BMS1901: CALCULUS FOR LIFE SCIENCES

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Calculus for Life Sciences

Subject Code
BMS - Biomedical Sciences
Course Number
1901

Academic Unit
Biomedical Sciences (BMS)

College/School
Jockey Club College of Veterinary Medicine and Life Sciences (VM)

Course Duration
One Semester

Credit Units
3

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

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
(i) HKDSE Mathematics Compulsory Part, or
(ii) HKDSE Mathematics Compulsory Part and Extended Part Module 1, or
(iii) HKDSE Mathematics Compulsory Part and Extended Part Module 2 (Levels 1 – 3); or equivalent

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

The course aim to show students how calculus is used to analyze phenomena in nature and life sciences. The course prepares students well for more advanced courses in mathematics and statistics in biology or life sciences. The applications used in the course will cover population genetics, pharmacology, and the evolution of microbial cooperation. Some fundamental probabilistic tools will be used to demonstrate how to estimate probability distributions in the end of the course.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Understand limits and continuity; Perform techniques of differentiation to obtain derivatives	30	x		
2	Understand the Mean Value Theorem, L'hopital's rule; Solve optimization problem using population genetics and other biological examples	20		x	x
3	Perform separation of variables and solve First-Order Linear Differential Equations using many examples in biology and epidemiology; Perform integration	30		x	x
4	Understand linear models and the matrix methods needed to solve them; Calculate eigenvalues and eigenvectors	10		x	
5	Understand probability, probability distribution and randomness. Understand the application of stochastic processes in biology	10	x	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	Lectures	Learning through teaching is primarily based on lectures	1, 2, 3, 4, 5	33 hours in total including Lectures and tutorials

2	Tutorials	Learning through tutorial sessions is primarily based on hands-on statistical problem solving allowing interaction	1, 2, 3, 4	
3	Assignments	Learning through take-home assignments to understand basic concepts, statistical methods and some related applications in biomedical and biological sciences	1, 2, 3, 4	After class
4	Lab Sessions	Learning through lab sessions is primarily based on hands-on statistical problem solving allowing interaction	3	3 hours x 2 weeks

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Hand-in assignments	1, 2, 3, 4	40	These assignments evaluate whether students understand concepts of calculus and let students to practice techniques of differential calculus, and are able to solve first order differential equations in many applications in biology.
2	In-class assessments	1, 2, 3	30	These assessments evaluate whether students understand concepts of calculus and are able to perform techniques of differential calculus.

Continuous Assessment (%)

70

Examination (%)

30

Examination Duration (Hours)

2-3

Additional Information for ATs

A minimum of 30% in coursework as well as in examination, in addition to a minimum of 40% in coursework and examination taken together.

Remarks for Examination: The exam assess whether students understand the basic concepts, are able to perform techniques of differential calculus and to solve some applications in biology using the above techniques.

Assessment Rubrics (AR)

Assessment Task
1. Hand-in assignments

Criterion
Ability to explain the basic mathematical concepts and to perform differential calculus

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. In-class assessments

Criterion
Ability to apply mathematical concepts and techniques of differentiation to solve problems in biology

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
Ability to apply statistical concepts and methods to a range of problems in biological and biomedical sciences

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
Differentiation, first order linear differential equation, limits, continuity, eigenvector, probability

Reading List

Compulsory Readings

	Title
1	James Stewart, Troy Day Biocalculus: Calculus for Life Sciences

Additional Readings

	Title
1	Raymond A. Barnett and Michael R. Ziegler. Calculus for Business, Economics, Life Sciences, and Social Sciences (13th Edition)