Tutorial Sheet 1 – The Basics (Revision)

Q1 Write an equation relating the input $u(t)$ to the output $y(t)$ for each of the following different types of SISO systems. In addition, clearly identify the dependent variable, the independent variable and the parameters.

(i) A linear time invariant dynamic system

(ii) A nonlinear time invariant dynamic system

(iii) A linear static system

(iv) A nonlinear static system

(v) A linear time variant dynamic system

Q2 (i) Define what is meant by a linear system.

(ii) Prove that the system $y = 2u$ is linear.

(iii) Prove that the system $y = 2\sqrt{u}$ is nonlinear.

(iv) Determine whether or not the system $y = 2u + 1$ is linear or nonlinear.

Q3 Using the Inverse Laplace Transform, obtain $f(t)$ for the Laplace transform:

$$F(s) = \frac{s}{(s+2)(s+5)}$$

Q4 (i) Obtain the Laplace transform for the following differential equation:

$$\frac{dx(t)}{dt} + 3x(t) - 4 = 0 \quad \text{given that at time } t = 0,\ x = 1$$

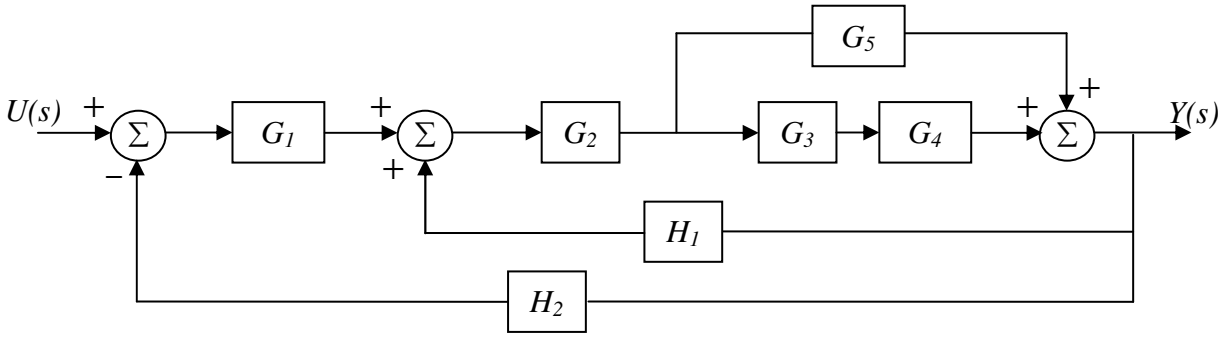
(ii) Using the Inverse Laplace Transform, obtain an expression for $x(t)$.

(iii) Convert the differential equation into a transfer function model.

Q5 (i) State the main advantages of using transfer function models over differential equations?

(ii) Give one disadvantage of using transfer function models over differential equations.

Q6 Using block diagram algebra, determine a single transfer function for the following system:



Q7 Determine the transfer function of the system given below: