Module designation	*Introduction to Dynamical System*
Semester(s) in which the module is taught	*5*
Person responsible for the module	*Kus Prihantoso Krisnawan S.Si., M.Si.*
Language	*Bahasa Indonesia*
Relation to curriculum	*Elective course*
Teaching methods	*150 minutes lectures and 180 minutes structured activities per week.*
Workload (incl. contact hours, self-study hours)	*Total workload is 136 hours per semester which consists of 150 minutes lectures, 180 minutes structured activities, and 180 minutes self-study per week for 16 weeks.*
Credit points	*3*
Required and recommended prerequisites for joining the module	*MAT6324-Mathematical Modelling*
Module objectives/intended learning outcomes	*CO1 Respecting the views, opinions, or original findings of others* *CO2 Thinking critically and systematically in understanding definitions, theorems, and properties in mathematics independently and in groups* *CO3 Communicating ideas or thoughts in understanding or solving mathematical problems in writing and orally* *CO4 Explaining the meaning or definition of several terms and the intent of theorems or properties in Dynamic Systems* *CO5 Formulating a mathematical model of a simple real-world problem that produces a dynamic system, analyzing, simulating, and interpreting it.*

<table>
<tr><td>Content</td><td>The Introduction to Dynamic Systems course covers linear dynamic systems, nonlinear dynamic systems, and bifurcation. Before discussing the first topic, an introduction to dynamic systems will be provided. This introduction contains several mathematical modeling cases that result in dynamic systems, followed by a formal definition of dynamic systems. In the section on linear dynamic systems, solutions and phase portraits will be determined for 2-dimensional systems that have unpaired forms, real and distinct roots, complex roots, and twin/identical roots. Furthermore, the form of the solutions and phase portraits will be characterized to see the relationship between the stability of linear systems and their eigenvalues. In the topic of nonlinear systems, the definitions of equilibrium points, linearization, Jacobian matrices, stable manifold theorem, parameterized systems, non-hyperbolic equilibrium points, and center manifold theorem are provided. Furthermore, in the last topic, several types of bifurcations with one parameter will be discussed.</td></tr>
<tr><td>Examination forms</td><td>CO1: Attitude assessment is carried out at each meeting by observation and / or self-assessment techniques using the assumption that basically every student has a good attitude.</td></tr>
<tr><td>Study and examination requirements</td><td>The student is given a value of very good or not good attitude if they show it significantly compared to other students in general. The result of attitude assessment is not a component of the final grades, but as one of the requirements to pass the course. Students will pass from this course if at least have a good attitude.

The final mark will be weight as follow:
<table>
<tr><th>No</th><th>CO</th><th>Assessment Object</th><th>Assessment Technique</th><th>Weight</th></tr>
<tr><td>1</td><td>CO 1</td><td>a. Presentation
b. Discussion</td><td>Observation</td><td>5%
10%</td></tr>
<tr><td>2</td><td>CO 2, CO 3, CO 4</td><td>a. Individual assignment
b. Group assignment
c. Quiz
d. Midterm
e. Final test</td><td>Written</td><td>10%
10%
20%
20%
25%</td></tr>
<tr><td colspan="4">Total</td><td>100%</td></tr>
</table></td></tr>
<tr><td>Reading list</td><td>1. Perko, L. 2000. Differential Equations and Dynamical Systems. Springer-Verlag: New York.
2. Kuznetsov, Y.A. 1998. Elements of Applied Bifurcation Theory. Second edition. Springer-Verlag: New York.
3. Wiggins, S. 1990. Introduction to Applied Nonlinear Dynamical Systems and Chaos. Springer-Verlag: New York</td></tr>
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