Artificial Intelligence in Medical Sciences (PhD)

Total Course Credits

The number of credits in this course is 40, which is as follows:

Compulsory (Core) credits	16
Optional (Non-core) credits	6
Dissertation	18
Total	40 Credits

Program Description

Artificial intelligence is to study and develop machines (computers, robots and physical systems) that can carry out tasks commonly dependent on human intelligence such as seeing, understanding, recognition, communication, decision making and translating languages independently without the human assistance. Artificial intelligence systems are called systems that can be similar to human intelligent behaviors, including understanding complex conditions, simulating thinking processes and human reasoning practices and their response to them, learning and the ability to gain knowledge and reason for solving issues.

Definition

Artificial Intelligence in Medical Sciences specifically is focusing and developing applications of artificial intelligence in medical sciences such as predicting, prevention, diagnosis and treatment of diseases, its use in areas such as pharmacy, psychiatry, rehabilitation, making smart monitoring device health, building robots and devices help patients and people with disabilities and build devices for promoting the human senses.

Aim

- Training the creative force and processor to increase the efficiency of information in the field of health
- Organizing the information storage and facilitating access to them in health fields
- Processing and converting data collected in the health area to quantitative information required for treatment staff to distinguish, predict and provide effective treatment
- Reducing the risk of diagnostic and therapeutic errors and reducing medical costs
- Eliminating the limitation of providing medical treatments to help patients who are not allowed to attend a specialist doctor and help treat patients through developed diagnostic and therapeutic methods developed by artificial intelligence as well as products produced with artificial intelligence knowledge.

- Qualitative and quantitative provision of health care services with reduced related costs
- Using current developed models or new models in artificial intelligence to solve the issues of medical sciences and meet the needs of this area

Admission Requirements

Acceptance in the entrance exam is in accordance with the Ministry of Health, Treatment and Medical Education.

The volunteers entered the doctorate of artificial intelligence in medical sciences should have one of the following academic degrees:

Graduates of General Practitioner (Medicine, Dentistry and Pharmacy)

Masters of Computer Sciences, Computer Engineering (all specialties and fields), Electrical Engineering (all fields), Medical Engineering (all fields), Mechanical Engineering (Biomechanical field, Applied Design and Mechatronics), Bioinformatics and Medical Biotechnology can participate in the entrance exam.

Expected Competencies at the End of the Program
General Competencies*

The expected public capabilities for graduates of this field are:

- Communication skills- effective interdisciplinary interaction
- Acquiring the ability to instruct artificial intelligence courses in medical sciences
- Accomplishing research and writing scientific articles on the use of artificial intelligence knowledge in medical sciences
- Critical thinking and problem solving skills to help early diagnosis of diseases and predicting the effect of treatment, lowering cost and risk by modeling facts
- Management skills (policy, planning, organizing, monitoring, and control, evaluation) founded on evidence-based issues
- Professionalism

Specific Competencies and Skills

Expected capabilities and professional tasks for graduates of this field are:

Exclusive Capabilities	**Duties**	**Lesson Code(s)**
Communication skills and interaction	Effective interdisciplinary relationship in the field of health	Project related to lesson 5, 10, 11, 12

Educational skills	Ability to program and apply specialized software, extracting the pattern of bulky medical data in order to detect and predict diseases	11
	The ability to program and use specialized software, processing software and quantitative quantification by extracting functional patterns in order to detect and use in treatment.	13
	The ability to program and apply specialized software, processing software for quantifying these data, including the volume, thickness for diagnostic applications in radiology and neurology and neurological surgery	13
	The ability to program and apply specialized software modeling in virtual environments and designing educational and therapeutic systems in these environments	14
	Computational modeling skills of medical data	5, 10, 11, 12
	Performing complex mathematical calculations on medical bulk data and their statistical analysis to help diagnose, predict and control the treatment process	4
Research skills	Modeling facts and cases in medical issues that involve high risk and expenses for implementation.	10, 11, 12, 14
	Ability to use biosensors and remote sensing methods to help diagnose and control the treatment process	7, 19, 23, 27
	Setting up and working with data and processing servers	4, 5, 3
	Acquiring skills in using moving robots in medicine and rehabilitation	07

	Design of environments for medical applications such as brain and car interface algorithms **brain–computer interface** (**BCI**)	14, 29
	Designing new systems and algorithms for diagnostic assistance and financial process control	9
	Designing, implementing and monitoring big data mining in medical sciences	PhD thesis
Critical thinking and problem-solving skills	Problem solving skills to help early diagnosis of diseases and predicting the effect of treatment Lowering the cost and risk by modeling the realities	10, 11, 12, 14 PhD thesis
Professional commitment	Practical training by clinical training	Workshops, PhD thesis

Expected Procedural Skills

Skill	**Minimum Number of Skills to Learn**			
	Observation	**Assistance**	**Performed Independently**	**Total Times**
Programming and Application of Specialized Software for Extraction from Big Medical Data to Diagnosis and Predicting Diseases	2	-	4	6
Programming and application of specialized software processing and quantifying them by extracting applied patterns in order to diagnose and use in treatment	2	-	2	4

Programming and application of specialized software processing of medical images to quantify data, including the volume, thickness for diagnostic applications in radiology and neurology and neurological surgery	2	1	2	5
Designing intermediate environments for medical applications such as brain-computer interference algorithms	1	1	1	3
Performing complex mathematical calculations on medical data and their statistical analysis to help diagnose, predict and control of the treatment process	1	1	1	3
Design of new systems and algorithms of diagnostic and processing therapeutic process	1	1	1	3
Applying biosensors and remote sensing methods to help diagnose and control of the treatment process	1	-	1	2
Performing and working with data and processing servers	-	1	-	1
Programming and applying mobile robots in medicine and rehabilitation	-	1	-	1
Programming and applying specialized Software Modeling Reality in Virtual Environment and Designing Educational and Medical Systems in these environments	1	1	-	2

