**DESCRIPTION/Syllabi of Curricula/Module**

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| **Short Name of the University/Country codeDate (Month / Year)**  | **DUK****Jan 2019** |
| **TITLE OF THE MODULE** | **Code**  |
| Implantable sensors and systems |  |

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| **Teacher(s)** | **Department** |
| **Coordinating:** **Others:**   | Dep. for integrated sensor systems |

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| **Study cycle** **(BA/MA)** | **Level of the module** **(Semester number)** | **Type of the module****(compulsary/elective)** |
| Bachelor/Masters | 5th/6th semester (third year) for Bachelor, or any semester for Masters | Elective |

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| **Form of delivery****(theory/lab/exercises)** | **Duration** **(weeks/months)** | **Language(s)** |
| Lectures, laboratory |   | English |

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| **Prerequisites** |
| **Prerequisites:** Knowledge: basic knowledge on electronics, electrochemistry, chemistry and mechanicsSkills: noneCompetences: none | **Co-requisites (if necessary):** none |

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| **ECTS (Credits of the module)**  | **Total student workload hours** | **Contact hours** | **Individual work hours** |
| 3,5 | 77 | 20 | 40 |
| **Aim of the module (course unit): competences foreseen by the study programme** |
| Students should be able to:* Obtain a mutual understanding of the technical and biological aspects at the base of the working mechanisms of implantable sensors.
* Obtain the competences necessary for partaking in the design and development of implantable sensors
* Transfer notions and know-how to other working groups
* Perform practical exercises on selected examples
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| **Learning outcomes of module (course unit)** | **Teaching/learning methods****(theory, lab, exercises)** | **Assessment methods****(written exam, oral exam, reports)** |
| **Knowledge:**The students will obtain wide knowledge on the principles of sensing biological parameters related to the human body health. | Slides, lecture notes, suggested books and literature | Written/oral exam |
| **Skills:** Efficient topic discussion. Performing simple laboratory exercises. Team working | Lectures, laboratory groups | Laboratory reports  |
| **Competences:**Perform critical literature research on the subject, exchange notions, working in group | Laboratory groups | Laboratory reports |

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| **Themes** | **Contact work hours**  | **Time and tasks for individual work** |
| Lectures | Consultations | Seminars  | Practiacl work | Laboratory work | Placements | **Total contact work** | **Individual work** | **Tasks** |
| Introductory topics  | 2 |  |  |  |  |  | **2** | **3** | Learn why and for which pathologies implantable sensors are needed. Learn the sensor performance metrics commonly used. |
| Requirements for implantable sensors | 3 |  |  |  |  |  | **3** | 6 | Understand and learn the technical requirements for implantable sensors (low power, wireless interface…)Understand and learn what it is understood under “biocompatibility” in the general case of an implanted device (sensor in the specific). Understand and learn the sterilization techniques. |
| Electrical and physical sensors | 5 |  |  |  |  |  | **5** | **7** | Understand and learn about electrical bioimpedance, temperature sensors, MEMS-based motion sensors, strain and pressure sensors, neural interfaces (only brief overview), multi-parametric sensing systems |
| Electrochemical sensors | 5 |  |  |  |  |  | **5** | **7** | Understand and learn about potentiometric ionic sensing, amperometric sensors, voltammetry, and affinity-based biosensing |
| Optical sensors | 2 |  |  |  |  |  | **2** | **3** | Understand and learn about in vivo optical imaging techniques and implantable visual prosthetics |
| Laboratory units |  |  | 6 |  |  |  | **6** | **18** |  Unit on electrical sensors: analysis of tissue impedance with external electrodes Unit on electrochemistry: detection of enzyme activity through voltammetry/amperometry Unit on image processing: videos of blood microcirculation, red blood cell fluid paths identification.  |
| Final Exam | 2 |  |  |  |  |  | **2** | **8** |  |
| **Total** | **19** |  | **6** |  |  |  | **25** | **52** |  |

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| **Assessment strategy** | **Weight in %** | **Deadlines** | **Assessment criteria** |
| Laboratory units attendance and reports | 20 |  | Attendance and reports |
| Final exam | 80 |  | Test |

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| **Author** | **Year of issue** | **Title**  | **No of periodical or volume** | **Place of printing. Printing house or internet link** |
| **Compulsory literature** |
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| **Additional literature** |
| Yang, Guang-Zhong | 2018 | Implantable sensors and systems; from theory to practice | ISBN 987-3-319-69748-2 | Springer |
| Andreas Inmann, Diana Hodgins | 2013 | Implantable sensor systems for medical applications | ISBN 9781845699871 | Woodhead Publishing |