*South East Asian J. of Mathematics and Mathematical Sciences*
*Vol. 19, No. 1 (2023), pp. 301-322*

DOI: 10.56827/SEAJMMS.2023.1901.25 **ISSN (Online): 2582-0850**

**ISSN (Print): 0972-7752**

# MATHEMATICAL ANALYSIS OF SVEIQR MODEL FOR COVID-19

**Laxman Bahadur Kunwar and Vijai Shanker Verma***

Department of Mathematics,
Thakur Ram Multiple Campus, Tribhuvan University, Birgunj, NEPAL

E-mail : laxman.kunwar@trmc.tu.edu.np

*Department of Mathematics and Statistics
Deen Dayal Upadhyaya Gorakhpur University,
Gorakhpur - 273009, Uttar Pradesh, INDIA

E-mail : drvsverma01@gmail.com

(**Received:** *Feb. 21, 2023* **Accepted:** *Apr. 13, 2023* **Published:** *Apr. 30, 2023)*

**Abstract:** In this paper, we have proposed an SVEIQR compartmental model modifying the classical SEIR model with inclusion of vaccinated and quarantined classes to explain the COVID-19 outbreak mathematically. We have calibrated our model with the daily COVID-19 data reported by the WHO coronavirus dashboard. To observe the disease dynamics of COVID-19, a detailed stability analysis of the proposed SVEIQR model is carried out. Our results show that the disease free equilibrium (DFE) is stable if the basic reproduction number is less than unity and unstable otherwise. Moreover, endemic equilibrium (EE) is found to be stable when certain restrictions hold. The expression for effective reproduction number has been derived analytically and its value is calculated based on the reported cases. Sensitivity analysis of effective reproduction number is performed employing PRCCs and Latin hypercube scheme. We have compared short-term and long-term transmission dynamics of COVID-19 for India with different levels of vaccination and without control strategies. The impact of different degrees of control interventions is ascertained with the numerical simulation of the model.

**Keywords and Phrases:** COVID-19, Equilibrium point, Stability, Sensitivity analysis, Effective reproduction number, Numerical simulation.