Q4. PID’s New PID?

Universal Questecopter (UniQuest) seeks your advice on whether they should patent and license the following control circuit presented to them by Dr Ahab of Pequod Industrial Design. He claims to have invented a new PID controller using an integrator and a first-order lag controller as follows:

Is Dr Ahab correct? (i.e. is this a “lead-lag compensator”)? Should UniQuest patent this?

Let’s investigate this by determining the transfer function $C(s) = \frac{E_{\text{out}}(s)}{E_{\text{in}}(s)}$ for this circuit

a. What is the impedance of $Z_1$ and $Z_2$?

b. What is $\frac{E(s)}{E_{\text{out}}(s)}$?

c. What is $\frac{E_{\text{in}}(s)}{E(s)}$?

d. Now consequently what is the transfer function for the entire system as a function of $R_1$, $R_2$, $R_3$, $R_4$, $R_5$, $C_1$ and $C_2$?

e. It’s claimed that ratio $\frac{R_5}{R_4}$ adjusts the overall gain of the controller. Is this correct?