**Homework – Block Diagrams with Units**

1. Show the following
2. Show that the transfer function of two systems in parallel, as seen below, is equal to the sum of the transfer functions i.e. **(5-points)**



1. Show that the transfer function of two systems in series (cascade), as seen below, is equal to the product of the transfer functions i.e. **(5-points)**



1. Show the transfer function for the following **(5-points each)**







1. A feedback control system is given below. The plant transfer function is



1. Show that the plant’s differential equation that relates and is given by. **(5-points)**
2. The compensator and sensor transfer functions are given by and. Modify the equation of part (A) to show that the differential equation that relates and is given by **(5-points)**
3. Show that the system transfer function from the results of part (B) is given by **(5-points)**
4. Use the relationship for block diagrams like the one above to show that **(5-points)**
5. The transfer function pole term yields a time constant where is real. Show that the time constant for the open-loop system is seconds and the time constant for the closed-loop system is seconds **(5-points)**
6. Repeat Question 3 but with the transfer functions, , and .
7. Show that the plant’s differential equation that relates and is given by. **(5-points)**
8. Modify the equation of part (A) to show that the differential equation that relates and is given by +16r **(5-points)**
9. Show that the system transfer function from the results of part (B) is given by **(5-points)**
10. Use the relationship for block diagrams like the one above to show that **(5-points)**
11. For part (e), recall that the transfer function’s underdamped pole terms yields a time constant. Show that the time constant for the open-loop system is second and the time constant for the closed-loop system is seconds **(25-points)**.
12. Repeat Question 3 but with the transfer functions, , and **(25-points)**.
13. Show that the plant’s differential equation that relates and is given by. **(5-points)**
14. Modify the equation of part (A) to show that the differential equation that relates and is given by **(5 points)**
15. Show that the system transfer function from the results of part (B) is given by **(5-points)**
16. Use the relationship for block diagrams like the one above to show that **(5-points)**
17. Show that the time constant for the open-loop system is second and the time constants for the closed-loop system is milliseconds and seconds **(25-points)**.