## Module Name

**Dynamical System**

### Module Level

Bachelor

### Code, if applicable

MMM-3306

### Subtitle, if applicable

- 

### Courses, if applicable

Dynamical System

### Semester(s) in which the module is taught

6th (Sixth Semester)

### Person responsible for the module

Chair of the Lab. of Applied Mathematics

### Lecture(s)

Dr. Fajar Adi Kusumo, M.Si., and Prof. Dr. Widodo, M.S.

### Language

Bahasa Indonesia

### Relation to curriculum

Compulsory course in the third year (6th semester) Bachelor Degree

### Type of teaching, contact hours

150 minutes lectures and 180 minutes structured activities per week.

### Workload

Total workload is 136 hours per semester, which consists of 150 minutes lectures per week for 14 weeks, 180 minutes structured activities per week, 180 minutes individual study per week, in total is 16 weeks per semester, including mid exam and final exam.

### Credit points

3

### Requirements according to the examination regulations

Students have taken Dynamical System course (MMM-3306) and have an examination card where the course is stated on.

### Recommended prerequisites

Students have taken Elementary Linear Algebra course (MMM-1202), Elementary Differential Equations course (MMM-2301), and have participated in the final examination of the course. Before taking this course, students must have a good understanding about the basic concepts of the Linear Algebra and Differential Equations.

### Module objectives/intended learning outcomes

After completing the course, the students will be able to:

- **CO1.** recognize the concept of the Discrete and Continuous Dynamical Systems.
- **CO2.** recognize the concept of the Nonlinear Differential Equations.
- **CO3.** analyze the fixed point and periodic point of the Discrete Dynamical System.
- **CO4.** analyze the invariant structures of the continuous dynamical system.
- **CO5.** do simple analysis to the mathematical models which are use the nonlinear differential equations and difference equations.

### Content

**Topics:**

- **Discrete Dynamical Systems:** History and Definition of Discrete Dynamical Systems, Orbits, Graphical Analysis, Fixed Point, Fixed point and periodic points, Fixed point and periodic points, Bifurcations, Dynamics of quadratic maps’ family
  \[ Q_c(x) = x^2 + c \]

- **Continuous Dynamical System:** Linear and Nonlinear Differential Equations, Definition of the Dynamical System and examples, Invariant structures (equilibrium points, periodic solution, and invariant manifold), Linearization and Stability of the equilibrium point, First Integral and Lyapunov Function, Poincare Map (introduction).

### Study and examination requirements and forms of examination

The final mark will be weighted as follows:

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<tr>
<th>No.</th>
<th>Assessment methods (components, activities)</th>
<th>Weight (percentage)</th>
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<tr>
<td>1</td>
<td>Final Examination</td>
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<td>2</td>
<td>Mid-Term Examination</td>
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The initial cut-off points for grades A, B, C, and D should not be less than 80%, 70%, 50%, and 40%, respectively.

Media employed

- White/Black Board
- LCD Projector
- Laptop/Computer

Reading List


### PLO and CO Mapping

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