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Module 19 Alex Yeoh Table 11

```
sympref('FloatingPointOutput',true);
```

Chapter 7

42a

```
clear all
syms vo s vin t
vo = solve((vo-vin)/2+vo/4+vo*3*s, vo)
H(s) = simplify(vo/vin)
V(t) = ilaplace(H(s)*12/s)
subs(V(t),t,200)
```

vo =

*(2*vin)/(12*s + 3)*

H(s) =

*2/(12*s + 3)*

V(t) =

*8 - 8*exp(-0.2500*t)*

```
ans =

8.0000
```

45

```
clear all
syms va vo vs s t
[va,vo] = solve((va-vs)/20000+va/40000+(va-vo)/10000,(vo-
va)/10000+vo*3e-6*s,va,vo)
H(s) = vo/vs
V(t) = ilaplace(H(s)*30/s)


va =

(2*vs*(1.1068e+18*s + 3.6893e+19))/(7.7476e+18*s + 1.1068e+20)


vo =

(7.3787e+19*vs)/(7.7476e+18*s + 1.1068e+20)


H(s) =

7.3787e+19/(7.7476e+18*s + 1.1068e+20)


V(t) =

20 - 20*exp(-14.2857*t)
```

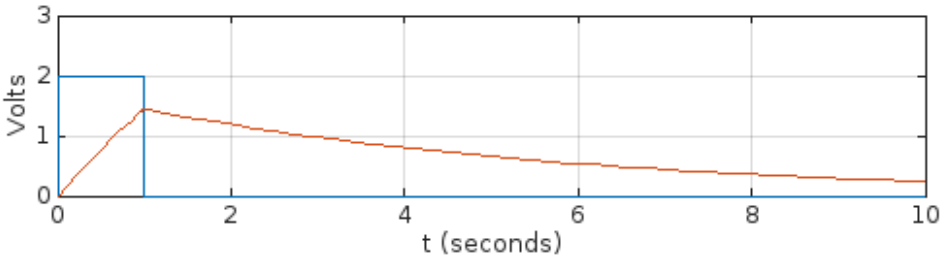
46

```
clear all
syms va vo is s t
[va,vo] = solve(-is+va/6+(va-vo)/2,(vo-va)/2+vo*0.25*s,va,vo)
H(s) = vo/is
V(t) = ilaplace(H(s)*5/s)


va =

(3*is*(s + 2))/(2*s + 1)


vo =
```

```
(6*is)/(2*s + 1)


H(s) =

6/(2*s + 1)


V(t) =

30 - 30*exp(-0.5000*t)
```

49

```
clear all
syms va v is s t
[va,v] = solve(-is+va/4+(va-v)/6,(v-va)/6+v*0.5*s,va,v)
H(s) = v/is
V(t) = ilaplace(H(s)*(2/s-2/s*exp(-1*s)))

unitstep = @(t) +(t>0);
clf
tmax = 10;
subplot(3,1,3)
fplot(@(t) 2*unitstep(t) - 2*unitstep(t-1) , [0,tmax])
hold on
fplot(V(t), [0,tmax]), grid
axis([0, tmax, 0, 3])
xlabel('t (seconds)'); ylabel('Volts')


va =

(4*is*(3*s + 1))/(5*s + 1)


v =

(4*is)/(5*s + 1)


H(s) =

4/(5*s + 1)


V(t) =

8*heaviside(t - 1)*(exp(0.2000 - 0.2000*t) - 1) - 8*exp(-0.2000*t) + 8
```



68

```
clear all
syms vo vs s t
vo = solve(vs/10000+(vs-vo)/10000,vo)
H(s) = vo/vs
V(t) = ilaplace(H(s)*4/s)
```

```
vo =

2*vs


H(s) =

2


V(t) =

8
```

70

```
clear all
syms vo vs s t
vo = solve(vs/20000+(vs-vo)*5e-6*s,vo)
H(s) = vo/vs
V(t) = ilaplace(H(s)*20e-3/s)
```

```
vo =

(2.7105e-19*(3.6893e+19*vs + 3.6893e+18*s*vs))/s


H(s) =

(2.7105e-19*(3.6893e+19*vs + 3.6893e+18*s*vs))/(s*vs)


V(t) =

0.2000*t + 0.0200
```

72

```
clear all
syms vo vi vs s t
vo = vs*(1/(10e-6*s))/(1/(10e-6*s)+10000)
H(s) = vo/vs
V(t) = ilaplace(H(s)*3/s)
vi = vs/(1/(10e-6*s)+10000)
Hi(s) = vi/vs
Vi(t) = ilaplace(Hi(s)*3/s)
% unsure how to do the v(0) = -2 part
```

```
vo =

(100000*vs)/(s*(100000/s + 10000))


H(s) =

100000/(s*(100000/s + 10000))


V(t) =

3 - 3*exp(-10*t)


vi =
```

```
vs/(100000/s + 10000)


Hi(s) =

1/(100000/s + 10000)


Vi(t) =

3.0000e-04*exp(-10*t)
```

