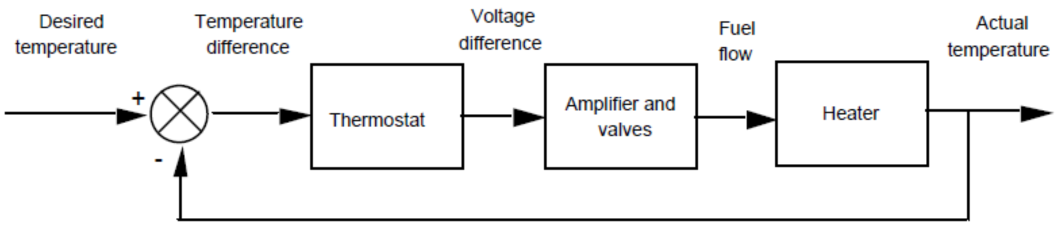
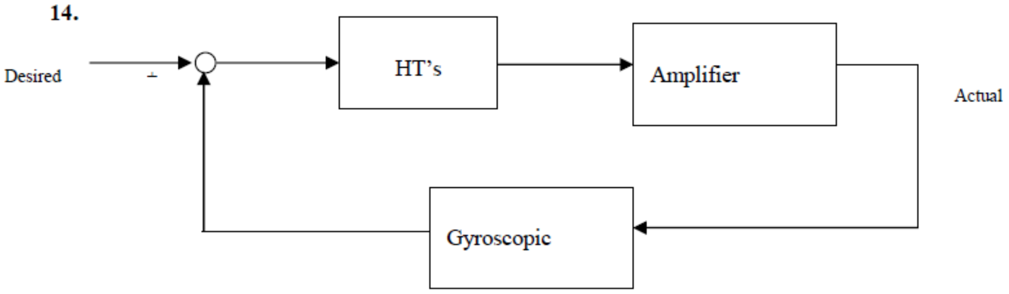
2.



14.



17.

a. $L\frac{di}{dt} + Ri = u(t)$

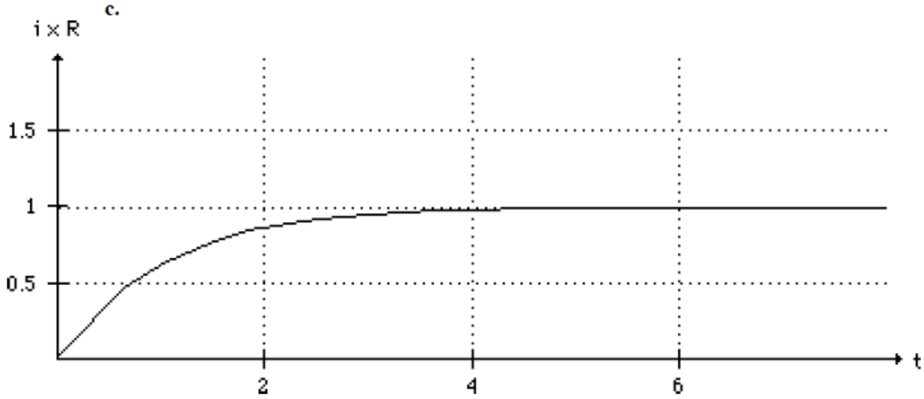
b. Assume a steady-state solution i_{ss} = B. Substituting this into the differential equation yields RB =

1,

from which $B = \frac{1}{R}$. The characteristic equation is LM + R = 0, from which $M = -\frac{R}{L}$. Thus, the total

solution is $i(t) = Ae^{-(R/L)t} + \frac{1}{R}$. Solving for the arbitrary constants, $i(0) = A + \frac{1}{R} = 0$. Thus, $A = -\frac{1}{R}$. The final solution is $i(t) = \frac{1}{R} - \frac{1}{R}e^{-(R/L)t} = \frac{1}{R}(1 - e^{-(R/L)t})$.

c.



2.

a. Using the frequency shift theorem and the Laplace transform of sin ωt, $F(s) = \frac{\omega}{(s+a)^2+\omega^2}$.

b. Using the frequency shift theorem and the Laplace transform of cos ωt, $F(s) = \frac{(s+a)}{(s+a)^2+\omega^2}$.

c. Using the integration theorem, and successively integrating u(t) three times, $\int dt = t$; $\int t\,dt = \frac{t^2}{2}$;

$\int \frac{t^2}{2} dt = \frac{t^3}{6}$, the Laplace transform of $t^3u(t)$, $F(s) = \frac{6}{s^4}$.

4309 93

7.

The Laplace transform of the differential equation, assuming zero initial conditions, is,

$(s^3+5s^2+7s+1)Y(s) = (s^3+6s^2+2s+8)X(s)$.

Solving for the transfer function, $\frac{Y(s)}{X(s)} = \frac{s^3+6s^2+2s+8}{s^3+5s^2+7s+1}$.

9.

The transfer function is $\frac{C(s)}{R(s)} = \frac{s^5+3s^4+4s^3+5s^2+3}{s^6+8s^5+3s^4+2s^3+3s^2+3}$.

Cross multiplying, $(s^6+8s^5+3s^4+2s^3+3s^2+3)C(s) = (s^5+3s^4+4s^3+5s^2+3)R(s)$.

Taking the inverse Laplace transform assuming zero initial conditions,

$$\frac{d^6c}{dt^6} + 8\frac{d^5c}{dt^5} + 3\frac{d^4c}{dt^4} + 2\frac{d^3c}{dt^3} + 3\frac{d^2c}{dt^2} + 5c = \frac{d^5r}{dt^5} + 3\frac{d^4r}{dt^4} + 4\frac{d^3r}{dt^3} + 5\frac{d^2r}{dt^2} + 4r.$$