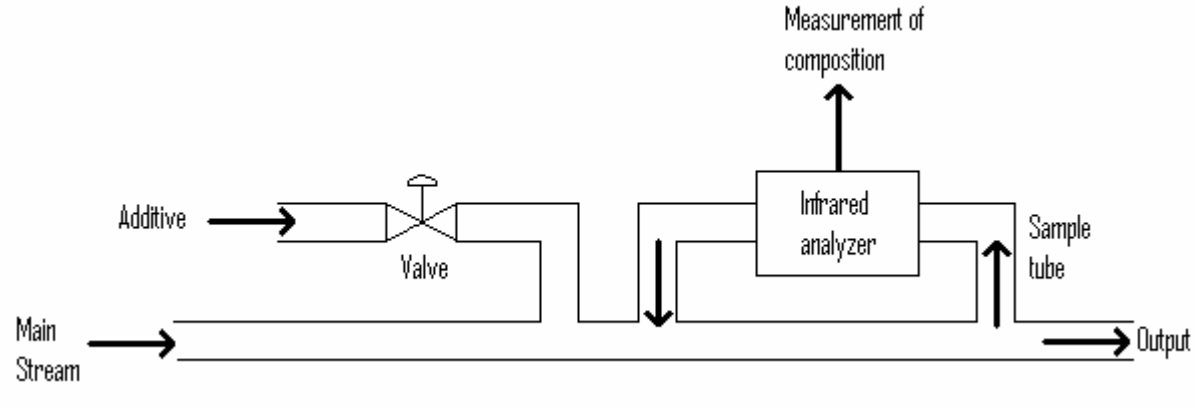
1- *In a chemical process control system, it is valuable to control the chemical composition of the product. To do so, a measurement of the composition can be obtained by using an infrared stream analyzer, as shown in Figure. The valve on the additive stream may be controlled. Complete the control feedback loop, and sketch a block diagram describing the operation of the control loop.*



2- *The story is told about the sergeant who stopped at the jewelry store every morning at nine o'clock and Compared and reset his watch with the chronometer in the window. Finally, one day the sergeant went in to the store and complimented the owner on the accuracy of the chronometer.*

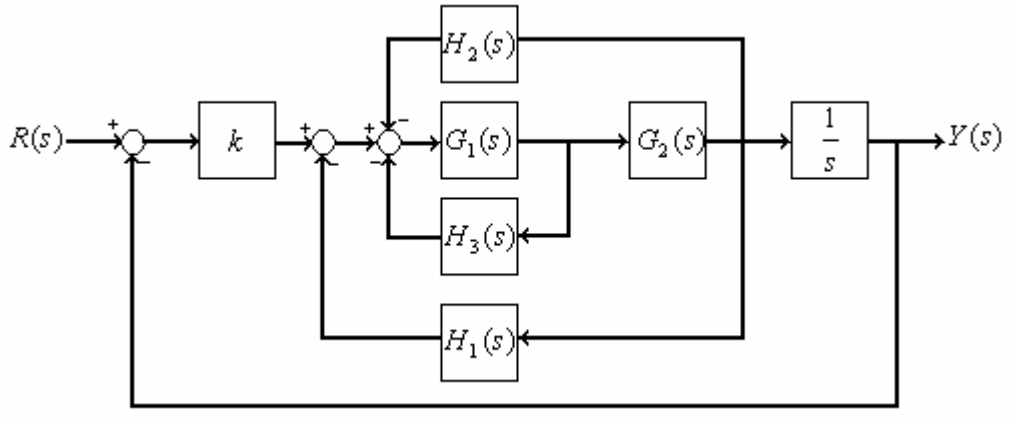
" Is it set according to time signals from Arlington?" asked the sergeant.

" No" said the owner, " I set it by the five o'clock (P.M.) cannon fired from the fort. Tell me, Sergeant , why do you stop every day and check your watch?"

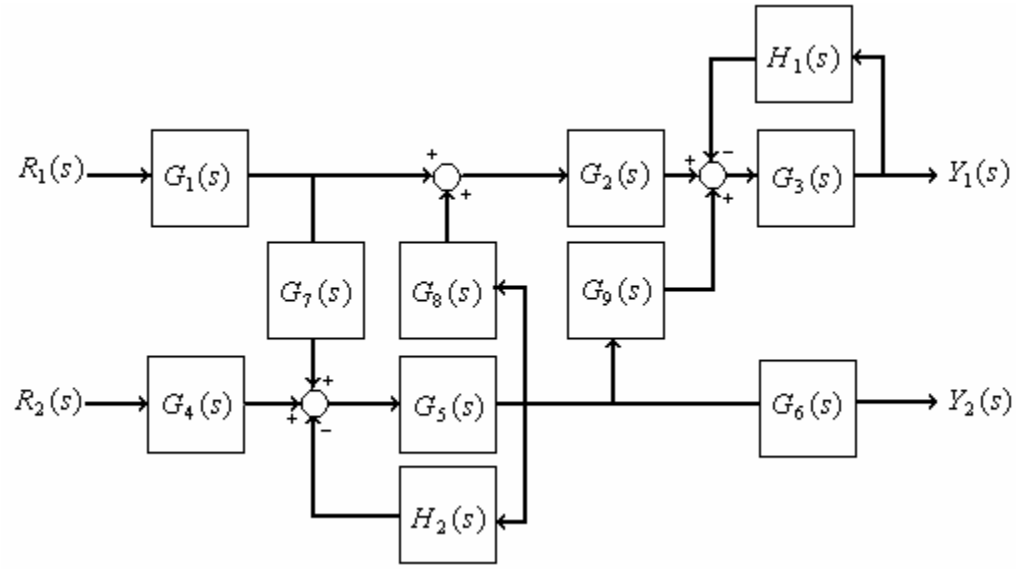
The sergeant replied. " I'm the gunner at the fort!"

Is the feedback prevalent in this case positive or negative? The jeweler's chronometer loses tow minutes each 24-hour period and the sergeant's watch loses three minutes during each eight hours. What is the net time error of the cannon at the fort after 12 days?

3- *A control engineer, N.Minorsky, designed an innovative ship steering system in the 1930s for the U.S. navy. The system is represented bye the signal-flow graph shown in figure where Y(s) is the ship's course, R(s) is the desired course, and A(s) is the rudder angle. Find the transfer function Y(s)/R(s).*



4- *Find the transfer function* $\frac{Y_1(s)}{R_2(s)}$ *for the multivariable system in Figure.*



5- *The position control system for a spacecraft platform is governed bye the following equations:*

$$\frac{d^2p}{dt^2} + 2\frac{dp}{dt} + 4p = \theta$$

$$v_1 = r - p$$

$$\frac{d\theta}{dt} = 0.6v_2$$

$$v_2 = 7v_1 .$$

The variables involved are as follows:

$r(t) =$ *desired platform position*

$p(t) =$ *actual platform position*

$v_1(t) =$ *amplifier input voltage*

$v_2(t) =$ *amplifier output voltage*

$\theta(t) =$ *motor shaft position*

Sketch a signal-flow diagram of the system, identifying the component parts and their transmittances; then determine the system transfer function $\frac{P(s)}{R(s)}$.

6- A system has a signal-flow diagram as shown in Figure. Determine the transfer function.