MATH 4360 Mathematical Modeling

Course Outline – Spring Term 2023/2024

1. Instructor: MATH 4360 by Professor ***Tiezheng QIAN***

Email: maqian@ust.hk **Office**: Room 3437

Office hours: Appointments via email

2. Lecture/Tutorial Hours and Venues:

MATH4360	Mathematical Modeling	QIAN, Tiezheng/maqian	L1	Mon/Wed	12:00 - 13:20	2302
		LI, Yakun/ylinv	T1A	Fri	16:30 - 17:20	LG426(LIB)
		ZHANG, Wenlin/wzhangdh	T1B	Thu	15:00 - 15:50	5508

3. COURSE DESCRIPTION

Credits: 3

Mechanical Vibrations, Population Dynamics — Mathematical Ecology, Traffic Flow, Random Walk and Diffusion, Principles of Mathematical Modeling.

Exclusion: N.A.

Pre-requisite: MATH 2350 OR MATH 2351 OR MATH 2352

4. INTENDED LEARNING OUTCOMES (ILOs)

Upon successful completion of this course, students should be able to

1	Understand the foundations of mathematical modeling, including principles, methods, dimensional analysis, scale, approximation, and model validation.
2	Understand a range of mathematical models built in a range of disciplines, with a focus on mechanical vibrations, population dynamics, and traffic flow.
3	Solve problems by building mathematical models, carrying out theoretical analysis, and performing numerical computation.
4	Develop experiences in and familiarity with analysis and computation skills for mathematical models.
5	Develop mathematical maturity to undertake higher level studies in mathematics and related fields.

5. ASSESSMENT SCHEME (to be updated)

80% Homework: Course ILOs: 1, 2, 3, 4, 5

20% Final Exam. Course ILOs: 1, 2, 3, 4, 5

Final exam is comprehensive, i.e., all the materials taught in the whole semester will be tested, including those already tested in the midterm exam. But **focus** will be on those topics not covered in the midterm.

Closed-book exams: No notes and no calculators. More information will be given prior to the exams.

6. Student Learning Resources

Textbook: ***Mathematical Models: Mechanical Vibrations, Population Dynamics, and Traffic Flow*** (Classics in Applied Mathematics, Series Number 21) by Richard Haberman (Author)

Reference: ***Principles of Mathematical Modeling*** 2nd Edition by Clive Dym (Author)

The course materials will be provided from a variety of resources. *No specific textbook is required for this course*. Lecture notes will be uploaded to the course's Canvas page on a regular basis.

7. Teaching and learning Activities

Scheduled activities: 4 hours (Lecture for 3 hours & Tutorial for 1 hour) per week

8. TEACHING SCHEDULE (with flexibility)

Topic 1.	**Mechanical Vibrations**	**~ 4 classes**
Topic 2.	**Population Dynamics — Mathematical Ecology**	**~ 4 classes**
Topic 3.	**Traffic Flow**	**~ 4 classes**
Topic 4.	**Random Walk and Diffusion**	**~ 4 classes**
Topic 5.	**Perturbation Methods**	**~ 4 classes**
Topic 6.	**Principles of Mathematical Modeling**	**~ 4 classes**

9. Rationale for introducing this course

There are three motivations for introducing this course. Firstly, knowledge of mathematical modeling is *essential* to Applied Mathematics students. This course provides them with an opportunity to gain *introductory yet comprehensive training in mathematical modeling*, from foundations to many applications. Secondly, being a traditional component of applied mathematics, mathematical modeling has become increasingly important for students to treat and solve *real-world problems* which present more challenges and opportunities than ever before. Thirdly, this course helps students be better prepared for a more advanced and challenging *career in the future*, from academia to industry.