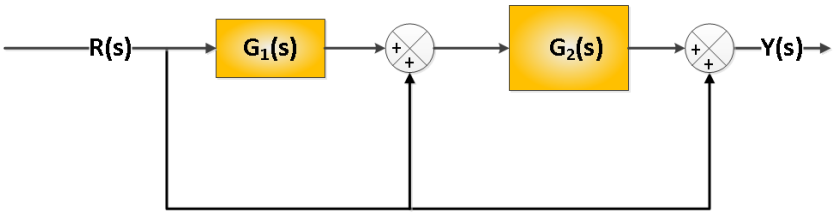
**ENG8344E – CONTROL SYSTEMS**
**Final Review, winter 2019**

*Final exam includes all the topics covered during the semester; not only the topics covered after the Midterm.*
*Final review does not imply that similar and/or identical questions will appear on the final exam. The purpose of the review questions is to assist you to better prepare for the final.*
*Final exam is open book (1.5 hr duration). Only one binder allowed. No loose papers.*
Exam date: Thursday, Apr 25, 2019 at 9:00 AM to 10:30 AM. Location: WT119.

1) Simplify the block diagram shown below, using the block diagram techniques. Obtain the transfer function Y(s)/R(s)




2) Identify the poles and zeros of the following Y(s) function. Given: a = 1, b = 3, c = 1

$$Y(s) = \frac{as + 2}{as^2 + bs + c}$$

3) Pole cancellation technique affects the:
   a) Numerator of the system's transfer function
   b) Denominator of the system's transfer function
   c) Both, the numerator and denominator of the system's transfer function

4) Stability of a control system is not related to the location of the roots in the s-plane.
   a. True
   b. False

5) What is the final value of the given function ω, where Vin is the Setpoint, while ψ is the disturbance effect. Briefly show your work.

$$\omega = V_{in}\frac{2}{3s^2 + 2s + 4} + \Psi s/4\,\frac{2}{3s^2 + 2s + 4}$$

6) Which value of damping factor is used to achieve a critical damping system?

a. Damping factor less than 1
b. Damping factor greater than 1
c. Damping factor less than 1.1 and greater than 0.9

7) Proportional gain gives us control over the steady state error of a system.

a. True
b. False

8) Given the formula below, what value of feedback H can be used to achieve an $F_{Gain}$ of 8.33?

$$F_{Gain} = \frac{1}{H}$$

9) For the given position control system with derivative, where the disturbance effect is expressed as shown below:

$$\theta(s) = \psi(s)\frac{1}{2s^2 + (1+2DH)s + 2PH}$$

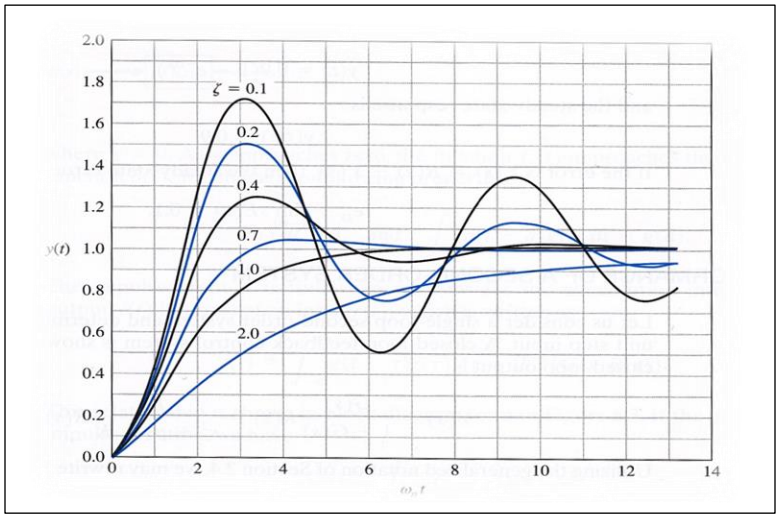
Note: P is the proportional gain of a system, D is the derivative gain, H is the feedback, and ψ is the disturbance.

a) What is the effect of disturbance at the steady-state?

b) Does the derivative part D have effect on the steady-state position of a system?

10) A manufacturing plant is controlled by a PID controller. In order to eliminate the steady-state error: which PID parameter do we need to adjust?

11) In the graph below, identify the underdamped, overdamped, and critically damped response of a system.



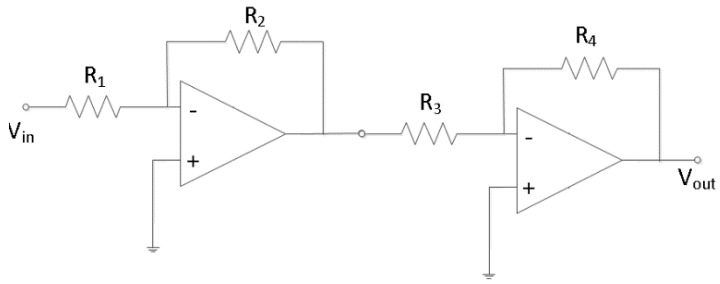
12) The comparator converts the discrete value into a continuous waveform

a. True
b. False

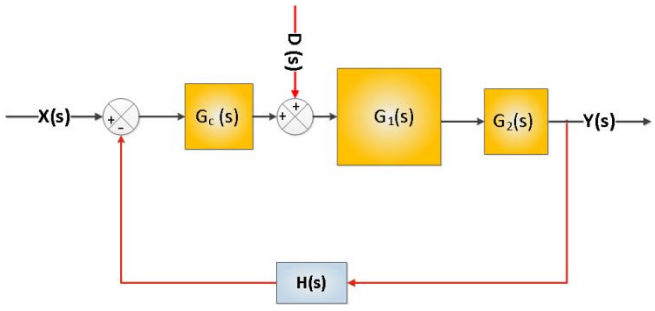
13) As a part of a project group which is responsible for the design of a PID control system, one of assigned tasks is the signal conditioning part of the project. As part of the project requirements is to remove (attenuate) the frequencies above 1kHz. Your plan is to incorporate a passive low pass (RC) filter. Given the resistor value R = 1 kΩ, find the value of a capacitor C, to meet the signal conditioning requirements. Show your work.

14) Given the op amp circuit below…

a. Find the transfer function Vout/Vin for the circuit shown below. Show your work.

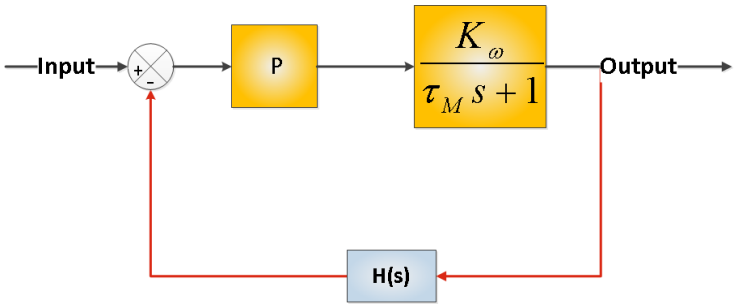



15) For the closed-loop control system shown below, find the output Y(s). X(s) is the input to the system, while D(s) is the disturbance. Show your work.



16) Given: P = 1V/V, $K_\omega$ = 2 (rad/sec)/V, H = 0.1 V / (rad/sec);
$\tau_M$ = 1 sec, Input = 1.5 V.

a) What are the output units of the following system?
b) If the disturbance is applied to the input of the plant, will the output of this system recover completely?
c) What is the output value of this system if input is doubled?




17) For non-linear systems, response to few inputs can be calculated by treating one input at a time and adding the results.

a. True
b. False

18) For the system shown below, calculate:

a. zeta
b. natural frequency
c. settling time (2% criterion) and
d. steady-state gain:

$$T(s)=\frac{8}{2s^2+4s+8}$$

19) What is the steady-state gain of the following system?

$$T(s)=\frac{(2s+4)\times 3}{0.5s^2+0.2s+2}$$