73

```
clear all
syms vo vs s t
vo = solve(-vs/(10000+1/(20e-6*s))-vo/20000,vo)
H(s) = vo/vs
V(t) = ilaplace(H(s)*4/s)
% unsure how to do the v(0) = 1 part


vo =

-(2*s*vs)/(s + 5)


H(s) =

-(2*s)/(s + 5)


V(t) =

-8*exp(-5*t)
```

Chapter 8 no clue if any in this section is correct

5

```
clear all
syms v i va is s t
[va,v,i] = solve(-is+va/4+va*0.25*s+(va-v)/s,(v-va)/s+v/6,va/4==i,va,v,i)
H(s) = v/is
Hi(s) = i/is
V(t) = ilaplace(H(s)*4/s)
```

```
I(t) = ilaplace(Hi(s)*4/s)
```

```
va =
```

```
(4*is*(s + 6))/(s^2 + 7*s + 10)
```

```
v =
```

```
(24*is)/(s^2 + 7*s + 10)
```

```
i =
```

```
(is*(s + 6))/(s^2 + 7*s + 10)
```

```
H(s) =
```

```
24/(s^2 + 7*s + 10)
```

```
Hi(s) =
```

```
(s + 6)/(s^2 + 7*s + 10)
```

```
V(t) =
```

```
6.4000*exp(-5*t) - 16*exp(-2*t) + 9.6000
```

```
I(t) =
```

```
0.2667*exp(-5*t) - 2.6667*exp(-2*t) + 2.4000
```

45

```
clear all
syms v i is s t
[v,i] = solve(-is+v/2+v*0.5*s+v/s,v/s==i,v,i)
H(s) = v/is
Hi(s) = i/is
V(t) = ilaplace(H(s)*4/s)
I(t) = ilaplace(Hi(s)*4/s)
```

```
v =
```

```
(2*is*s)/(s^2 + s + 2)
```

```
i =

(2*is)/(s^2 + s + 2)


H(s) =

(2*s)/(s^2 + s + 2)


Hi(s) =

2/(s^2 + s + 2)


V(t) =

6.0474*exp(-0.5000*t)*sin(1.3229*t)


I(t) =

4 - 4*exp(-0.5000*t)*(cos(1.3229*t) + 0.3780*sin(1.3229*t))
```

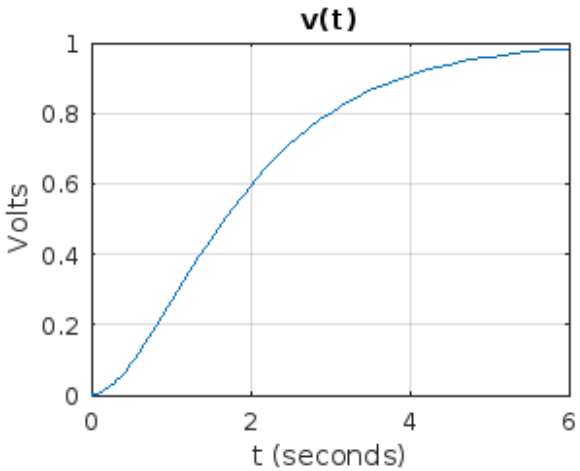
56

```
clear all
syms va vb i vin s t
[va,vb,i] = solve((va-vin)/6+(va-vb)/4+(va-vb)*s/25,(vb-va)*s/25+(vb-va)/4+vb/
(s/4),(vb-va)/4==i,va,vb,i)
Hi(s) = i/vin
I(t) = ilaplace(Hi(s)*20/s)


va =

(4*vin*s^2 + 25*vin*s + 400*vin)/(4*s^2 + 121*s + 1000)


vb =

(vin*(4*s^2 + 25*s))/(4*s^2 + 121*s + 1000)


i =

-(100*vin)/(4*s^2 + 121*s + 1000)


Hi(s) =

-100/(4*s^2 + 121*s + 1000)
```

```
I(t) =

2*exp(-15.1250*t)*(cos(4.6081*t) + 3.2823*sin(4.6081*t)) - 2
```

68

```
clear all
syms vs v s t
v = vs*(1/s)/(1/s+s+2)
H(s) = v/vs
V(t) = ilaplace(H(s)*1/s)

clf
tmax = 6;
fplot(V(t), [0,tmax]), grid
axis([0, tmax, 0, 1])
title('v(t)'); xlabel('t (seconds)'); ylabel('Volts')
% except this, I'm pretty sure about this one


v =

vs/(s*(s + 1/s + 2))


H(s) =

1/(s*(s + 1/s + 2))


V(t) =

1 - t*exp(-t) - exp(-t)
```



