BME2102: INTRODUCTION TO BIOMECHANICS

Effective Term
Semester B 2022/23

Part I Course Overview

Course Title
Introduction to Biomechanics

Subject Code
BME - Biomedical Engineering
Course Number
2102

Academic Unit
Biomedical Engineering (BME)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
BCH1200/CHEM1200 Discovery in Biology or AP1201/PHY1201 General Physics I#

Precursors
Nil

Equivalent Courses
MBE2102 Introduction to Biomechanics

Exclusive Courses
Nil

Additional Information
Prerequisites which are not part of the Major Requirement are waived for students admitted with Advanced Standing.

Part II Course Details

Abstract

This course aims to introduce students to the fundamental concepts that are required for the development of biomedical prosthetic devices in the human body; to provide a supportive, directed experiential and cooperative learning environment for students to acquire and develop technique skills to solve diverse engineering problems in various biomedical products.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the fundamental concepts of biomechanics and their impacts on the behavior of physical bodies subject to forces or displacements.			x	
2	Identify the mechanical engineering problems in biomaterials and biomedical devices, explain the problems with critical thinking generated from mechanics concepts, and calculate the problems with mechanics theory.		x	x	
3	Apply the biomechanics knowledge to explain structural and functional behavior of biological systems such as humans, animals, plants, organs, cells.			x	x
4	Present the procedure, results and analysis of the lab experiments in scientific written reports.			x	

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Teaching and Learning Activities (TLAs)

	TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	Take place in classroom setting which consist of lectures and student activities in between.	1, 2, 3	3 hrs/week
2	Tutorial/Laboratory Sessions	Take place in classroom and laboratory, with assignments towards developing laboratory reports.	1, 2, 3, 4	1.5 hrs/week for 2 weeks/3 hrs/week for 3 weeks

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	In-class Test	1, 2, 3	20	
2	Laboratory Reports	4	20	3 reports to be submitted

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

2

Additional Information for ATs

For a student to pass the course, at least 30% of the maximum mark for both coursework and examination should be obtained.

Assessment Rubrics (AR)

Assessment Task

1. In-class Test

Criterion

Describe the mechanical design concepts and principles and provide solution to related design problems.

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Assessment Task

2. Laboratory Reports

Criterion

Attendance of the lab/demo session; ABILITY to EXPLAIN the methodology and procedure and ANALYSE the lab data.

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
3. Examination

Criterion
Explain the fundamental concepts and working principles, select proper machine elements and solve problems in the design process.

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

- Biomechanics, biomaterials, cells, tissues, organs, implants, human musculoskeletal system, biomedical devices, cell/surface interactions, endovascular system, drug delivery, dental implants, hip/knee implants, doctor and patients, ethical issues
- Solid mechanics, fluid mechanics, physical bodies, vector, force, displacement, moment, mechanical properties, Hooke’ s law, stress, strain, elasticity, plasticity, viscoelasticity, fracture, fatigue, wear, corrosion, toughening of materials, composites
- Problem identification and solving techniques, lab planning and control, reporting and presentation

In addition to the examination and in-class test, students are required to learn through collaborative lab sessions in order to improve their understanding on strategic thinking, problem solving, team working processes, the relationships and interactions between the fields of knowledge that they have learnt in this and other courses.

Reading List

Compulsory Readings

	Title
1	Biomechanics: Concepts and Computation (Cambridge Texts in Biomedical Engineering), Cees Oomens, Marcel Brekelmans and Frank Baaijens, Cambridge University Press, 2009

Additional Readings

	Title
1	Biomechanics: Mechanical Properties of Living Tissues, Y.C. Fung, Springer, 1993 (Second Edition)
2	Fundamentals of Biomechanics, Duane Knudson, Springer, 2007 (Second Edition)
3	Introductory Biomechanics: from Cells to Organisms, C. Ross Ethier and Craig A. Simmons, Cambridge University Press, 2007
4	Biomechanics: Circulation, Y.C. Fung, Springer, 2010
5	Biomechanics: Principles and Applications, D.R. Peterson and J.D. Bronzino, Editors, CRC Press, 2008
6	Biomaterials Science: An Introduction to Materials in Medicine, B.D. Ratner, A.S. Hoffman, F.J. Schoen and J.E. Lemons, Editors, Academic Press, 2004 (Second Edition)
7	Biomechanics in the Muskuloskeletal System, M. Panjabi & A.A. White II, Philadelphia, PA, 2001
8	Basic Orthopedic Biomechanics, V.C. Mow and W.C. Hayes, Lippincott-Willimas & Wilkins Press, 1997
9	An Introduction to Tissue-Biomaterials Interactions, K.C. Dee, D.A. Puleo and R. Bizios, Wiley-Liss, John Wiley & Sons, 2002