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## Research Master Neuroscience Programme

***Course Outline***

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| Course Code | RMNS-1.4 |
| Course Name | Sensorimotor systems |
| Teaching Methods | Lectures, presentations, workshops, self-study and group discussion |
| Aims of the Course | To outline the anatomical and functional organization of the various sensory systems. |
| Learning Goals | At the end of this module, the student can:<br>1. explain the anatomical circuits involved in the senses from the sensory neurons to the higher order brain regions.<br>2. explain the physiological processes underlying the reception of sensory input in each of the senses<br>3. describe the strategies the brain uses to compensate for self-motion<br>4. describe how volition becomes motor action from cortical regions down to the activation of synergistic muscles.<br>5. explain how movements can be controlled by feedback and feedforward circuits.<br>6. describe reflex pathways and the functioning of the brain regions involved in adjusting them<br>7. describe the common pathologies of the sensorimotor system and their cellular and subcellular origins<br>8. describe the computational elements involved in the sensory and motor systems.<br>9. understand stimulus encoding in primary sensory systems via spiking neuron models.<br>10. grasp the principles of sensorimotor processing via neural network models of compensatory eye motion. |
| Target Group | MSc Neuroscience students |
| Organisation | Erasmus MC – Department of Neuroscience |
| Level<br>Credits<br>Study load | 2 (Master)<br>7 ECs (duration: 8 weeks)<br>196 hrs |
| Testing: | Written exam, presentation |
| Language | English |
| Number of Participants | 1st year students MSc Neuroscience curriculum |
| Location | Erasmus MC – Education Center |
| Date | January / February |
| Registration | This course is part of the MSc Neuroscience curriculum. Separate registration is not necessary for admitted students |

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| Absent | If you are unable to attend class, you are kindly requested to report your absence in advance, via masterneuroscience@erasmusmc.nl. |
| Responsibility | Erasmus MC – Department of Neuroscience |
| Coordination | Dr. M. Schonewille |
| Contact | E. Buitenhuis-Linssen<br>E-mail: masterneuroscience@erasmusmc.nl |
| Alumni | LinkedIn Group RM Neuroscience, Erasmus MC<br>https://www.linkedin.com/groups/8133912 |

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| ***Information*** | |
| | **Summary of the Course**<br>Building on the basic knowledge of anatomy and physiology, students will learn how sensory transduction is converted into motor outputs by the nervous system and how brain regions and cell-types are specialized to perform specific elements of these computations. |
| | **Teaching Methods**<br>Lectures, presentations, workshops, self-study and group discussion. |
| ***Programme*** | |
| | **Content**<br>This module will start with the sensory system. Here, for the visual system we will follow the information processing the retina up to information processing in the thalamus and visual cortical areas, zooming in on the dorsal and ventral visual pathways and the resulting visual perception. For the auditory system the focus will also be on the information processing from the cochlea up to auditory cortical areas. A similar approach is used for the vestibular system. Emphasis will be put on the analogy between these systems in terms of labeled line theories. We will also focus on the functional organization of the two main somato-sensory systems: the epicritic system and the protopathic system. First the basic principles that underlie these systems, like modality, location, intensity and duration are addressed. Next, the different pathways and connections at the main anatomical levels (spinal cord, brainstem, thalamus and cortex) will be presented as well as the type of processing that occurs at each level. Finally, two non-human sensory systems, whiskers and the lateral line, are discussed. Based on these systems, the mechanisms involved in correction for self-motion will be addressed.<br>The motor part of this module starts with an introduction of the neurobiology of movement control, discussing the different types of movements (reflexive, rhythmic, voluntary), the principal CNS regions that control these movements, and some of the psycho-physical principles that may govern voluntary movements. The special case of eye movements is discussed because of their crucial role in active vision. Subsequently, the course will focus on the properties of the musculoskeletal system and functional units that execute movements: the motor-units, i.e. the motoneurons and the muscle fibers they innervate. Finally, disease of the motoneurons and the skeletal muscles that lead to muscle weakness are discussed. The analogy with simple control systems and the relation with the somatotopy found in the brain are discussed.<br>Finally, the program aims to build on the computational understandings obtained in the previous modules to generate a deeper understanding of sensorimotor information processing. Models of spiking neurons are discussed in the context of sensory encoding and motor behavior. At the systems levels, different aspects of sensorimotor integration are addressed in relation to potential type of learning and the related models. |

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| | **Duration of the Course**<br>8 weeks |
| | **Expected Resources for Students**<br>▪ Purves (6th edition), selected chapters, Kandel (5th edition): selected chapters<br>▪ Handouts provided by coordinator |
| | **Teachers**<br>Dr. M. Schonewille. Dr. M de Jeu, Dr. M. Negrello & team |
| | **Graduate Attributes**<br>Upon completion of this course, if you have attended and actively participated in the classes, and when you passed the exam presentation and written exam with sufficient results, you are awarded 7 ECs. |
| ***Testing and Assessments*** | |
| | **Testing**<br>The written exam with multiple choice and essay questions. The exam will cover all learning goals, with max. 10 points for each goal (max. 10p total).<br>The presentation will be graded by two assessors, based on content and style of presentation. |
| | **Testing Procedure**<br>Both tests will be assessed by two MSc faculty members. You will receive a grade on a scale from 1 (worst) to 10 (best).<br>Grade appeal is subject to the rules laid out in the Teaching and Examinations Regulations of Erasmus MC. For every component of the exam a 5,5 or higher must be scored. |
| ***Quality Management*** | |
| | **Course evaluation and development**<br>The MSc programme co-ordinators are open for suggestions from course participants on possible improvements. Course adjustments can be made on the basis of your direct feedback. Additionally, at the end of the course, you will receive an invitation for an online survey on the contents and setup of the course.<br><br>Course contents and setup are re-evaluated periodically, at least once a year, by the course directors and MSc programme chair members. |
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