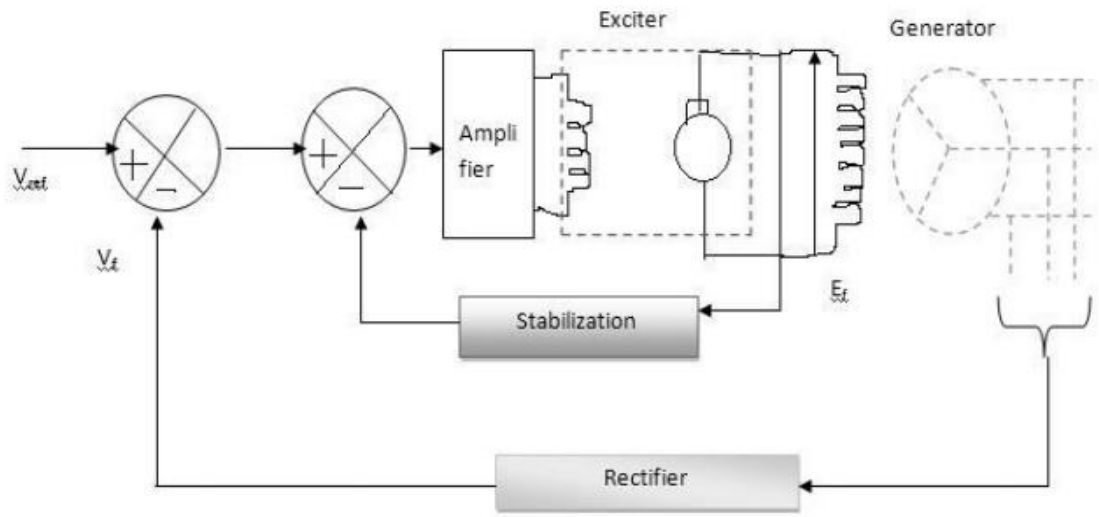
MODELING OF EXCITATION SYSTEM

- Mathematical model of excitation system are essential for the assessment of desired performance requirement, for the design and coordination of supplementary control and protective circuits, and for system stability studies related to the planning and purpose of study.

Generator Voltage Control System

- The voltage of the generator is proportional to the speed and excitation (flux) of the generator.
- The speed being constant, the excitation is used to control the voltage.
- Therefore, the voltage control system is also called as excitation control system or automatic voltage regulator (AVR).
- For the alternators, the excitation is provided by a device (another machine or a static device) called exciter.
- For a large alternator the exciter may be required to supply a field current of as large as 6500A at 500V and hence the exciter is a fairly large machine.
- Depending on the way the dc supply is given to the field winding of the alternator
- (which is on the rotor), the exciters are classified as:
  i) DC Exciters;
  ii) AC Exciters; and
  iii) Static Exciters.
- Accordingly, several standard block diagrams are developed by the IEEE working group to represent the excitation system.

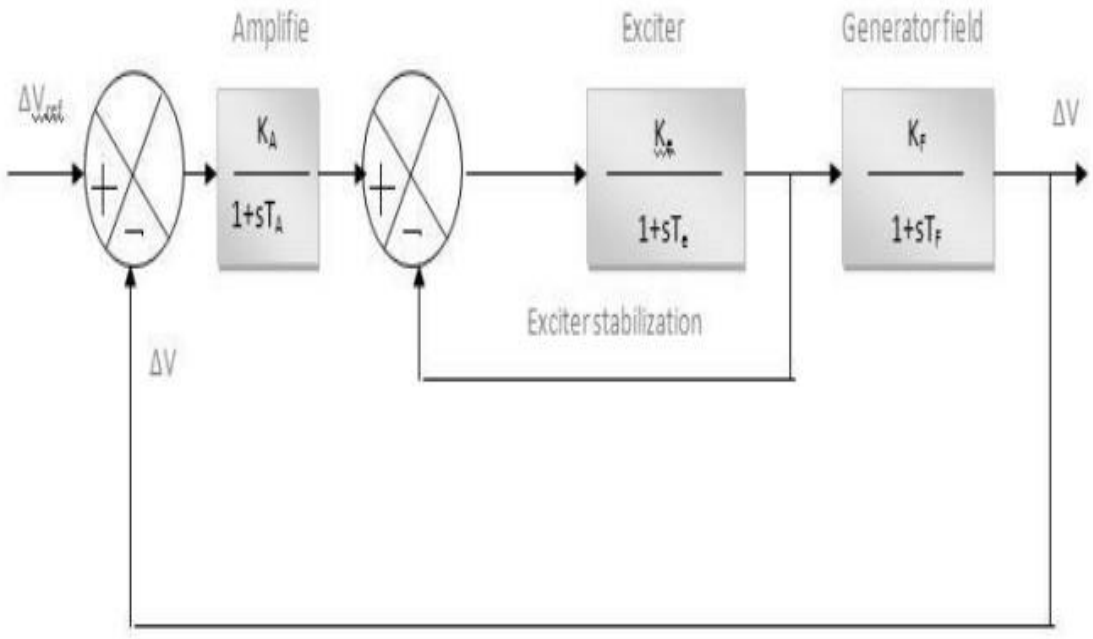


A schematic of Excitation (Voltage) Control System.

- A simplified block diagram of the generator voltage control system .
- The generator terminal voltage Vt is compared with a voltage reference Vref to obtain a voltage error signal ΔV.
- This signal is applied to the voltage regulator shown as a block with transfer function KA/ (1+TAs).
- The output of the regulator is then applied to exciter shown with a block of transfer function Ke/ (1+Tes).
- The output of the exciter Efd is then applied to the field winding which adjusts the generator terminal voltage.
- The generator field can be represented by a block with a transfer function KF/(1+sTF). The total transfer function

$$\frac{\Delta V}{\Delta V_{re}} = \frac{G(s)}{1+G(s)} \quad \text{Where,} \quad G(s) = \frac{K_A K_e K_F}{(1+sT_A)(1+sT_e)(1+sT_F)}$$

The stabilizing compensator shown in the diagram is used to improve the dynamic response of the exciter. The input to this block is the exciter voltage and the output is a stabilizing feedback signal to reduce the excessive overshoot.



A simplified block diagram of Voltage (Excitation) Control System.

Performance of AVR loop

- The purpose of the AVR loop is to maintain the generator terminal voltage within acceptable values.
- A static accuracy limit in percentage is specified for the AVR, so that the terminal voltage is maintained within that value.
- For example, if the accuracy limit is 4%, then the terminal voltage must be maintained within 4% of the base voltage.