Neural engineering

Academic Year: (2022 / 2023)   Review date: 20-06-2022

Department assigned to the subject: Department of Bioengineering and Aerospace Engineering

Coordinating teacher: VAQUERO LOPEZ, JUAN JOSE

Type: Electives ECTS Credits : 6.0

Year :   Semester :

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

It is recommended to have completed the following courses:

- Biophysics 1: Molecular, cell and tissue physical biology
- Signals, systems and circuits
- Advanced sensors and measurement techniques

DESCRIPTION OF CONTENTS: PROGRAMME

1. INTRODUCTION TO NEUROPHYSIOLOGY

- Neurons, Synapses, Neuronal Circuits, and Central Nervous System
- Sensory Systems
- Somatosensory System
- Motor System
- Complex Integrative Functions of the Motor System
- Autonomic Nervous System
- Vision
- Sound and Hearing

2. NEURAL MODELLING

- Excitability
- Propagating Activity
- Channels and Electrical Activity
- Nonlinear Dendritic Processing
- Neural Models
- Neural Information Processing
- Neural Tissue Engineering

3. BRAIN IMAGING

- Introduction to brain imaging
- Magnetic resonance imaging
- Electroencephalography
- Magnetoencephalography

4. BRAIN NETWORKS

- The connectome
- Anatomical brain networks
- Functional brain networks
- Aging and disease

5. BRAIN-COMPUTER INTERFACES

- Definition and Structure

- Signal Acquisition
- Signal Processing
- BCI Applications

6. BRAIN-MACHINE INTERFACES

- Motor BMI
- Decoding Approaches
- Neural Signals for Motor BMI
- Input-Output Modelling

7. MANAGING INJURIES OF THE NERVOUS SYSTEM

- Seizure Prediction
- Neural Modulation
- Sensory Prostheses
- Motor Prostheses

LEARNING ACTIVITIES AND METHODOLOGY

AF1. THEORETICAL-PRACTICAL CLASSES. Knowledge and concepts students mustacquire. Receive course notes and will have basic reference texts.Students partake in exercises to resolve practical problems.

AF2. TUTORING SESSIONS. Individualized attendance (individual tutoring) or in-group (group tutoring) for students with a teacher.Subjects with 6 credits have 4 hours of tutoring/ 100% on- site attendance.

AF3. STUDENT INDIVIDUAL WORK OR GROUP WORK.Subjects with 6 credits have 98 hours/0% on-site.

AF8. WORKSHOPS AND LABORATORY SESSIONS. Subjects with 3 credits have 4 hours with 100% on-site instruction. Subjects with 6 credits have 8 hours/100% on-site instruction.

AF9. FINAL EXAM. Global assessment of knowledge, skills and capacities acquired throughout the course. It entails 4 hours/100% on-site.

AF8. WORKSHOPS AND LABORATORY SESSIONS. Subjects with 3 credits have 4 hours with 100% on-site instruction. Subjects with 6 credits have 8 hours/100% on-site instruction.

MD1. THEORY CLASS. Classroom presentations by the teacher with IT and audiovisual support in which the subject`s main concepts are developed, while providing material and bibliography to complement student learning.

MD2. PRACTICAL CLASS. Resolution of practical cases and problem, posed by the teacher, and carried out individually or in a group.

MD3. TUTORING SESSIONS. Individualized attendance (individual tutoring sessions) or in-group (group tutoring sessions) for students with teacher as tutor. Subjects with 6 credits have 4 hours of tutoring/100% on-site.

MD6. LABORATORY PRACTICAL SESSIONS. Applied/experimental learning/teaching in workshops and laboratories under the tutor's supervision.

ASSESSMENT SYSTEM

SE1. FINAL EXAM. Global assessment of knowledge, skills and capacities acquired throughout the course.The percentage of the evaluation varies for each subject between 60% and 0%.

SE2. CONTINUOUS EVALUATION. Assesses papers, projects, class presentations, debates, exercises, internships and workshops throughout the course.The percentage of the evaluation varies for each subject between 40% and 100% of the final grade.

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

BASIC BIBLIOGRAPHY

- Bin He, editor Neural Engineering, Springer, 2013

- Eliasmith, C., & Anderson, C. H. Neural engineering: Computation, representation, and dynamics in neurobiological systems, MIT Press, 2004