Educational Strategies, Methods and Techniques

This program is based on the following strategies:

- Task based education
- Problem based education
- Subject based education
- Evidence based education
- Simultaneous student- teacher based education
- Hospital based education
- Lab based education

Methods and Techniques

In this course, the following methods and techniques will be used:

Different types of intra-departmental, inter-departmental wards, hospitals, interdisciplinary, and inter- university seminar conferences

Discussion in small groups, training workshops, the journal clubs, and reading book, case presentation

Entrepreneurship, outpatient education, research laboratories

Using Simulation and Remote Training Techniques in terms of facilities

Participation in lower classes

Self-study, self-education

Other necessary educational techniques and methods and educational goals

It is expected that students:

comply with the patients' legal charter (1).

consider the provisions associated with the protection and safety of patients, employees and work environments in a precisely respected way (these regulations are reviewed by the relevant educational group).

observe regulations associated with the Dress Code (2).

consider professionalism

protect resources and equipment used under any circumstances

respect the professors, employees and learners and participate in the creation of intimate and respectful atmosphere in the workplace.

consider ethical, social and professional attentions in the critique of programs.

should observe research ethical laws in conducting research related to the discipline.

Student Assessment (Methods and Types)

The assessment program:

The student will be evaluated in the following methods:

Written ■ oral ■ computer-interactive based test ■ DOPS ■ 360 degree evaluation ■ Portfolio ■

Evaluating based on portfolio, includes the evaluation of the log book, the results of the tests, articles, advancements, and remarks, certificates etc.

Evaluation

continuous■ periodic■ final■

In-group tests are available to the educational group.

According to the selected research area of students in this major, and with the supervisor guidance, each student is required to provide specialized services related to its research field during the doctoral period in the centers.

Tables of the Courses

Table 1. Compensatory Courses in:

Code	Subject	Number of Course Credits			Number of Course Hours			Prerequisite or Concurrent
		Practice	Theory	Total	Practice	Theory	Total	
01	Neurophysiology & Neuroanatomy	--	2	2	--	34	34	-
02	Cellular & Molecular Neurobiology	--	2	2	--	34	34	-
03	Basic of Machine Learning	--	2	2	--	34	34	-
04	Advanced Statistics & Research Methodology	--	2	2	--	34	34	-
05	Matlab & Python Programming	2	--	2	64	--	64	-
06	Basic Digital Signal Processing	--	2	2	--	34	34	-
07	Principles of Robotic Applications in Medical Sciences	1	1	2	23	17	51	-
08	Medical Information Systems*	0.5	0.5	1	17	9	26	-
Total		15						-

In addition to the course credits, student is required to take a maximum of 12 credits of compensatory courses at the discretion of the department and with the approval of the University Graduate Council.

*Passing this course is mandatory for all students who have not passed it before, as a compensation course.

Table 2. Core Courses in:

Code	Subject	Number of Course Credits			Number of Course Hours			Prerequisite or Concurrent
		Practice	Theory	Practice	Theory	Practice	Theory	
09	Principles of Neuroscience	--	2	2	--	34	34	01 & 02
10	Technology & the Future of Medicine	--	2	2	--	34	34	--
11	Real & Artificial Neural Networks	1	1	2	34	17	51	03 & 04
12	Big Data in Medicine	1	2	3	34	34	68	03 & 04
13	Computational Neuroscience	1	1	2	34	17	51	01 & 02 & 04
14	Biomedical Signal & Image Processing	1	2	3	34	34	68	06
15	Intelligent Interfaces in Medical Sciences	1	1	2	34	17	51	05 & 07
Total		16						

Table 3. Non-Core Courses in:

Code	Subject	Number of Course Credits			Number of Course Hours			Prerequisite or Concurrent
		Practice	Theory	Practice	Theory	Practice	Theory	
16	Computational Medicine	1	2	3	34	34	68	04
17	Neuroimaging	1	2	3	34	34	68	01 & 06
18	Fuzzy Logic in Medical Decision Analysis	1	2	3	34	34	68	04
19	Advanced Data Mining in Medical Sciences	1	2	3	34	34	68	03 & 04 & 05
20	Remote Sensing in Medical Sciences	--	2	2	--	34	34	05 & 06
21	Medical Expert Systems	--	2	2	--	34	34	03
22	Clinical Image Processing	1	2	3	34	34	68	01 & 06
23	Natural Language Processing	--	2	2	--	34	34	03
24	Biosensors	--	2	2	--	34	34	14
25	Cognitive Neuroscience	--	3	3	--	51	51	01
26	Bioinformatics	1	1	2	34	17	51	02 & 04
27	Game Theory	--	3	3	--	51	51	04

28	Medical Data Bank Security	--	3	3	--	51	51	12
29	Mobile Robots in Medical Sciences	1	2	3	34	34	68	--
30	Brain Computer Interface	1	2	3	34	34	68	01 & 15
31	Special Topics in Computing, Artificial Intelligence and Cognition	--	2	2	--	34	34	--
Total		42						

Student must pass 6 credits of the courses in this table, in accordance with the topic of his / her dissertation, the approval of the supervisor and the approval of the University Graduate Council.