Subject Description Form

Subject Code	BME1D02
Subject Title	**Wearable Healthcare and Fitness Devices for Everyone** (Eligible for English Writing (EW) and English Reading (ER) requirements)
Credit Value	3
Level	1
Pre-requisite / Co-requisite / Exclusion	Nil
Objectives	Wearable healthcare technology is becoming a hot commodity[*]. Applications include encouraging a person to walk more daily, maintaining a good posture, monitoring sleep condition, measuring vital health data like heart rate and electrocardiography (ECG), and assisting parents to take care of babies. This subject aims to enable student to 1) understand how current technology can be used to evaluate and improve health and fitness and why it is needed, gain real experiences in using state-of-the-art wearable devices, and 2) discuss the benefits, potentials, limitations, challenges, and future trends of such technologies, through lectures, tutorials, group discussion, and hands-on experience on wearable devices. A wearable device involves multidisciplinary efforts, from healthcare, sports, social science, engineering and technology, textile, design, branding, marketing, even fashion. We expect that students of this subjects will come from different majors and they will interact with each other in the class, group project, sharing sessions to enhance their study. Students will be encouraged to think critically how their own major studies can contribute to this rapidly growing area, and to predict the future trends in this area so as to inspire them for life-long learning on top of the skills of effective communication, learning materials acquiring and summarizing, problem solving, etc. [*]Sales of mobile wearable devices, including health and fitness devices, are expected to reach almost 70 million items by 2017, based on a new report from Juniper Research.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Comprehend the important healthcare data and fitness needs for different members of the public;

b. Appreciate the key functions and basic principles of various technologies that are used in wearable devices;

c. Follow the development, design, marketing, application of wearable devices from appropriate reading sources and physical products;

d. Critically review the strength and limitations of current wearable healthcare devices and predict future trend in this area.

In addition, this subject enhances literacy, higher order thinking and skills for life-long learning by:

Literacy: Students will read textbooks and research papers of about 200 pages. Some guidelines and lecture materials will be given to the students to facilitate their understanding and critical thinking of the contents that they read. Quizzes will be conducted to test the understanding of the textbooks and lecture materials. They will also write an academic essay of more than 2,500 words, showing their understanding of the subject and exercising their critical thinking on the wearables. Technology news and book chapters as reading materials will also be assigned to students, which arouse their learning interest and enhance comprehension of the lecture topics.

Higher order thinking: Students will relate and integrate different subject matters and think critically. Higher order thinking is facilitated when students integrate the knowledge of healthcare (outcome a) and technology (outcome b) in order to know about the principle behind the wearable healthcare device. Students will critically evaluate currently available and experimental wearable healthcare devices (outcome d) in group discussion, laboratory/practical work and preparing their assignments. A wearable device will be provided to each student to use throughout the semester, students have to use it, observe its function and application, think about its pro and cons, and share among students. The health information provided from the wearable will be submitted weekly by students throughout the semester. Students will learn and analyze the collected health and activities information for understanding their health status.

Skills for life-long learning: Students will develop a reading habit on books, research papers and technology news (outcome c) and a mind of asking and evaluating how things work (outcome d), which are essential as a life-long learner. Since students will use many items like wearable devices in their daily lifer after graduation, they will be inspired to think beyond the device, to dig into the working principles, pros and cons, future developments, etc. This will facilitate them to be a lifelong learner. In addition, students will be an active learner, which is an important aspect of life-long learning, in this subject. They will actively enquire, obtain, and share related information during the tutorial and group discussion and to critically evaluate them through guided discussion. What they gain will

