

The Hong Kong Polytechnic University

Subject Description Form

Subject Code	AMA4440
Subject Title	Dynamical Systems
Credit Value	3
Level	4
Pre-requisite	AMA3410 Differential Equations, or AMA3724 Further Mathematical Methods
Objectives	This course provides the introduction to dynamical systems and chaos. It helps students understand simple models of dynamical systems, mathematical theory underlying their behaviour, their relevance to natural phenomena, and methods of data analysis and interpretation.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: <ul style="list-style-type: none"> (a) explain clearly basic ideas of dynamical systems and nature of chaotic behaviour; (b) analyse parametric families of mappings and their applications in modelling dynamical systems; (c) describe properties of solutions of differential equations and their applications in modelling dynamical systems; (d) apply mathematical techniques of dynamical systems and chaos in modelling real-life phenomena.
Subject Synopsis/ Indicative Syllabus	One-Dimensional Flows, Fixed Points and Stability, Logistic Equation, Existence and Uniqueness, Bifurcations. Two-Dimensional Flows, Linear Systems, Phase Plane, Limit Cycles, Poincare-Bendixson Theorem, Hopf Bifurcation. Chaos, Lorenz Equations, Strange Attractor, Logistic Map, Liapunov Exponent.
Teaching/Learning Methodology	This course will use lectures, tutorials, and learning activities to teach students about dynamical systems. Lectures will introduce the concepts, while tutorials will provide support. Learning activities will reinforce the concepts and encourage critical thinking. Students will engage in self-directed learning, and assessment will be through homework, test and exam. This methodology balances theory and application, encourages participation.

Assessment Methods in Alignment with Intended Learning Outcomes	Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)			
			a	b	c	d
	1. Homeworks	10 %	✓	✓	✓	✓
	2. Test and/or Quizzes	30 %	✓	✓	✓	✓
	3. Exam	60 %	✓	✓	✓	
	Total	100 %				
	The subject focuses on knowledge, skill and understanding of dynamical systems, thus, Exam-based assessment is the most appropriate assessment method, including 40% continuous assessment and 60% examination. Moreover, continuous assessment can keep the students in progress. Continuous Assessment comprises of assignments and test and/or quizzes. A written examination is held at the end of the semester.					
Student Study Effort Expected	Class contact:					
	▪ Lecture					26 Hrs.
	▪ Tutorial					13 Hrs.
	Other student study effort:					
	▪ Self-study					78 Hrs.
	Total student study effort					117 Hrs.
Reading List and References	Strogatz, S. (2020). <i>Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry, and Engineering</i> . CRC Press.					
	Hirsch, M., Smale, S., & Devaney, R. (2012). <i>Differential Equations, Dynamical Systems, and an Introduction to Chaos</i> . Academic Press.					
	Layek, G. (2015). <i>An Introduction to Dynamical Systems and Chaos</i> . Springer.					