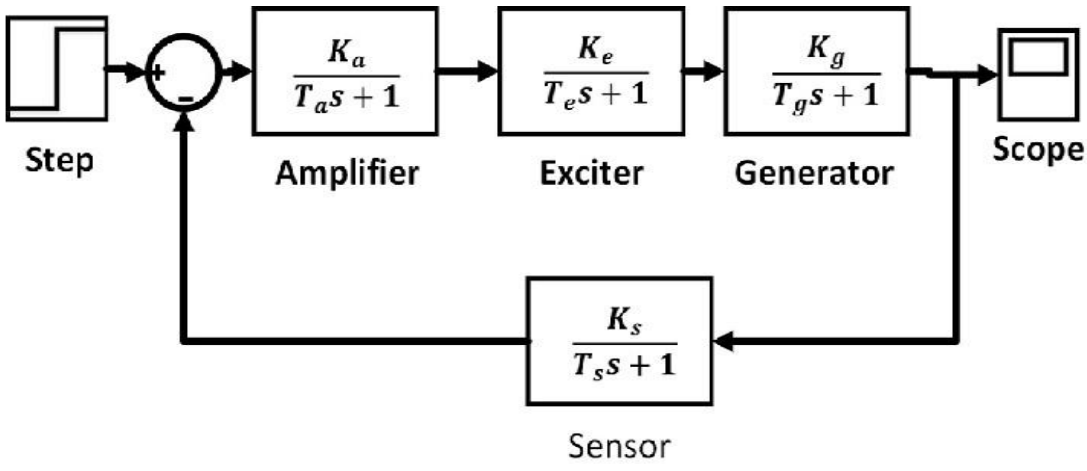
Automatic Voltage Regulator (AVR)

Introduction

The excitation control of synchronous generator is one of the most important factors that improve power system stability and electrical power quality. It adjusts the terminal voltage of synchronous generator to its nominal voltage under all loading conditions (no load, half load, full load and etc..). The **Automatic Voltage Regulator (AVR)** is a device that adjusts the terminal voltage of synchronous generator by varying the excitation current of the exciter of synchronous generator.

Block diagram

The block diagram of the **Automatic Voltage Regulator (AVR)**



Main components of AVR system.

Component	Transfer function	Gain ranges	Time gain ranges	Gain	Time constant
Amplifier	$\frac{K_A}{1+ST_A}$ (1)	$10 \le K_A \le 40$	$0.02 \le T_A \le 0.1$	$K_A = 10$	$T_A = 0.1$
Exciter	$\frac{K_E}{1+ST_E}$ (2)	$1 \le K_E \le 10$	$0.4 \le T_E \le 1$	$K_E = 1$	$T_E = 0.4$
Generator	$\frac{K_G}{1+ST_G}$ (3)	$0.7 \le K_G \le 1$	$1 \le T_G \le 2$	$K_G = 1$	$T_G = 1$
Sensor	$\frac{K_S}{1+ST_S}$ (4)	$0.7 \le K_S \le 1$	$0.001 \le T_S \le 0.06$	$K_S = 1$	$T_S = 0.01$

