the Speech and Hearing Sciences (3ª ed.). New Jersey: Lawrance Erlbaum Associates. Dexter, J., Butler, T., Wilkins, R. (2001). A Pocket Guide to Respiratory Disease. Davis Company. Kimura, J. (2013). Electrodiagnosis in Diseases of Nerve and Muscle: principles and practice. Oxford University Press. Rasmussen, T.E., Clouse, W.D., Tonnessen, B.H. (2008). Handbook of Patient Care in Vascular Diseases. Lippincott Williams & Wilkins. Yamanda, T., Meng, E. (2011). Practical guide for clinical neurophysiologic testing EP, LTM, IOM, PSG and NCS. Philadelphia: Wolters Kluwer.

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Human-Technology Interaction pon Clinical Environment- IPP**	
Module number	6 IPP
Module coordination/ responsibility	Dr. Ana Cristina Baeta Serra de Campos Silva
Duration/ term/ frequency	One semester / 2st semester / summer term
Credit Points (CP) /Presence hours per week (SHW)	5 CP / 2 SHW
Workload	140 h In-class Lecture: 2 SHW x 15 weeks = 30 h Self-study: Autonomous Work (hours) = 110 h
Type of Module	Obligatory module
Preconditions /Required skills	Recommended: Appropriate knowledge from previous academic studies in a professionally associated field, bachelor degree Required: none
Language	English
Competencies /Learning Outcome	This unit gives an overview about different human-technology interactions on clinical environment. A multidisciplinary approach will be emphasized. **Professional Competence (Knowledge and Understanding)** Students are able to …: • recognize concepts of telemedicine and clinical decision support systems • recognize the limitations of human-technology interactions in clinical environment • develop knowledge to measure usability to user interface components of clinical devices **Methodological Competence (Usage, Application and Generation of Knowledge)** Students are able to …: • be in contact with a virtual environment • understand the equipment from user's and patient's perspective

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Human-Technology Interaction pon Clinical Environment- IPP**	
	• to learn about usability, perception, cognition, clinical decision support systems **Social Competence (Communication and Cooperation)** Students are able to …: • critically discuss the topics presented **Personal Competence (academic self-conception, professionalism)** Students are able to …: handle tasks with awareness and responsibility
Content of Module	1. Telemedicine 2. Clinical Decision Support Systems: physical overview and applications 3. Remote clinical follow-up: multimodality approach and future trends 4. Clinical Interface equipment 5. Interactive patient simulators 6. User's and Patient's Perspective 7. Life Support Technologies
Applicability of Module	The program outline is intended to develop the thinking and critical capacity of each student. To make this possible, it is recommended to read articles and case studies (to allow a focused debate in the classroom). At the same time, questions are posed to students (over which they have to reflect).
Requirements for the award of credit points / **Type of Assessment**	The assessment includes the presentation and discussion of a written report and / or poster (100%) at the end of the semester. The frequency of the two gatherings is required to graded examination.
Related Courses	• none
Type of course and media	This UC has a multidisciplinary and integrative environment of knowledge and develops through the following methods: • expository and demonstrative teaching methodology Group discussions on related topics (two gatherings)
Literature	Decker, N., Carrel, T. (2004). Instrumentation: An Introduction for the students in the Speech and Hearing Sciences (3th ed.). New Jersey: Lawrance Erlbaum Associates. Gravlee, G., Davis, R., Utley, J., Kurusz, M. (2008). Cardiopulmonary Bypass, Principles and Practice. USA: Lippincott Williams & Wilkins. Hersh W. (2009). Information retrieval: a health and biomedical perspective (3th ed.). New York: Springer. Other bibliographic resources, such as articles and study cases.

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Human-Technology Interaction pon Clinical Environment- IPP**	
	Hoyt, R., Sutton, M., Yoshihashi, A. (2007). Medical informatics: practical guide for the healthcare professional. Pensacola [EUA]: University of West Florida.

