

Subject Description Form

Subject Code	BME11101
Subject Title	Bionic Human and the Future of Being Human
Credit Value	3
Level	1
Pre-requisite / Co-requisite / Exclusion	Nil
Objectives	To introduce, in a multidisciplinary and interactive approach, the various ways through which defective body parts can be replaced or augmented by artificial devices. The focus is to illustrate how modern biomedical engineering technologies deal with diseases, trauma, and ageing. These technology-enabled medical advancements are discussed along with the associated philosophical and ethical issues.
Intended Learning Outcomes	<p>Upon completion of the subject, students will be able to:</p> <ol style="list-style-type: none"> a. Describe some of the amazing designs in human body and their potential damages due to injuries, diseases, and ageing; b. Give examples on how engineering has helped in reconstructing damaged body parts and/or body functions, such as hearing, seeing, movement, etc.; c. Reflect on our human imagination about the bionic human of the future; d. Discuss some of the philosophical, societal and ethical issues associated with such technological developments; and e. Fulfill the CAR reading and writing requirements in English.
Contribution of the Subject to the Attainment of the Programme Outcomes	<p>Programme Outcomes:</p> <p><u>Category A: Professional/academic knowledge and skills</u></p> <ul style="list-style-type: none"> ▪ Programme Outcomes 1: Understand the fundamentals of science and engineering, and have the ability to apply them. ▪ Programme Outcomes 6: Know the contemporary issues, and understand the impact of engineering solutions in a global and societal context. <p><u>Category B: Attributes for all-roundedness</u></p> <ul style="list-style-type: none"> ▪ Work with others collaboratively in a multi-disciplinary team and have a knowledge of leadership ▪ Recognize social, professional and ethical responsibility

	<ul style="list-style-type: none"> ▪ Communicate effectively ▪ Recognize the need for and engage in life-long learning
<p>Subject Synopsis/ Indicative Syllabus</p>	<p>Human life is both amazing and vulnerable. Amazing – the designs and working of our human bodies are the envies of engineering science. Vulnerable – the best and the strongest are still mortal. We are susceptible to trauma, diseases, ageing and finally death. Advances in life science and engineering are bringing to us in fast cadence and big strides innovative breakthroughs and new possibilities in healing and rejuvenation, functional recoveries and health enablement. Powered intelligent prostheses for subjects with amputation, fully implantable artificial hearts for subjects with heart failures, tissue engineered skin for severely burnt subjects, stem cells therapies for impaired brain tissues are examples that our body can be fixed by replacing the defective components with artificial “spare parts” and other augmentative measures. At the same time, research laboratories are developing intelligent robots that can see, hear, smell, talk, walk, dance, think, and feel like human – following a centuries-long human quest for “living” machines.</p> <p>The mechanistic implications of these biomedical and engineering advances seem apparent – Is human a robot? Can robot one day become human? The artists among us are quick to perceive and even exploit these implications. The entertainment media have imaginatively presented many kinds of human- robotic hybrids, both as heroes and villains, often with power and abilities beyond those of a human. What could we tell about ourselves from our quests, pursuits, and dreams? How may one define the borderline between human and robot? What does it mean to be a human?</p> <p>This subject derives from the instructors’ teaching and research in biomedical engineering, prosthetics, robotics, etc. and their well-round reflections in the realms of science, technology and humanity. The subject starts by illustrating the many amazing designs in our human body and yet how vulnerable we are in terms of injuries, diseases and ageing. Examples on how modern biomedical engineering helps us face our human conditions are given. The topics “intelligence and artificial intelligence” and “senses and artificial senses then follows, along with a historical account of human quest for “living” machine, including a brief coverage of modern movies on bionic human. The subject wraps up with some social, ethical and philosophical reflections on the above issues and on the meaning of being human, opening up questions concerning the perennial human quest of becoming super human. All students keen in the above issues are welcome to take this subject.</p> <p>Indicative Syllabus</p> <p>The Amazing Human Body</p> <p>The Vulnerable Human Body</p>

