# **CHAPTER 3**

# **DESIGN OF PROPOSED GENERATOR**

In previous chapters, background about wind energy conversion systems and detailed overview of most used generator types are given. Then, challenges of modern wind turbine systems and fundamental equations are discussed. In chapter 2, direct drive axial flux permanent magnet generator is chosen for design in this thesis study because of its lower mechanical losses due to eliminated gearbox, high torque per volume and axial length advantages to selected axial flux permanent magnet synchronous machine topology. In this chapter electrical and mechanical design parameters of axial flux permanent magnet generator will be described. To do this, analytical design equations of proposed generator are given in the following sub-sections. These design equations will be used in following chapters for genetic algorithm optimization and electromagnetic design. Finally, a comparison of electromagnetic FEA and analytical calculation for given dimensions of proposed generator will be given to ensure the accuracy of the finite element analysis technique.

## Mechanical and Electrical Parameters

In previous chapter, it’s decided to use axial flux permanent magnet synchronous machine. In this machine, inner air-cored stator and outer rotor surface mounted magnets will be used. General overview of proposed generator is given in Figure 1. In Figure 1, three axially stacked generator block are given. However, this image includes only 4 poles of proposed system. Permanent magnets are shown with blue and red colors, showing the direction of magnetization. Concentrated windings are shown with green colors. C-shaped steel rotor discs are shown with gray colors.

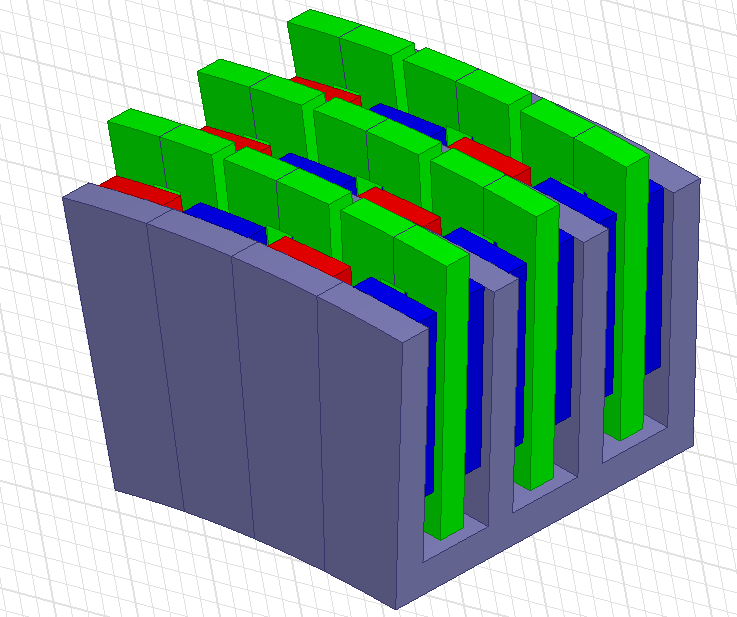


Figure-1. Proposed AFPM generator

## Sizing Equations

Output rms phase voltage of typical synchronous machine is calculated as follows,

(1)

Where, *Eph,rms*is the induced emf and *Zph,rms* is the phase impedence under steady state temperature.

