Subject Description Form

Subject Code	BME32138
Subject Title	**Cellular Engineering**
Credit Value	3
Level	3
Prerequisite	**Prerequisites** ABCT2331 Human Biology for Biomedical Engineering I; and ABCT2332 Human Biology for Biomedical Engineering II; or equivalent subjects
Objectives	▪ Deliver knowledge in the fundamentals of cell biology with particular emphasis on cellular physiological and pathological processes. ▪ Introduce the principles of engineering methods/technologies applied in cellular/molecular biology and biomedical sciences. ▪ Prepare undergraduate students with basic concepts and skills for biomedical research using cellular engineering approaches.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Understand the fundamental concepts in cellular/molecular biology and significances of cellular engineering in biomedical research and applications. b. Comprehend the principles of technologies in cellular engineering. c. Design experiments with cellular engineering methods to solve basic scientific questions in cell biology and biomedical sciences.
Contribution to Programme Outcomes (Refer to Part I Section 10)	▪ Programme Outcome 1: Demonstrate an ability to apply knowledge of mathematics, science, and engineering appropriate to the Biomedical Engineering (BME) discipline. (Teach, Practice and Measure) ▪ Programme Outcome 2: Demonstrate an ability to design and conduct BME experiments, as well as to analyze and interpret data. (Practice and Measure) ▪ Programme Outcome 4: Demonstrate an ability to identify, formulate, and solve BME problems. (Teach, Practice and Measure) ▪ Programme Outcome 6: Demonstrate an ability to critically evaluate research and professional literature, and understand the principles and practice of conducting research in clinical and industrial environments relevant to BME. (Practice and Measure)

<table>
<tr><td>Subject Synopsis/ Indicative Syllabus</td><td>Conceptual: Overview of cellular engineering in cell biology and biomedical sciences; Cell structure and subcellular organelles; Genetics and epigenetics of the cell; Protein synthesis-; Cell cycle and growth; Cell mechanics and cytoskeletal dynamics (e.g. cell stiffness and cellular contractility); Cell-cell and cell-extracellular environment interactions; Cellular and intercellular signal transduction and networks; Mechanotransduction; Cells in development (stem cells), ageing (cell senescence) and diseases; Cellular engineering in regenerative medicine.

Technological: Cell culture technology; Cellular genetic engineering, Measurements of cell growth and death; Gene expression assessments; Cellular imaging; Live-cell function and activity assessments; Molecular and cellular tracking (e.g. genetic lineage tracking, bioluminescence); Cell manipulation technology (e.g. Dielectrophoresis trap, Surface acoustic waves and magnetic trapping); Cell positioning technology (e.g. Micro-contact printing and microfluidic patterning); Technologies for cell mechanics measurement (e.g. Optical tweezers, Atomic force microscopy, and Magnetic twisting cytometry); Technologies for cellular traction measurement (e.g. Traction force microscope and Micropost array).</td></tr>
<tr><td>Teaching and Learning Methodology</td><td>Lectures: The major concepts and principles in cellular engineering will be delivered through lectures and invited seminars.

Student Group Discussion: Students will be assigned to read, present and discuss recent research papers to gain knowledge in the latest advances and developments in cellular engineering.

Laboratory Tutorials: Students will be grouped to observe and learn the laboratory techniques in cellular engineering.</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="8">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Assignments and quizzes</td><td>60%</td><td>√</td><td>√</td><td>√</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Final examination</td><td>40%</td><td>√</td><td>√</td><td>√</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Total</td><td>100%</td><td colspan="8"></td></tr>
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Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes</td></tr>
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Student Study Effort Expected	Class contact:	
	▪ Lecture	30 Hrs.
	▪ Laboratory	9 Hrs.
	Other student study effort:	
	▪ Self-Study	60 Hrs.
	▪ Assignment	27 Hrs.
	Total student study effort	126 Hrs.
	Class Contact	
Reading List and References	▪ Alberts B. Molecular biology of the cell. Sixth edition. ed. New York, NY: Garland Science, Taylor and Francis Group; 2015. ▪ King MR. Principles of cellular engineering: understanding the biomolecular interface. Amsterdam; Boston: Elsevier Academic Press; 2006. ▪ Bronzino JD, Peterson DR. Molecular, cellular, and tissue engineering. Fourth edition. ed. Boca Raton: CRC Press, Taylor & Francis Group; 2015. ▪ Cortassa S. An introduction to metabolic and cellular engineering. Second edition. ed. Hackensack, New Jersey: World Scientific; 2012. ▪ Cathomen T, Hirsch M, Porteus MH, American Society of Gene & Cell Therapy. Genome editing: the next step in gene therapy. New York: Springer; 2016. ▪ Stein GS. Human stem cell technology and biology: a research guide and laboratory manual. Hoboken, N.J.: Wiley-Blackwell; 2011. ▪ Lodish HF. Molecular cell biology. Eighth edition. ed. New York: W.H. Freeman-Macmillan Learning; 2016. ▪ Pörtner R. Animal cell biotechnology: methods and protocols. Third edition. ed. New York: Humana Press; 2014. ▪ Doulatov S, Daley GQ. Development. A stem cell perspective on cellular engineering. Science. 2013;342(6159):700-2. ▪ Nielsen J, Keasling JD. Engineering Cellular Metabolism. Cell. 2016;164(6):1185-97.	
Date of Last Major Revision	8 October 2017	
Date of Last Minor Revision	20 July 2019	