City University of Hong Kong
Course Syllabus

offered by
Department of Biomedical Engineering
with effect from Semester B 2019 / 2020

Part I Course Overview

Course Title:	Dynamics and Control
Course Code:	BME4010
Course Duration:	1 semester
Credit Units:	3 credits
Level:	B4
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites[#]: *(Course Code and Title)*	MBE2003/MNE2003 Mechanics or MBE2109/BME2109/MNE2109 Engineering Mechanics
Precursors: *(Course Code and Title)*	MBE3049/MNE3049 Control Principles
Equivalent Courses: *(Course Code and Title)*	MBE4010/MNE4010 Dynamics and Control
Exclusive Courses: *(Course Code and Title)*	Nil

[#]Prerequisites which are not part of the Major Requirement are waived for students admitted with Advanced Standing.

Part II Course Details

1. Abstract

(A 150-word description about the course)

The course aim is to provide students with the understanding of system dynamics and feedback control, and develop the students' ability to model, analyse and control mechanical systems in simplified engineering situations. Dynamic models of various systems will be developed using principles of the underlying physics including the force, work, momentum and energy. The initial focus on kinematics of particles shifts to systems of particles and then solid bodies. Simple harmonic motion is analysed. Lagrange's and also Hamilton's equations of motion are introduced. Students have the opportunity to discover how motor-control system-parameters vary during the machine/mechanism motion and to innovate with strategies of adapting the control to suit all phases of the motion.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs	Weighting* (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Comprehend fundamental concepts of rigid body dynamics, vibration and control.				√
2.	Create mathematical models of a mechanical system through analysis of displacement, velocity and acceleration.			√	
3.	Analyse simple dynamics problems.			√	
4.	Develop appropriate control algorithms for simplified engineering situations.		√		√
5.	Evaluate the overall system performance via integrated modelling and controller design through simulation/experiments.		√	√	√
** If weighting is assigned to CILOs, they should add up to 100%.*		N.A.			

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 self-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.

3. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

TLA	Brief Description	CILO No.					Hours/week (if applicable)
		1	2	3	4	5	
Lecture	Explain key concepts and approaches.	✓	✓	✓	✓	✓	2 hrs/week
Tutorial	Requires students to develop appropriate dynamics modelling and control algorithms for simplified engineering problems. Some additional work is given to the students to do subsequently at their own pace.	✓	✓	✓	✓	✓	1 hr/week
Laboratory Activities	Work in a team to get hands on experience on modelling and controller design.	✓	✓	✓	✓	✓	3 hrs/week for 3 weeks

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.					Weighting*	Remarks
	1	2	3	4	5		
Continuous Assessment: 40%							
Assignment	✓	✓	✓	✓	✓	25%	A large assignment requiring work of over 5-6 weeks
Laboratory Reports	✓	✓	✓	✓	✓	15%	3 reports to be submitted
Examination: 60%							
Examination	✓		✓		✓	60%	Duration: 2 hours
** The weightings should add up to 100%.*						100%	

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

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Assignment	Ability of modelling, analysing simplified mechanical systems and design appropriate control algorithms for simplified engineering situations; Ability to explain in detail of the methodology and procedure.	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Laboratory Reports	Ability to explain in detail of observation and evaluate the system performance.	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Examination	Ability to model, analyse and control simplified mechanical systems.	High	Significant	Moderate	Basic	Not even reaching marginal levels

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

(An indication of the key topics of the course.)

Force, work, momentum and energy; kinematics of particles, systems of particles and solid bodies; simple harmonic motion; mechanical systems; mechatronics systems; mathematic modeling; differential equation; difference equation; transfer function; stability; feedback control; advanced control; adaptive control.

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

1.	William J. Palm III, Modeling, Analysis, and Control of Dynamic Systems, 2nd Edition, John Wiley & Sons, Inc.
2.	M. Plesha et al., Engineering Mechanics: Dynamics, McGraw-Hill.
3.	Norman S. Nise, Control Systems Engineering, 7th Edition, John Wiley & Sons, Inc.
4.	Gene F. Franklin, J. David Powell, Abbas Emami-Naeni, Feedback Control of Dynamic Systems, 6th Edition, Prentice-Hall, 2010.