MATH 213 - Tutorial 6: Systems 2 Solutions

1. Determine if the system with transfer function given by

$$H(t) = \frac{7s + 9}{s^5 - 2s^3 - 3s}$$

is marginally stable (i.e. remains bounded for bounded inputs).

2. Consider the unstable system with transfer function given by

$$H(s) = \frac{1}{s - a}$$

for $a > 0$.

   (a) Draw the system diagram for the controlled system.

   (b) Find the transfer function for the proportionally controlled system.

   (c) Determine a condition on k_p so that the controlled system is stable (all poles have a negative real part).

3. Consider the system with transfer function given by

$$H(s) = \frac{1}{s(s+2)(s+5)((s+1)^2+4)((s+4)^2+9)}.$$

   (a) Find the poles of the transfer function.

   (b) Use the locations of each pole to identify the contribution to the behaviour of the system's impulse response due to the existence of that pole.

   (c) Use the final value theorem to find the final value of the impulse response of this system.

   (d) Using the slowest decaying pole(s) to determine an expression that approximated the time for which the impulse response would decay to 1% of its final value. Your expression can be in terms of some coefficients that could be found via partial fraction decomposition.