Outline of the Ph.D. Program in Humanics

- **Program Coordinator: Masashi Yanagisawa**
  (Director, International Institute for Integrative Sleep Medicine)
- **Degrees Conferred:**
  Ph.D. in Medical Sciences, Ph.D. in Science, Ph.D. in Engineering
- **Enrollment: up to 15 /year** (from April 2019)

Doctoral talent cultivated in this program

The Ph.D. Program in Humanics cultivates leaders equipped with doctoral-level knowledge and skills in the fields of both biomedical sciences and physical sciences/engineering/informatics, together with the scientific expertise to achieve integration of these fields and the capacity to apply them in wider society. The program aims thereby to address challenges to human life and health and enable the sustainable prosperity of all humankind. The leaders fostered in this program are expected to become drivers of science and technology to surmount various challenges facing the world, including the onset of the super-aged society and the associated rise in medical costs and health insecurities, as well as increasing mental health problems. Resolution of these problems will require the capacity to combine the latest knowledge and technology from the field of biomedical science with cutting-edge knowledge and technology from different fields, employ the vocabulary of both fields to engage in dialogue between them, and apply deep insights into them in order to formulate new paradigms. Such paradigms can only be realized through outstanding ***bi-disciplinary expertise*** that integrates two different fields of research. Furthermore, it will be essential to seek out real-life applications for research findings on an ongoing basis, utilizing the specific capabilities of ***problem discovery*** (the capacity for conceptualization of research topics), ***breakthrough*** (the capacity to overcome difficulties sincerely and earnestly), and ***application*** (the capacity to communicate solutions to wider society and apply them in practice).

Through such initiatives as the Leading Graduate School Doctoral Program (PhD Program in Human Biology) and the World Premier International Research Center Initiative (WPI) (International Institute for Integrative Sleep Medicine), the University of Tsukuba has worked to develop interdisciplinary education and research in the field of biomedical sciences, and has achieved great progress therein. In the physical sciences/engineering/informatics field, the university has pioneered the field of cybernics, which incorporates insights from neuroscience, kinesiology, robotics, and other fields into cybernetics, leading to the development of revolutionary human assistive technologies such as the

HAL robotic suit.

Building on these strengths, this new program defines “humanics” as a discipline that sheds light on the fundamental principles of the physiology and pathology of the “human” as an individual organism, generating new science and technology to achieve a healthy and comfortable life of human beings. Through the development of expertise and applied skills, the program will cultivate individuals capable of independently uncovering basic principles of human life, creating systems to reconstitute and assess the validity of discovered principles, and building new theories of life. The candidates of this program will pursue research, for example, on problems such as decline in cognitive function and sleep disorders in the super-aged society, adding to their previous learning in the field of medicine with studies in engineering and information science, employing fundamental neurological principles to develop artificial neural network devices connectable to the human brain, and using them to advance understanding and control of sensitivity, motivation, ideation, and other mental functions. Others who have previously studied materials chemistry in the engineering field may study medicine and develop molecular robots capable of intervening in cellular functions, enabling understanding and control of the molecular mechanisms of infectious diseases, cancer, and other illnesses.

Characteristic Features, Excellence, Competitiveness, and Future Potential of the Program

1. Combination of biomedical sciences and physical sciences/engineering/informatics

The program will build structures for collaboration between the fields of biomedical sciences and physical sciences/engineering/informatics, through a variety of horizontal linkages with university research centers, centering on the internationally competitive and outstanding International Institute for Integrative Sleep Medicine, the Center for Cybernics Research that develops medical/nursing care robots and other cutting-edge human assistive technologies, and the Center for Computational Sciences and the Life Science Center for Survival Dynamics (TARA), both of which are working at the front lines of research internationally. Linkages will also be developed with national research and development corporations within the Tsukuba Science City (National Institute for Materials Science, National Institute of Advanced Industrial Science and Technology), international partner universities, and private companies.

2. Bi-disciplinary educational structure

The program will cultivate students’ bi-disciplinary expertise using a “**full double mentor system**” in which faculty members from the fields of both biomedical sciences and physical

sciences/engineering/informatics provide research guidance to students in their respective laboratories in the course of pursuing joint research projects.

3. Seamlessly integrated curriculum from pre-admission to graduate education

The program will create a seamlessly integrated system for transition to graduate school, whereby prospective students currently studying medicine or physical sciences/engineering/informatics are offered a pre-admission program on physical sciences/engineering/informatics or medicine as applicable. This is one approach to achieving a genuine MD-PhD combined program – something which has proven difficult in Japan thus far. This reform of graduate school admissions has the potential to become a leading model in interdisciplinary education through identification and nurturing of talented prospective candidates for admission, and educational intervention at the pre-admission stage.

4. Procurement of external resources in partnership with business and complete program self-sufficiency in future

During the period of government funding, resources shall be procured through such channels as special joint research projects with business. At the end of the period, complete self-sufficiency will be achieved with the establishment of the CYBERDYNE Ph.D. Program in Humanics (tentative name) through a corporate collaboration.

The Humanics Graduate Program

Cultivating outstanding doctoral talents to overcome intractable problems in human life and health: New "humanics" program integrates biomedical sciences and physical sciences/engineering/informatics

Ph.D. in Medical Sciences
Ph.D in Science
Ph.D in Engineering

Diploma

Int'l Institute for Integrative Sleep Medicine
World Premier International Research Center Initiative (WPI-IIIS)
Director: Masashi Yanagisawa

Cybernics
University of Tsukuba

Center for Cybernics Research
Japanese government Cabinet Office's Impulsing Paradigm Change through Disruptive Technologies Program (ImPACT)
Program Manager: Yoshiyuki Sankai

Doctoral research based on joint research integrating two fields

Double mentor/ reverse mentor systems
Years 3-5

Grad. School

Campus-in-Campus
University of California, Irvine
University of Bordeaux
National Taiwan University

QE

National R&D Corporation
National Institute for Materials Science (WPI-MANA)

Sciences/Engineering/ Informatics
Medical cybernics
Artificial intelligence
Computational biology
Numerical/statistical analysis
Biosignal processing
Organic materials chemistry
Nanomaterial engineering, etc.

Basic Medicine
Anatomy, physiology, pathology, pharmacology, immunology, etc.

Clinical Medicine
Basic knowledge of diagnosis and treatment in each organ system.
Social medicine, epidemiology, bedside, etc.

Practicum/ seminars/PBL
Years 1-2

Company-in-Campus

CYBERDYNE
Cyberdyne Inc.
(university venture)

HITACHI
Inspire the Next
Hitachi, Ltd.
(special joint research project)

TOYOTA
R&D Center for Strategic Frontiers in Social Planning
(Toyota Motor Corp.)

PMC
Research and Development Center for Precision Medicine
R&D Center for Precision Medicine
(iLAC Inc., Toyo Kohan Co.,Ltd., Shimadzu Corp.)

Admission

Pre-Admission Program

On-campus **Humanics Course**
Research lab seminars in each division
Off-campus (incl. overseas) **Boot Camp**
Courses provided through e-learning

Undergrad.

Physical Sciences/ Engineering/ Informatics

Medicine Biomedical Sciences

Others
University research centers (6)
National R&D corporations (2)
Private companies (3) incl. university ventures