ABSTRAK

Gressya Yola Perbina T, NIM 4172230008 (2024). Kontrol Optimal Model SEIR Pada Penyebaran Penyakit Covid-19 dengan Pengaruh Vaksinasi.

Covid-19 (Coronavirus Disease) merupakan penyakit yang menyerang sistem pernafasan akibat infeksi SARS-CoV-2 (Severe Acute Respiratory Syndrome). Covid-19 pertama kali ditemukan di Wuhan, provinsi Hubei, Cina pada Desember 2019 dan dinyatakan sebagai pandemi oleh WHO pada Maret 2020. Peneliti dari berbagai bidang berkontribusi untuk mengatasi pandemi Covid-19. Ilmuwan matematika mempelajari karakteristik epidemi wabah, memprediksi penyebaran virus serta menawarkan berbagai langkah intervensi melalui pengembangan model matematika sehingga dapat mengendalikan penyebaran penyakit. Penelitian ini bertujuan untuk menganalisis stabilitas dan kontrol optimal dari model SEIR penyebaran Covid-19 dengan menerapkan strategi kontrol berupa vaksinasi individu rentan. Analisis kestabilan dilakukan dengan menggunakan Kriteria RouthHurwitz dan analisis kontrol optimal dilakukan dengan menggunakan Prinsip Maksimum Pontryagin. Simulasi numerik analisis kestabilan dan kontrol optimal dilakukan dengan metode Runge-Kutta Orde 4 dan bantuan software Matlab R2016a. Analisis kestabilan menunjukkan bahwa titik ekuilibrium bebas penyakit stabil asimtotik pada saat $R_0 < 1$ dan titik ekuilibrium endemik stabil asimtotik pada saat $R_0 > 1$. Analisis kontrol optimal menunjukkan bahwa strategi kontrol yang diterapkan efektif untuk menurunkan jumlah individu yang terinfeksi Covid-19.

Kata kunci: Covid-19, Vaksinasi, Analisis kestabilan, kontrol optimal, model SEIR.

ABSTRACT

Gressya Yola Perbina T, NIM 4172230008 (2024). Optimal Control of The SEIR Model on The Spread of Covid-19 Disease with The Effect of Vaccination

Covid-19 (Coronavirus Disease) is a disease that attacks the respiratory system due to infection with SARS-CoV-2 (Severe Acute Respiratory Syndrome). Covid-19 was first discovered in Wuhan, Hubei province, China in December 2019 and was declared a pandemic by WHO in March 2020. Researchers from various fields contributed to overcoming the Covid-19 pandemic. Mathematical scientists study the characteristics of plague epidemics, predict the spread of viruses and offer various intervention measures through the development of mathematical models so that they can control the spread of disease. This research aims to analyze the stability and optimal control of the SEIR model for the spread of Covid-19 by implementing a control strategy in the form of vaccination of vulnerable individuals. Stability analysis was carried out using the RouthHurwitz Criterion and optimal control analysis was carried out using Pontryagin's Maximum Principle. Numerical simulation of stability analysis and optimal control was carried out using the Runge-Kutta Order 4 method and the help of Matlab R2016a software using data on the spread of Covid-19. Stability analysis shows that the disease-free equilibrium point is asymptotically stable when $R_0 < 1$ and the endemic equilibrium point is asymptotically stable when $R_0 > 1$ Optimal control analysis shows that the control strategy implemented is effective in reducing the number of individuals infected with Covid-19.

Keywords: Covid-19, Vaccination, Stability analysis, optimal control, SEIR model.