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Project Seminar in Healthcare Business- ILIS**	
Module number	1 ILIS
Module coordination/ responsibility	Hélène Gorge (The projects must be individually supervised by a professor of the department)
Duration/ term/ frequency	One semester / 3st semester / winter term
Credit Points (CP) /Presence hours per week (SHW)	5 CP / 4 SHW
Workload	150 h In-class Lecture: 4 SHW x 18 weeks = 72 h Self-study: = 78 h
Type of Module	Obligatory module
Preconditions /Required skills	Recommended: Appropriate knowledge from previous academic studies in a professionally associated field, bachelor degree. Required: none
Language	English
Competencies /Learning Outcome	Students are able to understand the challenges of regulatory affairs and quality, with a focus on the pharmaceutical sector. **Professional Competence (Knowledge and Understanding)** Students are able to: • understand the challenges of regulatory affairs • and quality, with a focus on the pharmaceutical sector. **Methodological Competence (Usage, Application and Generation of Knowledge)** Students are able to …: • **Social Competence (Communication and Cooperation)** Students are able to …: • **Personal Competence (academic self-conception, professionalism)** Students are able to …:

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Project Seminar in Healthcare Business- ILIS**	
	•
Content of Module	Provide insights into quality management and regulatory affairs in the healthcare sector. 1. Quality management 2. Regulatory affairs and European Union marking 3. EMA, PRAC, CHMP and new regulations
Applicability of Module	
Requirements for the award of credit points / **Type of Assessment**	Case studies
Related Courses	
Type of course and media	Theoretical lectures Group-works on case studies
Literature	

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Principles of Marketing in the Healthcare Business - ILIS**	
Module number	2 ILIS
Module coordination/ responsibility	Daphné Salerno
Duration/ term/ frequency	One semester / 3st semester / winter term
Credit Points (CP) /Presence hours per week (SHW)	5 CP / 4 SHW
Workload	150 h In-class Lecture: 4 SHW x 18 weeks = 72 h Self-study: = 78 h
Type of Module	Obligatory module
Preconditions /Required skills	Recommended: Required: none
Language	English
Competencies /Learning Outcome	**Professional Competence (Knowledge and Understanding)** Students are able to: • understand the challenges of applying marketing in the healthcare sector and to identify the various theories that can be applied. • anticipate potential threats, risks and barriers in order to succeed in his marketing initiative and convert an opportunity into strength **Methodological Competence (Usage, Application and Generation of Knowledge)** Students are able to …: • adjust their strategy with an efficient retroplanning and identification of specific metrics in order to either consolidate or revise his position (flexibility of the students) **Social Competence (Communication and Cooperation)** Students are able to …: **Personal Competence (academic self-conception, professionalism)** Students will feel more comfortable and natural when speaking in front of an audience and be able to argue on choices, directions, targets,

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Principles of Marketing in the Healthcare Business - ILIS**	
	segments to support his marketing initiative (real-life enterprise simulations)
Content of Module	**Theoretical basis of marketing:** Provide insights into marketing theories and their application to the healthcare sector and services marketing. • Marketing definitions • The marketing mix • The customer – patient **Healthcare business:** Presentation of the use of marketing and healthcare knowledge to develop, structure and present a marketing/business strategy in the healthcare sector. • Marketing and colours • Symbols in marketing and focus in healthcare • symbols • How to successfully utilize marketing tools to reach • specific selling goals • Various healthcare scenarii to be argumented, • discussed, criticized, revamped Tricks to be given to the students regarding their communication skills, body language, argumentation, selling skills on a group and individual basis
Applicability of Module	
Requirements for the award of credit points / **Type of Assessment**	**Theoretical basis of marketing:** Case study in class **Healthcare business:** General presentation by group in front of the other students, with adequate Powerpoint support. Evaluation on a global basis (group) and individual one for body language, ability to argue and respond to specific questions regarding their strategy.
Related Courses	• Theoretical basis of marketing • Healthcare business
Type of course and media	**Theoretical basis of marketing:** Theoretical lectures Group-works on marketing case studies **Healthcare business:**

