



(Knowledge for Development)

KIBABII UNIVERSITY
UNIVERSITY EXAMINATIONS
2024/2025 ACADEMIC YEAR
FIRST YEAR SECOND SEMESTER
MAIN EXAMINATION
FOR THE DEGREE OF MASTER OF SCIENCE IN APPLIED MATHEMATICS

COURSE CODE: MAT 8550E

COURSE TITLE: APPLIED DYNAMICAL SYSTEM I

DATE: 25/04/2025

TIME: 8:00 AM – 11:00 AM

INSTRUCTIONS TO CANDIDATES

Answer Any THREE Questions

TIME: 3 Hours

This Paper Consists of 2 Printed Pages. Please Turn Over.

QUESTION ONE (20 MARKS)

- a) Define bifurcation (4mks)
- b) State and explain the types of bifurcation (6mks)
- c) Describe the bifurcation of the system $\dot{x} = x^3 - 5x^2 - (\mu - 8)x + \mu - 4$ (10mks)

QUESTION TWO (20MARKS)

- a) Explain bifurcation in two dimensions (4mks)
- b) Define normal form for vector field (2mks)
- c) Name two features of normal form (2mks)
- d) Compute the normal form for the vector field on $\mathbb{R}^2$ in the neighborhood of a fixed point

$$J = \begin{pmatrix} 0 & 1 \\ 0 & 0 \end{pmatrix} \quad (12\text{mks})$$

QUESTION THREE (20MARKS)

- a) Define dynamical system (2mks)
- b) State and explain the classifications of dynamical systems (4mks)
- c) Define differentiable manifold (2mks)
- d) Develop the manifold for $M = \{(u, v, w) \in \mathbb{R}^3 | u^2 + v^2 + w^2 = 1\}$ (12mks)

QUESTION FOUR (20MARKS)

- a) Define normal space and tangent background (4mks)
- b) Define lyapunov characteristic exponent (6mks)
- c) Consider $\dot{x} = x - x^3$.
 $\dot{y} = -y$ Calculate the lyapunov exponent (10mks)

QUESTION FIVE (20MARKS)

- a) Define lyapunov type number (6mks)
- b) Compute the lyapunov type number for the function

$$\begin{pmatrix} \dot{x} \\ \dot{y} \end{pmatrix} = \begin{pmatrix} \lambda & 0 \\ 0 & -\mu \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} \quad \lambda, \mu > 0$$

$$\text{In } m = \{(x, y) | y=0, -1 < x < 1\} \quad (14\text{mks})$$