	<p>The State of Science in Biomedical Engineering</p> <ul style="list-style-type: none"> ▪ Musculoskeletal Prosthetics and Orthotics ▪ Cardiovascular Implants ▪ Other Artificial Organs ▪ Stem Cell and Tissue Engineering ▪ Bio-Nano-Robotics ▪ Senses & Artificial Senses ▪ Intelligence & Artificial <p>Bionic Human – Science Fiction or Reality</p> <p>Human versus Bionic Human versus Robot</p> <p>Ethical & Social Concerns</p> <p>The Meaning of Being Human</p> <p>Future Super Human - a Human Quest</p>																														
<p>Teaching/Learning Methodology</p>	<p><u>Lectures/ Videos/ Group Discussion</u></p> <p>Students are required to participate in writing instructional activities: online lectures on (1) integrating sources in writing; (2) developing cohesion and coherence in extended texts; and (3) developing an appropriate style for writing, as well as 2 writing consultation sessions for feedback, suggestions, and improvement on the book report writing by ELC staff. To fulfill the ER and EW requirements, students have to read a selected book (suggested by the instructor, total reading not less than 200 pages or 100,000 words) and write a book report (1,500 - 2,500 words in length). Students will submit the first draft of the book report (700-word continuous/ extended piece of writing) in the middle of the semester. Shortly afterward, ELC staff will provide detailed written feedback and discuss with the students their first drafts in the first consultation session. Close to the end of the semester, students will submit a revised draft (with changes made based on ELC staff's comments plus 800 more words) and attend the second consultation session to discuss the extent to which the students have revised the draft and how well. Students will receive further suggestions for improvement before they submit the final draft.</p>																														
<p>Assessment Methods in Alignment with Intended Learning Outcomes</p>	<table border="1"> <thead> <tr> <th data-bbox="472 1579 775 1794">Specific assessment methods/tasks</th> <th data-bbox="775 1579 943 1794">% weighting</th> <th colspan="6" data-bbox="943 1579 1442 1720">Intended subject learning outcomes to be assessed (Please tick as appropriate)</th> </tr> <tr> <td colspan="2"></td> <th data-bbox="951 1720 1023 1794">a</th> <th data-bbox="1023 1720 1102 1794">b</th> <th data-bbox="1102 1720 1182 1794">c</th> <th data-bbox="1182 1720 1262 1794">d</th> <th data-bbox="1262 1720 1342 1794">e</th> <th data-bbox="1342 1720 1442 1794"></th> </tr> </thead> <tbody> <tr> <td data-bbox="472 1794 775 1964">Short Quizzes on Lectures 50 Readings 10</td> <td data-bbox="775 1794 943 1964">60 %</td> <td data-bbox="951 1794 1023 1964">√</td> <td data-bbox="1023 1794 1102 1964">√</td> <td data-bbox="1102 1794 1182 1964">√</td> <td data-bbox="1182 1794 1262 1964">√</td> <td data-bbox="1262 1794 1342 1964">√</td> <td data-bbox="1342 1794 1442 1964"></td> </tr> </tbody> </table>	Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)								a	b	c	d	e		Short Quizzes on Lectures 50 Readings 10	60 %	√	√	√	√	√							
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Total	100 %																																
Student Study Effort Expected	Class contact:																																
	▪ Lecture							34 Hrs.																									
	▪ Short Quizzes							3 Hrs.																									
	▪ Writing Consultation Sessions (ELC)							1 Hr.																									
	▪ Tutorial for report writing							1 Hr.																									
	Other student study effort:																																
	▪ Online Writing Instructional Activities, Reading, and Book Report Writing							78 Hrs.																									
Total student study effort							117 Hrs.																										
Reading List and References	<p>Selected Books for Book Report (for Er and Ew Requirements):</p> <p>(Students will be asked to read <u>one of the following</u> books and complete a book report of 1,500~2,500 words)</p> <ul style="list-style-type: none"> ▪ Koops, Bert-Jaap., et al. Engineering the Human Human Enhancement Between Fiction and Fascination. 2013. ▪ Barfield, Woodrow. Cyber-Humans: Our Future with Machines. 2015. 																																