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Principles of Marketing in the Healthcare Business - ILIS**	
	Healthcare business cases to be proposed to the students, with the objective to define, develop and argue on a business strategy. Projections and return on investment (ROI) to be defended and forecasted. Financial metrics: assets, liability, income, revenue, gross margin, net loss, gain, etc.
Literature	Berkowitz E. (2017), Essentials of healthcare marketing 4th edition, Jones & Bartlett Learning.

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: International Healthcare Marketing and Business - ILIS**	
Module number	3 ILIS
Module coordination/ responsibility	Hélène Gorge
Duration/ term/ frequency	One semester / 3st semester / winter term
Credit Points (CP) /Presence hours per week (SHW)	5 CP / 4 SHW
Workload	150 h In-class Lecture: 4 SHW x 18 weeks = 72 h Self-study: = 78 h
Type of Module	Obligatory module
Preconditions /Required skills	Recommended: Required: none
Language	English
Competencies /Learning Outcome	The students should be able to: **Professional Competence (Knowledge and Understanding)** Students are able to: • define the best way to drive a sales opportunity. • to understand the challenges of applying marketing and market activities to the health sector, and to reflect upon the patient as a customer. Learning about the environment of medical devices, life cycle, classification, regulatory aspects, clinical trials, the CE marketing, the market, and the material vigilance. **Methodological Competence (Usage, Application and Generation of Knowledge)** Students are able to …: **Social Competence (Communication and Cooperation)** Students are able to …: • Argue **Personal Competence (academic self-conception, professionalism)** Students are able to …:

	• critically analyze the transformation of the health sector.
Content of Module	**Customers' Mapping:** Provide insights into the application of strategic selling methodology to drive better customer stakeholder understanding and 'mapping' of sales accounts. Identify how to target the right 'champions' within customer base to influence the purchasing process. 1. Theory 2. Hands-on experience **Consumerism and health:** Reflection on the role of the market and consumption in the health sector through an understanding of the patient-consumer and the marketization of healthcare organizations. 1. Market and health 2. Consumption and health 3. The challenges of the healthcare marketizaion **Medical devices:** This course allows to get knowledge of the organization of care, hospital organization and basic knowledge in physiology. 1. General information on MD (definitions, examples of MD, the different categories, the MD market) 2. Classification of the MD (criteria, classification rules, the different classes, exceptions) 3. Regulation of the MD (legislatives and regulatory sources, European directives, transposition into French law) 4. Life cycle of a MD: global information (research and development, industrial protection, clinical trials, market access) 5. Development of a MD (definition of the application domain, specifications, layout, prototyping) 6. Evaluation of the MD (technical documentations, compliance with standards, electrical and EMC tests, risk analysis, ergonomic assessment, clinical trials) 7. The CE marking (CE marking principle, the essential requirements, notified agencies, procedures function of classes) 8. Material vigilance (definition, organization, role of the 9. ANSM, declarations)
Applicability of Module	

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: International Healthcare Marketing and Business - ILIS**	
Requirements for the award of credit points / **Type of Assessment**	**Customers' Mapping:** Business game during the class (participation, interactivity …) Individual business case or MCQ **Consumerism and health:** Short presentation during the class **Medical devices:** Being able to namely distinguish between different classes of MD, to understand CE marketing procedures, to interpret the results of a clinical trial, understanding the process of industrial protection and market access.
Related Courses	• Customers' Mapping • Consumerism and health • Medical devices
Type of course and media	**Customers' Mapping:** Theory around customer mapping Hands-on experience to apply strategic selling methodologies to real world case studies. Teams will collaborate together to apply stakeholder mapping and journey mapping tools to better define and understand customers. **Consumerism and health:** Theory around consumption, marketing and health Reflection about research qualitative methods Illustrative examples to be analyzed by groups **Medical devices:** Individual and group works around examples of medical devices
Literature	The New Strategic Selling (Robert B. Miller, Stephen E. Heiman, Diane Sanchez, Tad Tuleja, Kogan Page Publishers, 2004) TBA – Readings given to the students before the course