	facilitate their preparation of the academic essay, thus reflecting their level of learning.
Subject Synopsis / Indicative Syllabus	Subject Synopsis Comprehension of basic healthcare data (Health Aspect) Students will comprehend some important healthcare data for different members of the public (including professionals, people of different age group and members with physical impairments and diseases). This includes heart rate, blood pressure, respiration rate, oxygen level, sugar level, ECG, EEG and EOG, which can be used to directly evaluate the health status of a person. The number of walking steps per day, level of physical activity and posture could reflect the overall fitness. This also includes subjective perception like perceived level of pain and tiredness. Appreciation of various technologies used for a wearable device (Technological Aspect) Students will comprehend the functions and some basic principles of different sensors, micro-motors and communication channels, that are used in wearable devices. These include accelerometers, optical sensor, GPS, various input methods, haptic technology (vibration), speaker, internet, and Bluetooth, etc. Student will also learn simple image and data processing as well as cloud-based big data analysis. Integration of health and technological knowledge in wearable healthcare devices Students will learn about the basic principles and the real applications of contemporary wearable healthcare devices in written forms and physical products. For example, they will be shown a wearable watch which remind people if they are physical inactive for a long time, an attachable device which remind people of poor posture, a goggle/helmet helping the blind to "see" what is around. They will learn to acquire and understand the information retrieved from the sensor built-in the wearables or using mobile phone apps. They will enter the Biomedical Engineering Laboratory to have hands-on experience on various wearable healthcare devices and/or analyze their health data using cloud platform. Potentials and limitations of emerging technologies Students will explore the various human and environmental factors influencing the sensor readings, the effectiveness of the feedback system in evaluating and improving health, and the responses of users of wearable devices. They will also discuss issues of data privacy, security, and overdependence of technology. Such explorations facilitate discussion on the advantages and disadvantages of various wearable healthcare devices. Wearables' technological limitations will be introduced. Various technologies measures will be discussed for overcoming the limitations including design and materials, harvesting energy from motion and environment, display, and input method etc.

How to make a wearable device product successful
A successful product can only be achieved when multiple factors work together, including technology development, intellectual protection, design, application needs, marketing strategy, etc. A number of successful cases in this areas will be shared, including Fitbit, Misfit, Apple Watch, etc. Visiting lecturers will share their business experience on applying wearables to improve their business outcome or marketing a new wearables.

Future development of wearable devices
Students will be encouraged to have critical thinking about the trend of future development based on what they learn and what they experience during the actual use of the wearable device. Various emerging and promising technologies will be introduced using latest research and development information to facilitate their imagination and critical thinking on the trend.

Hands-on experience in using a wearable device
Each student registered in this subject will be given with a wearable device (exact model and brand will be determined from time to time) throughout the whole semester (students can own the device after the semester if they pass the course). Students will be asked to share their first-hand experiences of using wearable device during group discussion and report. Demonstration of the use of different kind of wearables will be conducted in class.

Indicative Syllabus

- Introduction: technological approach in evaluating and enhancing health and fitness status
- Healthcare data: definitions, measurement methods (from conventional to more advanced), accuracy, normal aging effects, other factors influencing the measured data
- More comprehensive understanding on healthcare data: evaluation of health and fitness status, brief understanding on some diseases/disabilities that can be reflected by the healthcare data
- Basic concept of sensing technology: position, movement, force, electric signals, color detections and various input methods
- Basic concept of feedback technology: visual, auditory and vibration feedbacks as well as communications among various electronic components
- Basic concept of organ anatomy and different medical conditions on different disease and disabilities
- Understanding and evaluation of currently available wearable devices and smartphones that are used to evaluate and promote health and fitness for healthy and disabled people
- Emerging wearable technologies for healthcare use that are currently at the experimental stage
- Data privacy, security, accuracy of current technology, overdependence on technology, the difference between healthcare and medical use for data provided by wearable devices.

	▪ Design consideration and limitations on contemporary wearables; emerging technologies for overcoming the limitations ▪ First hand experiences in using a wearable device throughout the semester. ▪ Overview of IoT, and use of mobile phone as IoT for demonstration data acquisition, visualization and data repository.
Teaching / Learning Methodology	It is an introductory course for students from different educational backgrounds. It aims to facilitate students to gain basic healthcare and technology knowledge and to understand and evaluate wearable healthcare devices, which are becoming very hot topics of today. The **lecture** teaches knowledge about some most commonly used healthcare data, sensing and feedback technologies. Some **guided reading** and **self-study** will further extend their knowledge in respective areas. Group discussion among students are arranged in the class, on the topics related to technology, application, and the real experiences of students using wearable devices. Each student is provided with a wearable device that can record their daily activity and sleep pattern. Students submits their data for analysis, and the overall results are discussed in the class and also used as an example for big data analysis, which is introduce by an expert from a company. In addition, visiting lecturers are also invited to give talks from the industry and service sectors to introduce the latest development in the field and the challenges and needs in the service sectors. All these arrangements facilitate students for writing of the essay. In the group project, students need to work together on a topic to present the needs of a device or service, as well as different aspects about the device/service using that they learned, searched, experiences, as well as through their innovative thinking. Students' presentations are further discussed in another class for students to learn more from each other.
Assessment Methods in Alignment with Intended Learning Outcomes	

