GE1322: INTRODUCTION TO HUMAN BIONICS

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Introduction to Human Bionics

Subject Code
GE - Gateway Education
Course Number
1322

Academic Unit
Electrical Engineering (EE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

GE Area (Primary)
Area 3 - Science and Technology

GE Area (Secondary)
Area 2 - Study of Societies, Social and Business Organisations

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

Can we upload our consciousness to the internet? Are the tactics in Sci-Fi movies unimaginable? Does pop culture inspire front-end science or vice versa? Today, the human brain can control computer cursors and manipulate the directions of wheelchairs. Conversely, can a machine feed data into the human brain to enhance its performance? This course introduces human bionics, and particularly neural interface as a communication channel in the context of gaming industry, patient care, sports enhancement, military field, and daily routines. The students enrolled in this course will learn the science and operating principles behind human bionics. Furthermore, this course will address how popular culture shaped the public' s perception of science, the regulation involved in technology transfer, and the ethical consideration of brain-machine interaction. It is an introductory course to promote the awareness of realizing human bionics in this era.

This course aims to encourage intellectual exchange between students in biology and engineering with students in humanities and social science in the context of human bionics. That will enable students to gain insight into the impact on human health care through medicine and technology and translate abstract scientific knowledge into working systems. After taking this course, students will better understand fundamental principles in biology and engineering in the broader context of societal needs, i.e., pop culture, technology transfer, and legal regulation.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Explain basic neuroscience and the general technology enabling human bionics	25		x	
2	Evaluate the knowledge of human bionics	25	x		
3	Justify the use of human bionics and related ethical issues	25		x	x
4	Describe the process of commercialization, clinical implementation and approval	25		x	

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Teaching and Learning Activities (TLAs)

	TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Key concepts are described and illustrated	1, 2, 4	3hr/13 week
2	Labs	Illustrations and hands-on practice of technologies related to human bionics	3	3hr/2 weeks
3	In-Class Activities	Discussions on ethical and social impacts	3, 4	3hr

4	Group presentation	Group project presentations at the end of the semester	1, 2, 3, 4	3hr

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Tests (min. 2)	1, 2, 4	30	
2	Writing Assignment - Technologies behind human bionics: Students will submit a writing assignment to review the existing human bionics technology, and discuss the impact of technology involved.	3, 4	10	
3	Laboratory and In-Class Activities Students will also conduct laboratory and in-class activities related to neural interface.	1, 2, 3, 4	15	
4	Group Project - Infomercial: Students are required to work on a group project. The project requires student to present innovative ideas on designing new application for the human bionics that will be beneficial to the society (health-care sector, entertainment sector etc). There will be a short presentation of their topic.	1, 2	15	
5	A final exam on the working principles of human bionics technologies, applications of brain computer interface, medical device regulatory and ethics will be conducted for non-technical individual.	1, 2, 3, 4		

Continuous Assessment (%)

70

Examination (%)

30

Examination Duration (Hours)

2

Additional Information for ATs

Remark:
To pass the course, students are required to achieve at least 30% in continuous assessment i.e. projects and 30% of the examination.

Marks will be deducted for students fail to meet the lab attendance requirement. Cutoffs between letter grades will be set at the end of the semester. The grade distribution is not set in advance.

Assessment Rubrics (AR)

Assessment Task

Coursework

Criterion

Ability to explain the working principles, and evaluate the social impact of brain-machine interface technologies

Excellent (A+, A, A-)

Students not only show a thorough understanding on all of the CILOS, but also able to show independent thinking on other brain-machine interface not covered inside classroom

Good (B+, B, B-)

Students show a thorough understanding on all of the CILOS, able to explain the interconnection of the science behind the brain-machine interface with the popular culture, commerce and social communities.

Fair (C+, C, C-)

Students show a general understanding on most of the CILOS, able to highlight a few examples covered in the classroom

Marginal (D)

Students show a limited understanding on some of the CILOS, incapable of completing the group project

Failure (F)

Student fails to show a limited understanding on any of the CILOS, and fail to submit any group project

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Assessment Task

Final Exam

Criterion

Ability to explain the working principles, and evaluate the social impact of neural interface technologies

Excellent (A+, A, A-)

Students not only show a thorough understanding on all of the CILOS, but also able to show independent thinking on other neural interface not covered inside classroom

Good (B+, B, B-)

Students show a thorough understanding on all of the CILOS, able to explain the interconnection of the science behind neural interface with the popular culture, commerce and social communities.

Fair (C+, C, C-)
Students show a general understanding on most of the CILOS, able to highlight a few examples covered in the classroom

Marginal (D)
Students show a limited understanding on some of the CILOS, incapable of completing the group project

Failure (F)
Student fails to show a limited understanding on any of the CILOS, and fail to submit any group project

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Part III Other Information

Keyword Syllabus
Human bionics, brain-machine interface, brain-computer interface, neuro-prostheses, neuroscience, biomedical engineering, neural engineering, technology commercialization, popular culture

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Chang S. Nam, Anton Nijholt, Fabien Lotte, "Brain–Computer Interfaces Handbook: Technological and Theoretical Advances" (CRC Press, 2018)
2	Miguel Nicolelis, "Beyond Boundaries: The New Neuroscience of Connecting Brains with Machines - and How It Will Change Our Lives" (New York : Times Books, 2011, 1st ed.) - MN
3	Ray Kurzweil, "The Singularity is Near: When Humans Transcend Biology" (New York : Penguin, 2006) - RK
4	Peter Dayan and L. F. Abbott, "Theoretical Neuroscience: Computational and Mathematical Modeling of Neural Systems" (Massachusetts Institute of Technology Press, c2001) – PD
5	Eric R. Kandel, James H. Schwartz, and Thomas M. Jessell, "Principles of Neural Science" (Appleton & Lange, c1991) – ERK
6	Antonio R. Damasio, "Self Comes to Mind: Constructing the Conscious Brain" (Pantheon, 2010, 1st ed.) - ARD

Annex (for GE courses only)

A. Please specify the Gateway Education Programme Intended Learning Outcomes (PILOs) that the course is aligned to and relate them to the CILOs stated in Part II, Section 2 of this form:

Please indicate which CILO(s) is/are related to this PILO, if any (can be more than one CILOs in each PILO)

PILO 1: Demonstrate the capacity for self-directed learning
1, 2, 3, 4

PILO 3: Demonstrate critical thinking skills
3, 4

PILO 5: Produce structured, well-organised and fluent text
1, 3

PILO 6: Demonstrate effective oral communication skills
2

PILO 7: Demonstrate an ability to work effectively in a team

2

PILO 9: Value ethical and socially responsible actions

3, 4

B. Please select an assessment task for collecting evidence of student achievement for quality assurance purposes. Please retain at least one sample of student achievement across a period of three years.

Selected Assessment Task

Writing Assignment: Students are required to review the existing brain-machine interface technology and choose their favorite brain-machine interface, and discuss the impact of the popular culture on the technology involved.