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Marketing for Innovative Medical Technology - ILIS**	
Module number	4 ILIS
Module coordination/ responsibility	Suzanna Scott
Duration/ term/ frequency	One semester / 3st semester / winter term
Credit Points (CP) /Presence hours per week (SHW)	5 CP / 4 SHW
Workload	150 h In-class Lecture: 4 SHW x 18 weeks = 72 h Self-study: = 78 h
Type of Module	Obligatory module
Preconditions /Required skills	Recommended: Required: none
Language	English
Competencies /Learning Outcome	**Professional Competence (Knowledge and Understanding)** Students are able to …: • get familiar with external and internal environment of Health care businesses • to join a healthcare business entity with consitent background on Marketing **Methodological Competence (Usage, Application and Generation of Knowledge)** Students are able to …: • pitch a product/service **Social Competence (Communication and Cooperation)** Students are able to …: • present a firm, its products, services and stratgeies • make a convincing presentation in English • participate in English business meetings **Personal Competence (academic self-conception, professionalism)** Students are able to …:

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Marketing for Innovative Medical Technology - ILIS**	
	• « feel » how different internal & external factor could influence a strategy & tactics • talk fluently about healthcare marketing and healthcare technologies in a variety of settings.
Content of Module	**Strategic marketing in the healthcare sector:** • Creates a process to help teams develop and execute comprehensive, high-impact, global marketing strategies • Ensures focus on both strategies and tactics • Provide a « communication platform within the • marketing team and the rest of the organization 1) Some « Fundamentals » on Marketing a) Definition and « essence » of marketing b) The role of the Product manager c) Some key concepts 2) What sets of customers should we invest in and prioritize resources against – Where to Play a) Understand the Market b) Evaluate and target customers 3) What should we do for each set of key target customers – How to win a) Create positioning strategy and messaging b) Plan for the future c) Develop marketing tactics d) Monitor and reevaluate e) Franchise financials **Professional English for the health sector:** This course aims at giving students the English language skills they need to be effective in an international business marketing setting, and more specifically in their future jobs in the health sector. <u>Course introduction</u> 1. Healthcare marketing past a. Where have we come from? b. How have things changed? 2. Healthcare marketing present a. Where are we now? b. Presenting firms, projects, products, services c. High tech vs Low-tech devices 3. Healthcare marketing future

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Marketing for Innovative Medical Technology - ILIS**	
Applicability of Module	
Requirements for the award of credit points / **Type of Assessment**	**Strategic marketing in the healthcare sector:** Case study at half of the course and a group case study presented at the end of the course **Professional English for the health sector:** Continuous assessment
Related Courses	• Strategic marketing in the healthcare sector - How to build an integrated marketing business plan in a healthcare business • Professional English for the health sector
Type of course and media	**Strategic marketing in the healthcare sector:** This training will be delivered through 2 ways : • Initial lecture in order to built the fondaments (PPT) • Workshop groups in order to apply tools that will be covered (would require additional classroom to book) • The classroom will be divided into small groups (4 people/group ideally). Those groups will stay the same. • During courses will be delivered to each students some case studies related to real situation across Healthcare business. • Student will be rated according each groups they are part of. • Laptops are clearly key for sub group work **Professional English for the health sector:** The emphasis in class will be on spoken interaction. Some flip-teaching will be used, with students familiarising themselves with material and resources before class.
Literature	Emmerson P (2009), Business Vocabulary Builder, Macmillan

