

UNIVERSITI TEKNOLOGI MARA

TECHNICAL REPORT

DETERMINING THE LOCAL STABILITY
ANALYSIS OF
MICROCEPHALY INDUCED BY ZIKA VIRUS
(ZIKV)

WAN NUR ALIAA BINTI WAN MOHD NOR
2014632406 CS2496D
LIYANA QADIRAH BINTI AB KADIR
2014653434 CS2496D

Report submitted in partial fulfillment of the requirement
for the degree of
Bachelor of Science (Hons.) Mathematics
Center of Mathematics Studies
Faculty of Computer and Mathematical Sciences

JULY 2017

ACKNOWLEDGEMENTS

IN THE NAME OF ALLAH, THE MOST GRACIOUS, THE MOST MERCIFUL.

First of all, we would like to thank Allah for giving us the strength, knowledge and ability to complete our final year project. Without his blessings, this achievement would not have been possible. Besides, this achievement would not have been possible without the kind support and help of many individuals around us. Hereby, we would like to extend our sincere thanks to all of them.

We would like to express deep appreciation and indebtedness to our supervisor, Sir Mohd Rahimie bin Md Noor for his guidance and constant supervision as well as for providing necessary information regarding the project. Without his help, this project would not be complete.

Next, we would like to express gratitude to our parents and family members for providing us with continuous encouragement and unfailing support throughout our years of study. Those encouragement and support help give us the strength to complete this project.

Last but not least, our thank you and appreciation also goes to our lecturers, friends and other individuals who have willingly helped us in completing this project. This accomplishment would not have been possible without them. Thank you.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS	ii
TABLE OF CONTENTS	iii
LIST OF FIGURES	iv
LIST OF TABLES	v
ABSTRACT	vi
1 INTRODUCTION	1
1.1 Research Background	1
1.2 Problem Statement	3
1.3 Research Objective	3
1.4 Significant Of Project	3
1.5 Scope Of Project	4
2 LITERATURE REVIEW	5
3 METHODOLOGY	8
3.1 Derivation of the Model	8
3.2 Local Stability Analysis	13
4 IMPLEMENTATION	15
4.1 Findings and Calculations	15
5 RESULTS AND DISCUSSION	21
6 CONCLUSIONS AND RECOMMENDATIONS	23
REFERENCES	24

ABSTRACT

A non-linear ordinary differential equation model for the risk of microcephaly induced by ZIKV was derived by using a System Dynamic Approach. This research is focusing on a group of pregnant women in Armenia (Quindio), Colombia. By solving the non-linear algebraic system, equilibrium points for each possible cause that induces microcephaly was obtained. Next, Jacobian method was used to calculate eigenvalues for each equilibrium points to estimate the local stability. Then, the local stability analysis will be use to show the behavior of each equilibrium points obtain. Finally, the result was interpreted and conclusion was made.

1 INTRODUCTION

1.1 Research Background

Zika virus (ZIKV) was first isolated from a *Macaque* monkey in the forest region in Uganda during the year of 1947. Then in the year of 1954, the first human case was detected in Nigeria (Rodriguez-Morales et al., 2017). It is an arbovirus that is classified under the flavivirus family which also includes other types of arboviral disease such as Yellow fever, West Nile virus and Dengue virus. It was primarily transmitted by an *Aedes Aegypti* mosquito. In the year of 1960 to 1983, there are a few minor outbreaks that occur in the country such as Senegal, Pakistan, Indonesia, Cambodia, Costa Rica and also Malaysia due to strong rainy season. However, the first colossal outbreak occurs in Pacific Island of Yap in the Federated State of Micronesia in 2007 (Duffy et al., 2009).

According to Foy et al. (2011) in 2008, a US scientist conducted a field work in Senegal. He was sick with ZIKV infection after he returned home from Colorado and he also infected his wife. This marks the first case of **sexual transmission** of ZIKV. In the year of 2013 to 2014, the virus caused an outbreak in Pacific Islands which includes French Polynesia, Easter Islands, The Cook Island and New Caledonia. However, outbreak in French Polynesia with 28,000 cases (11% of population) was intensively investigated.

On 20th March 2014, Besnard et al. (2014) published an article showing the evidence of **perinatal transmission** of ZIKV. Clinical and laboratory features of two mothers and their newborns who had ZIKV infection were included in the article. Based on the result of ZIKV Real-Time Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) performed on serum collected within four days post delivery date, the infants' infection most probably occurred by transplacental transmission. This shows that ZIKV can also be transmitted by perinatal transmission.