Wrocław University of Science and Technology
Doctoral School

COURSE CARD

1. Basic information

Course name in English:	*Digital healthcare: conceptual approaches, technological and computational challenges*	
Course name in Polish:	Cyfrowa opieka zdrowotna: podejścia koncepcyjne, wyzwania technologiczne i obliczeniowe.	
Number of hours:	30	
Type of course:	Elective course	
Form of course:	mixed forms (combination of lecture, seminar and laboratory)	
Code of course:		
Course leader:	Dr. Remigiusz Szczepanowski, DSc *Surname*	
Faculty of the course leader:	W4 Faculty of Information and Communication Technology	
Email address of the course leader:	Remigiusz.szczepanowski@pwr.edu.pl	
Scientific discipline(s) assigned to the course (doctoral students representing the marked disciplines can participate in the course):	Architecture and urban planning	☐
	Automation, electronic, electrical engineering and space technologies	☐
	Information and communication technology	☒
	Biomedical engineering	☒
	Chemical engineering	☐
	Civil engineering, geodesy and transport	☐
	Materials engineering	☐
	Mechanical engineering	☐
	Environmental engineering, mining, and energy	☐
	Mathematics	☐
	Chemical sciences	☐
	Physical sciences	☐
	Management and quality studies	☐

2. Objectives

Increasing demand and costs of health care, aging population, shortages of medical staff contribute to the search for new, smarter healthcare systems. Modern medical technologies based on artificial intelligence, big data, and machine learning effectively solve problems in terms of disease progression, early diagnosis, and personalized care. Digital platforms can enable patients with chronic diseases to benefit from remote rehabilitation and secondary prevention. Smartphones have shown the potential to obtain real-time patient data (e.g., electrocardiograms), and smartwatches proved to be effective in detecting cardiac diseases. Machine learning, data mining, and data visualization can be used to derive real-world evidence from diverse healthcare data sources to provide personalized decision support for care delivery and care management. Computational phenotyping supports meaningful data-driven representations and patterns of chronic diseases. The course will discuss practical applications of new computational modeling and digital technologies in healthcare regarding

disease detection, clinical decision-making, disease progression, intervention recommendation, future risk prediction, and hospital workflow efficiency.

3. Content

Detailed information about the course content, including topics and form of classes.

No.	Topic	Number of hours	Form of classes
1	Introduction to digital healthcare	2	seminar
2	Application of artificial intelligence in medicine	2	seminar
3	Digital health technologies in personalized healthcare	2	seminar
4	Intelligent data visualization in healthcare	2	seminar
5	Data-driven analytics for personalized healthcare	2	seminar
6	Machine learning, big data and cloud computing in medical applications	2	seminar
7	Health digital platforms	2	seminar
8	Applications of personal monitoring devices and the Internet of Things in medicine	2	seminar
9	Machine learning of disease progression models	2	seminar
10	Identifying risk factors using electronic health records	2	seminar
11	Digital medicine: opportunities for disease prevention	2	seminar
12	Computational phenotyping in healthcare	2	seminar
13	Applying machine learning to monitor physiological data and intensive medical care	2	seminar
14	Application of digital healthcare in cardiology	2	seminar
15	Summary of the course	2	seminar

4. Prerequisites

List of prerequisites relating to knowledge, skills and other competences for course participants.

The course will allow students to:

To gain knowledge of the latest medical and information technologies in healthcare, including telemedicine tools, communication technologies, artificial intelligence, machine learning, big data

To gain information on the practical application of digital health in diagnosing conditions and early treatment, improving nursing care, supervising patients with chronic disease, optimizing the health care system, and supporting and caring for patients with disabilities and the elderly.

To gain knowledge in integrating, analyzing, and interpreting medical data, imaging data, or data from procedures, etc.

To get acquainted with intelligent solutions in digital healthcare in the field of drug dosage algorithms, algorithms to improve patient monitoring, algorithms to manage the healing process, medical decision support systems

5. Learning outcomes

List of learning outcomes at level 8 of the Polish Qualifications Framework assigned to the course (mark the learning outcomes in the last column).

Symbol	Learning outcome	
	KNOWLEDGE. Doctoral student knows and understands:	
SzD_W3	the main trends in the development of the scientific or artistic disciplines covered in the curricula;	☒
SzD_W4	research methodology;	☒
SzD_W5	the rules for the dissemination of scientific results, including in open access mode;	☒
SzD_W6	the fundamental dilemmas of modern civilization;	☒
SzD_W7	the legal and ethical conditions of scientific activity;	☒
SzD_W8	the economic and other relevant conditions of scientific activity;	☐
SzD_W9	basic principles of knowledge transfer to the economic and social spheres and commercialisation of results of scientific activity and know-how related to these results.	☐
	SKILLS. Doctoral student is able to:	
SzD_U2	use knowledge from different fields of science or art to creatively identify, formulate and innovatively solve complex problems or perform research tasks, in particular: - define the purpose and subject of scientific research, formulate a research hypothesis, - develop research methods, techniques and tools, and use them creatively, - draw conclusions on the basis of scientific research; critically analyse and evaluate the results of scientific research, expertise and other creative work and their contribution to knowledge development; transfer the results of scientific activities to the economic and social spheres;	☒
SzD_U3	communicate on specialised topics to the extent that they enable an active participation in the international scientific community;	☒
SzD_U4	disseminate research results, including in popular forms;	☐
SzD_U5	initiate debates and participate in a scientific discourse;	☒

SzD_U6	be able to speak a foreign language at B2 level of the Common European Framework of Reference for Languages to a level that enables them to participate in the international scientific and professional environment;	☐
SzD_U7	plan and implement an individual or collective research or creative activity, including in an international environment;	☒
SzD_U8	independently plan and act for one's own development and inspire and organize the development of others;	☐
SzD_U9	plan classes or groups of classes and implement them using modern methods and tools.	☒
	SOCIAL COMPETENCES. Doctoral student is ready to:	
SzD_K3	fulfilling the social obligations of researchers and creators, initiate public interest activities, thinking and acting in an entrepreneurial way;	☒
SzD_K4	maintaining and developing the ethos of research and creative environments, including: - carrying out scientific activities in an independent manner, - respecting the principle of public ownership of research results, taking into account the principles of intellectual property protection.	☒

6. Evaluation

Short description of the method(s) used to evaluate the learning outcomes assigned to the course, e.g., exam, test, report, presentation, etc.

test, developing written document on digital healthcare application, Journal club speech (scientific analysis and public presentation of selected scientific article)

7. Teaching methods

Short description of the teaching methods used during the course, e.g., multimedia presentation, discussion, literature studies, developing written documents, own work, etc.

Multimedia presentation, discussion, literature studies, developing written documents, own work

8. Literature

List of primary and secondary literature used to prepare the course and including additional knowledge for participants, e.g., books, textbooks, research papers, standards, web pages, etc.

1. Hoyt, R. E., & Yoshihashi, A. K. (2014). *Health informatics: practical guide for healthcare and information technoloy professionals*. Lulu. com.
2. Natarajan, P., Frenzel, J. C., & Smaltz, D. H. (2017). *Demystifying big data and machine learning for healthcare*. CRC Press.
3. Sarecka-Hujar, B., Ostróżka-Cieślik, A., & Banyś, A. (2016). Innowacyjne technologie w medycynie i farmacji. *Acta Bio-Optica et Informatica Medica. Inżynieria Biomedyczna*, *22*(1), 9-17.

9. Other remarks

Additional remarks, comments, (e.g., language of the course)

The course will be held in English.