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Legal and regulatory considerations in the healtcare industry - ILIS**	
Module number	5 ILIS
Module coordination/ responsibility	Hélène Gorge
Duration/ term/ frequency	One semester / 3st semester / winter term
Credit Points (CP) /Presence hours per week (SHW)	5 CP / 4 SHW
Workload	150 h In-class Lecture: 4 SHW x 18 weeks = 72 h Self-study: = 78 h
Type of Module	Obligatory module
Preconditions /Required skills	Recommended: Required: none
Language	English
Competencies /Learning Outcome	Key concepts to understand Health system definition, dynamic of its evolution, actors' roles, Healthcare policy and management. General culture about ethics, understanding of the inclusion of ethics into a business perspective **Professional Competence (Knowledge and Understanding)** Students are able to …: • identify unethical issues, their stakeholders and the solutions to bring in terms of communication and strategy • understand how and why a health system is • managed. • identify and analyzed their (students) future • business impact on health system **Methodological Competence (Usage, Application and Generation of Knowledge)** Students are able to …: • - **Social Competence (Communication and Cooperation)** Students are able to …:

	• **Personal Competence (academic self-conception, professionalism)** Students are able to …: • bring a reflexive look on ethics within professional activities
Content of Module	**Health systems:** The objective of this course is to provide key concepts of Health care system definition and management. 1. Introduction a. The concept of health b. The concepts of the health 2. Birth of the health systems a. Why a health system? b. The different health care system 3. Managed an Health Care system a. The key elements of health care system b. The actors c. Why to managed: the crisis in Health 4. 3 European health systems: working groups presentation. 5. Health Economics a. Context b. The medico-economics assessment 6. Management of Changes in Health System a. Policy perspective b. Organization perspective c. The future of health 7. The future of health : Students essays -> presentation **Business ethics:** This course offers an introduction to business ethics ; through the exploration of the conceptual frameworks around ethics, the study of examples and illustrations of unethical situations with a focus on the healthcare sector. 1. Some considerations on ethics a) Personal thoughts on ethics b) Defining ethics c) Morality and ethics d) Business and ethics e) Taking ethical decisions: a framework 2. The stakeholders involved in ethics a) Who may be concerned by business ethics ?

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Legal and regulatory considerations in the healtcare industry - ILIS**	
	b) Role and influence in business ethics… c) Of individuals as consumers-citizens and employees a) Of companies and shareholders b) Of public institutions and governements c) Of lobbyists and other associations 4) The biggest challenge – Building a ethical code a) Why having ethical regulation ? b) The most pressuring ethical issues c) Some cases of companies handling ethical d) issues e) The different types of regulations 5) Ethics in a multicultural environment a) What does multiculturalism mean ? b) Cultural perspectives about ethics c) How does multiculturalism interfere with ethics ? d) Some cases and potential « solutions » 6) Business Game
Applicability of Module	
Requirements for the award of credit points / **Type of Assessment**	Written essay on a personal ethical case (in class > 2 hours) Business game during the last class (> 6 hours)
Related Courses	• Health systems • Business ethics
Type of course and media	**Health systems:** The course will highlight key concepts to understand health care system, Healthcare policy and management; and practical cases aiming at illustrating these concepts. The course is supported by the reading of several articles in relation with Health system, Healthcare policy and management. The course also mixes a personal evaluation on Health system and concept through the final essay students have to write and a collective work on concrete European Health system. **Business ethics:** The course is organized around various theories of ethics, and case studies aiming at illustrating these concepts. The course is supported by the reading of several articles in relation with business ethics to create a dialogue with the students on their thoughts on ethical issues.