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b	c	d		
Continuous assessment	100%						
Presentation[1]	30%	√	√	√	√		
Quizzes[2]	30%	√	√	√			
Essay[3]	40%	√	√	√	√		

		Total	100%						

¹ 10% is contributed through the assessment of the wearables data report, sharing and peer review. The other 20% is contributed by the group presentation.

² 10% is contributed by the assessment of the reading assignment (~200 page textbooks' chapters). The other 20% is contributed by the assessment of lecture contents.

³ 30% is marked by the subject leader, and 10% is marked by ELC colleagues. Before submitting to the subject leader, students are required to submit online two drafts to ELC teachers for obtaining feedback, and assessing the progress in the writing process and the quality of their work.

Specific assessment methods/tasks	Contents
Presentation	*In groups:* Students have to select a public member and related health issue(s) for presenting a review on market with basic principles and evaluation findings about pros and cons of the wearable(s) used by the public member. Students suggest further improvements or design new wearables for overcoming the issue. Students have to present their business plan for developing their wearable.
Quizzes	*Individual:* Students have to demonstrate their understanding of textbooks' chapters (fulfilling ER requirement), some other short technological news as well as lecture contents on healthcare data, technologies for wearable device, and contemporary wearable devices.
Essay	*Individual:* Students have to suggest further improvements upon reviewing the working principles of wearable devices, claimed health benefits, mechanism of improving health, and hidden issues for a selected public member (fulfilling EW requirement). Students will also include the experiences and critical review of different wearables applied on the selected public member including pros and cons. Student will suggest a new approach using wearables for selected issue of selected public member. Guided group discussion will facilitate students to prepare the essay in high quality

Student Study Effort Expected	Class contact:	
	▪ Lecture	22 Hrs.
	▪ Tutorial	6 Hrs.

	▪ Quizzes	2 Hrs.
	▪ Laboratory work / Practical	6 Hrs.
	▪ Visit	3 Hrs.
	Other student study effort:	
	▪ Assignment preparation	40 Hrs.
	▪ Self study	25 Hrs.
	Total student study effort	104 Hrs.
Reading List and References	**Textbooks** ▪ Fawzi Behmann, Kwok Wu, Collaborative Internet of Things (C-IOT) For Future Smart Connected Life and Business. Hoboken: John Wiley and Sons, Inc., 2015. ▪ Janet Holland, Wearable technology and Mobile Innovation for Next-Generation Education. Hershey, PA: Information Science Reference, 2016. ▪ Joseph L. Dvorak, Moving Wearable into the Mainstream Taming the Borg. Boston, MA: Springer Science + Business Media, LLC., 2008. **Other Reading Materials** ▪ http://www.medgadget.com ▪ Selected publications from relevant journals ▪ Scientific American, Scientific American Inc. ▪ Popular Mechanics, Popular Mechanics Co. ▪ Popular Science, Bonnier Co. ▪ https://www.wareable.com/	

Note 1: Intended Learning Outcomes
Intended learning outcomes should state what students should be able to do or attain upon completion of the subject. Subject outcomes are expected to contribute to the attainment of the overall programme outcomes.

Note 2: Subject Synopsis/ Indicative Syllabus
The syllabus should adequately address the intended learning outcomes. At the same time over-crowding of the syllabus should be avoided.

Note 3: Teaching/Learning Methodology
This section should include a brief description of the teaching and learning methods to be employed to facilitate learning, and a justification of how the methods are aligned with the intended learning outcomes of the subject.

Note 4: Assessment Method
This section should include the assessment method(s) to be used and its relative weighting, and indicate which of the subject intended learning outcomes that each method purports to assess. It should also provide a brief explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes.