Tutorial Sheet 3 – Transfer functions & Block diagram algebra

Q1 Using the Inverse Laplace Transform, obtain $f(t)$ for each of the following Laplace transforms:

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

(ii) $$F(s) = \frac{s^2+8}{s(s^2+2s-8)}$$

Q2 (i) Obtain the Laplace transform for each of the following differential equations:

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

(b) $$\frac{d^2x(t)}{dt} - 4x(t) = 4$$ given that at time $x(0) = 2$ and $\dot{x}(0) = 1$

(ii) Using the Inverse Laplace Transform, obtain an expression for $x(t)$ for each of the above differential equations.

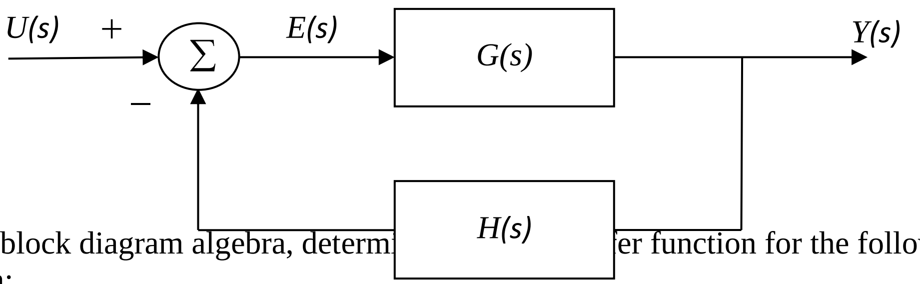
(iii) Convert each of the differential equations into transfer function models.

Q3 Obtain transfer function models for each of the differential equation models obtained in questions 5, 6, 8, 9 and 10 in Tutorial Sheet 1.

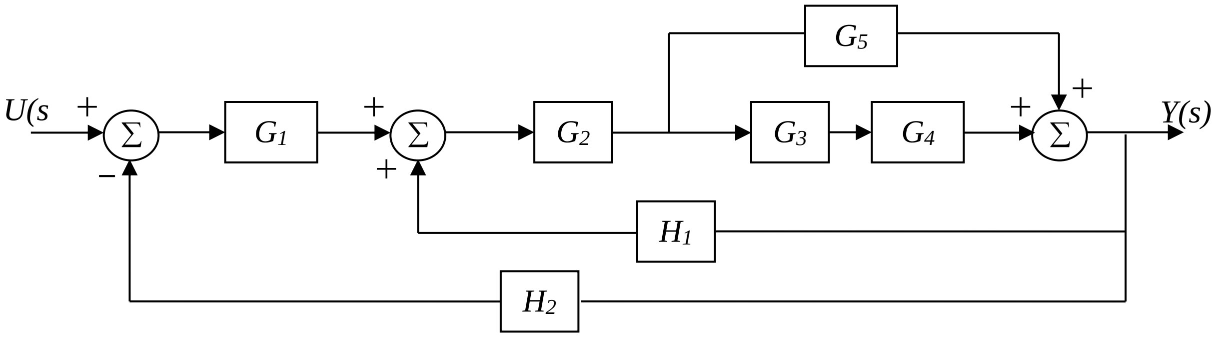
Q4 (i) State the main advantages of using transfer function models over differential equations?

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

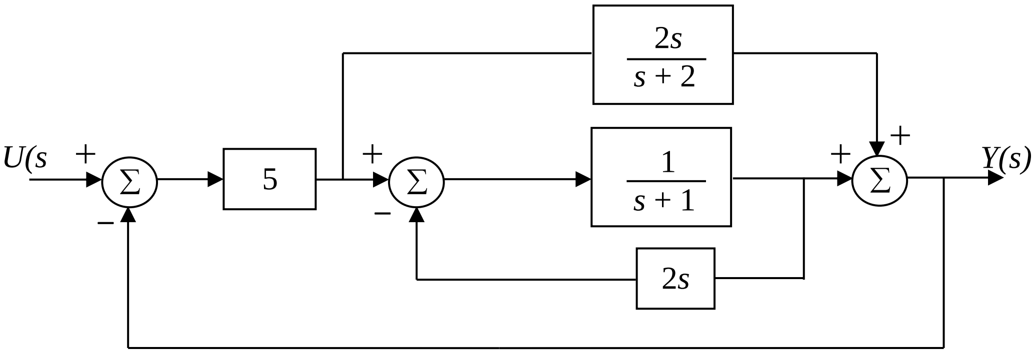
Q5 Derive the closed-loop transfer function (CLTF) for the standard feedback system, as shown below:



Q6 Using block diagram algebra, determi er function for the following system:



Q7 Determine the transfer function of the system given below:



Q8 Determine the transfer function of the system given below. Hence calculate the value of gain k that produces a unity gain system (*i.e. when s = 0, the transfer function block should be equal to 1*).