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Legal and regulatory considerations in the healtcare industry - ILIS**	
	The course also mixes a personal evaluation on ethics through the essay students have to write and a collective work on concrete ethical issues through the final business game.
Literature	Drummonds (2005) Methods for the Economic Evaluation of Health Care Programs. Mintzberg (2011): Managing. Creyer EH (1997), The influence of firm behavior on purchase intention : do consumers really care about business ethics ? Journal of Consumer Marketing. Werhane, P (2000), Business ethics, stakeholder theory and the ethics of healthcare organizations, Cambridge Quaterly of Healthcare Ethics, 9, 2, 169-181. Others references will be provided for each thematic.

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Industrial Purchasing, Outsourcing in the HealtCare Industry - ILIS**	
Module number	6 ILIS
Module coordination/ responsibility	Hélène Gorge
Duration/ term/ frequency	One semester / 3st semester / winter term
Credit Points (CP) /Presence hours per week (SHW)	5 CP / 4 SHW
Workload	150 h In-class Lecture: 4 SHW x 18 weeks = 72 h Self-study: = 78 h
Type of Module	Obligatory module
Preconditions /Required skills	Recommended: Required: none
Language	English
Competencies /Learning Outcome	General culture about purchasing and outsourcing Understanding of outsourcing process in the industry and in the distribution with an explanation of the role of each stakeholder involved in the process Negotiating skills Contract formalization Mastering of incoterms, price and cost concept **Professional Competence (Knowledge and Understanding)** Students are able to: • explain what are purchasing and outsourcing • identify the different risks concerning outsourcing and how to • manage them • explain the outsourcing process and roles of each stakeholder • understand what is a technical specification or a specification role **Methodological Competence (Usage, Application and Generation of Knowledge)** Students are able to …:

<table>
<tr><th colspan="2">Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc.
Module: Industrial Purchasing, Outsourcing in the HealtCare Industry - ILIS</th></tr>
<tr><td></td><td>• formalize a contract
Social Competence (Communication and Cooperation)
Students are able to …:
• lead a commercial negotiation
Personal Competence (academic self-conception, professionalism)
Students are able to …:
•</td></tr>
<tr><td>Content of Module</td><td>This course offers an introduction to industrial purchasing and outsourcing in the healthcare industry.
The objectives are to explain:
• What is the purchasing function
• The role of the purchaser and his impact on competitiveness and profitability for a company
• Outsourcing as a part of purchasing
• The reasons of strategic decision-making to outsource
• The outsourcing process with examples and illustrations in the healthcare industry
• The role of each stakeholder in the outsourcing process (internal customer/purchasing dept/procurements/quality dept/accountancy)
Lexicon
Incoterms 2010
General information (industrial purchasing and outsourcing, assessment of the current situation in the healthcare sector)
I Industrial purchasing
a. Definition
b. Classification of purchases
c. The purchasing process
d. Concept of price
e. TCO (Cost break down)
f. Negotiating
g. Contract formalization
h. Management of supplier’s performance
II Outsourcing
a. Definition
b. Reasons for outsourcing
c. Impact of globalization and internet
d. The potential risks and how to secure (manage) them</td></tr>
</table>

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Industrial Purchasing, Outsourcing in the HealtCare Industry - ILIS**	
	III Prerequisites before outsourcing decision making a. Clear description of the need (note, technical specification…) b. Identification of potential suppliers and analysis of their c. strengths and weakness on the market (expertise, prices, R&D d. and innovation policies) e. Identification of potential risks (economic, financial, f. geopolitical, environmental, legal, social and climatic) g. Make or buy study IV Roles of each stakeholder in the outsourcing process a. Description of the outsourcing process a. In the industry b. In the distribution b. Roles of the main stakeholders a. In the industry (general manager or the executive committee, project manager or production manager, purchaser, procurement, quality manager) b. In the distribution (product manager and executive committee, purchaser, procurement, quality manager) V Keys of successful management of the outsourcing a. Audit and qualification of suppliers b. Negotiating c. Contracts implementation d. Management of the suppliers performance
Applicability of Module	
Requirements for the award of credit points / **Type of Assessment**	
Related Courses	
Type of course and media	The course is organized around the theory, practical cases and role playing
Literature	Overby S – ABC: An introduction to outsourcing (2007) Rothman J: 11 steps to successful outsourcing (2003) Watchel D: Negotiating skills Report of healthcare Ministry on the challenges of the purchasing function in health facilities (2006)