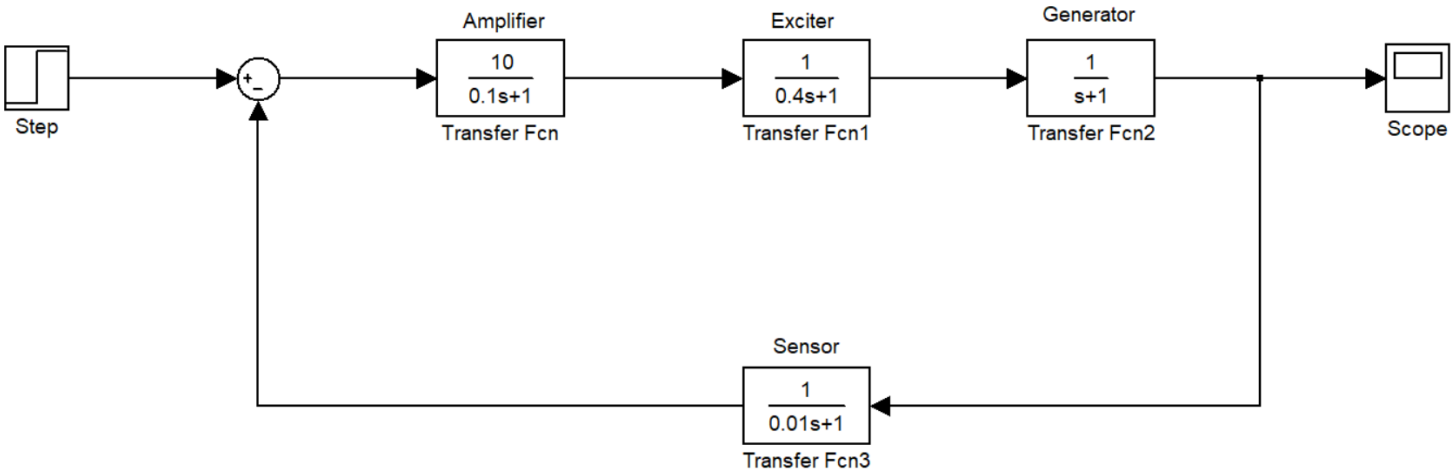
Example:

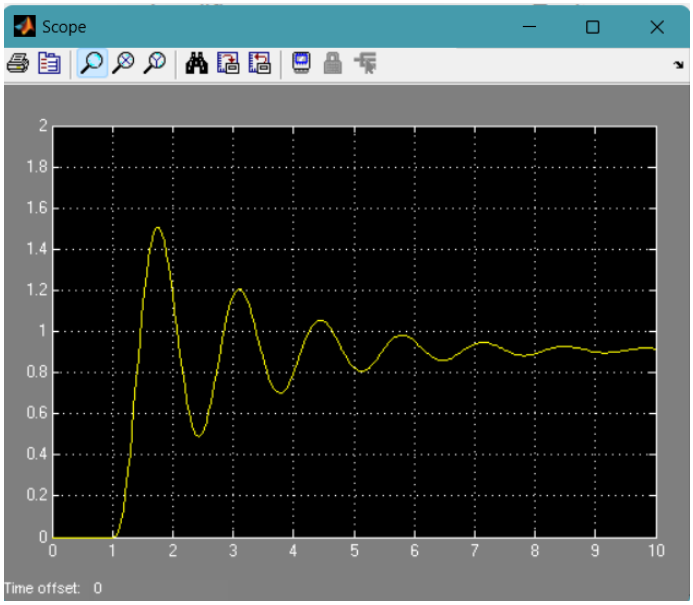
The AVR system of a generator has the following parameters.

	Gain	**Time Constant**
Amplifier	$k_A = 10$	$T_A = 0.1$
Exciter	$k_E = 1$	$T_E = 0.4$
Generator	$k_G = 1$	$T_G = 1$
Sensor	$k_S = 1$	$T_S = 0.01$

Solution

Value	Parameter
Step	
1	Step time
0	Initial value
1	Final value
Sum	
round	Icon shape
|+-	List of signs
Transfer	
[1]	Numerator coefficients
[0.1 1]	Denominator coefficients
Transfer1	
[1]	Numerator coefficients
[0.4 1]	Denominator coefficients
Transfer2	
[1]	Numerator coefficients
[1 1]	Denominator coefficients
Transfer3	
[1]	Numerator coefficients
[0.01 1]	Denominator coefficients


Step
+
-
Amplifier
10
0.1s+1
Transfer Fcn
Exciter
1
0.4s+1
Transfer Fcn1
Generator
1
s+1
Transfer Fcn2
Scope
Sensor
1
0.01s+1
Transfer Fcn3


Scope
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
1
2
3
4
5
6
7
8
9
10
Time offset: 0

Example2:

The AVR system of a generator has the following parameters with **PID**

	Gain	Time Constant
Amplifier	$k_A = 10$	$T_A = 0.1$
Exciter	$k_E = 1$	$T_E = 0.4$
Generator	$k_G = 1$	$T_G = 1$
Sensor	$k_S = 1$	$T_S = 0.01$

Where P=1 I=0.25 D=0.28

Solution