EE372 HW#1

Due Date: 17 Mar. 2014 class time

Consider a water heater system with the following transfer function model:

$$T(s) = \frac{\frac{cal}{f}}{\left(\frac{s\tau}{f} + 1\right)^2} P(s)$$

here:

P: Electrical input power (W)
T: Increase in Temperature (°C)
cal: Calorie equivalent of 1 Joule = 0.2388
f: Flow rate of water = 50 cc/s
τ : System parameter = 350 cc

Assume that the system is initially at rest, that is, all initial conditions are zero.

The input power P(t) is limited and can only be adjusted in the range of 0 to 7000 W.

Using a proper input power function P(t), we would like to reach a steady state value of 25°C at the output as fast as possible. In this regard, we would like to minimize the following cost function:

$$J = \int_0^{100} (T(t) - 25)^2 dt$$

Provide your best J value and corresponding input power function P(t) in either as a formula or as a graph.

Note: For simulation, you may want to use the command “lsim” in Matlab.