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Industrial Purchasing, Outsourcing in the HealtCare Industry - ILIS**	
	Bolognini A: Industrial purchasing

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Master thesis**	
Module number	
Module coordination/ responsibility	All university lecturers
Duration/ term/ frequency	One semester / 4st semester / summer term
Credit Points (CP) /Presence hours per week (SHW)	30 CP
Workload	900 h (Autonomous private study)
Type of Module	Obligatory module
Preconditions /Required skills	Recommended: Required: At least 210 CP from the previous academic studies in relevant scientific fields/ relevant knowledge in electronics, biomedical engineering, informatics, human biology Before the official start of the assignment the subject-matter and the supervisors must be approved by the board of examiners
Language	English
Competencies /Learning Outcome	**Professional Competence (Knowledge and Understanding)** Students are able to …: • solve challenging engineering or medical or economical specific and natural scientific problems. • deal with technical and medical working materials. • describe and overbring theoretical contexts in the bio medicine. **Methodological Competence (Usage, Application and Generation of Knowledge)** Students …: • are familiar with the concepts of scientific work and use them conducive. • are able to use mathematical / physical and technical methods on problems in the medical technology and healthcare business fields.

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Master thesis**	
	• have a scientific method-knowledge and are able to evaluate critical results from the literature and to express and transact them in their own words. **Social Competence (Communication and Cooperation)** Students ...: • are specially invoked to present and protect their results in form of scientific publications and/or public presentations. **Personal Competence (academic self-conception, professionalism)** Students ...: • have knowledges and abilities in project and time management that allow them to work out large scientific results in the given period. • are able to talk in trade public.
Content of Module	The contents of this curricular unit must be seen, not as pre-defined topics, but as technical and scientific guidelines whose substance is defined in each case, within each tutorial and according to the student's work process in a specific subject area is consistent with the purpose of ensuring and promoting the development of a master thesis or a scientifically informed project and applied to a specific object or domain. The Supervisor must therefore ensure that the student develops a dissertation or project of high quality, stimulating their analytical, critical thinking, and that their are able to communicate effectively and rigorously the results of their work and that they are innovative from the point of view of knowledge, institutions and / or practices.
Applicability of Module	
Requirements for the award of credit points / **Type of Assessment**	The aim of developing a scientific thesis or a scientifically informed intervention project, both in the area of specialty of this 2nd cycle of studies, is consistent with the methodology of tutorial and close supervision held by a teacher with PhD or specialist of recognized merit in the subject area of the dissertation or project.
Related Courses	
Type of course and media	This curricular unit, given its specificity, don't have any syllabus predefined as similar to other courses. The contents to be considered by the supervisor are defined according to the development specificities and needs of each dissertation or project. In general, the program consists in technical and scientific guidance necessary to perform the dissertation or project for the master's degree. Particularly, for theoretical and methodological and technical drawing, internal organization, in fulfil the necessary academic conventions and / or professional and to keep the high standard of accuracy, quality and timeliness of each scientific and professional work.

Master-programme: European Master of Medical Technology and Healthcare Business (EMMaH), M.Sc. **Module: Master thesis**	
Literature	Basten, G. (2010). Introduction to scientific research projects. Ventus Publishing ApS. Laake, P., Benestad, H. B., & Olsen, B. R. (2007). Research methodology in the medical and biological sciences. Amsterdam: Elsevier, Academic Press. Outra bibliografia definida por cada docente supervisor em articulação estreita com o aluno, de acordo com a natureza e especificidades científicas da investigação ou projeto a desenvolver por cada estudante. Silverman, D. (2011). Interpreting qualitative data. Los Angeles: Sage.