Chapter 16 probably also all wrong

16

```
clear all
syms vo i vin s t
[vo,i] = solve((vo-vin)/2+vo*s-4*i, (vin-vo)/2==i,vo,i)
H(s) = vo/vin
H(t) = ilaplace(H(s)*5/s)
```

vo =

*(5*vin)/(2*s + 5)*

i =

*(s*vin)/(2*s + 5)*

H(s) =

*5/(2*s + 5)*

H(t) =

*5 - 5*exp(-2.5000*t)*

48

```
clear all
syms vx vin s t
vx = solve((vx-vin)/10+vx*0.2*s+(vx-3*vx)/(0.25*s),vx)
H(s) = vx/vin
H(t) = ilaplace(H(s)*(5*10^(-2*t))/s)
```

vx =

*(s*vin)/(2*s^2 + s - 80)*

H(s) =

*s/(2*s^2 + s - 80)*

H(t) =

*0.3950/10^(2*t)*exp(-0.2500*t)*sinh(6.3295*t)*

61

```
clear all
syms va vo iin s t
[va,vo] = solve(-iin+va*0.5*s+(va-vo)/s,(vo-va)/s+vo/2+vo*s,va,vo)
H(s) = vo/iin
H(t) = ilaplace(H(s)*10/s)
```

va =

*(2*iin*(2*s^2 + s + 2))/(2*s^3 + s^2 + 6*s + 2)*

vo =

*(4*iin)/(2*s^3 + s^2 + 6*s + 2)*

H(s) =

*4/(2*s^3 + s^2 + 6*s + 2)*

H(t) =

*20 - 120*symsum((0.5000*exp(t*root(z^3 + z^2/2 + 3*z + 1, z, k)))/(root(z^3 + z^2/2 + 3*z + 1, z, k) + 3*root(z^3 + z^2/2 + 3*z + 1, z, k)^2 + 3), k, 1, 3) - 20*symsum((0.5000*exp(root(z^3 + z^2/2 + 3*z + 1, z, k)*t)*root(z^3 + z^2/2 + 3*z + 1, z, k))/(root(z^3 + z^2/2 + 3*z + 1, z, k) + 3*root(z^3 + z^2/2 + 3*z + 1, z, k)^2 + 3), k, 1, 3) - 40*symsum((0.5000*exp(t*root(z^3 + z^2/2 + 3*z + 1, z, k))*root(z^3 + z^2/2 + 3*z + 1, z, k)^2)/(root(z^3 + z^2/2 + 3*z + 1, z, k) + 3*root(z^3 + z^2/2 + 3*z + 1, z, k)^2 + 3), k, 1, 3)*

66

```
clear all
syms vo vs s t
vo = solve(-vs/20000-vo*50e-6*s-vo/10000,vo)
H(s) = vo/vs
H(t) = ilaplace(H(s)*(3*10^(-5*t))/s)
```

vo =

-vs/(s + 2)

H(s) =

```
-1/(s + 2)
```

```
H(t) =

1.5000/10^(5*t)*exp(-2*t) - 1.5000/10^(5*t)
```

misc extra questions

7.59

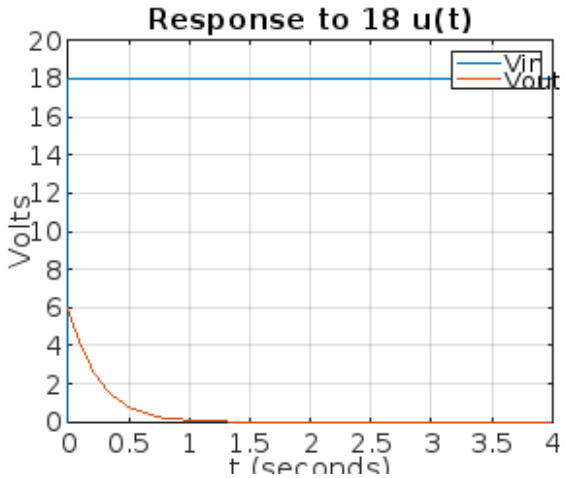
```
clear all
syms Vin Va Vout s t
[Va, Vout] = solve((Va-Vin)/6 + Va/3 + Va/(4+1.5*s) == 0,...
  Vout == Va*1.5*s/(1.5*s+4), Va, Vout)
%
H(s) = simplify(Vout/Vin)
% Define unitstep for plotting
unitstep = @(t) +(t>0);
clf
figure(59)
tmax = 4;
% The response to 18u(t)
vout(t) = ilaplace(H(s)*18/s)
fplot(@(t) 18*unitstep(t), [0,tmax])
hold on
fplot(vout(t), [0,tmax]), grid
axis([0, tmax, 0, 20])
legend('Vin','Vout')
title('Response to 18 u(t)'); xlabel('t (seconds)'); ylabel('Volts')
```

```
Va =

(0.1111*Vin*(3*s + 8))/(s + 4)
```

```
Vout =

(0.3333*Vin*s)/(s + 4)
```

```
H(s) =

(0.3333*s)/(s + 4)
```

```
vout(t) =

6*exp(-4*t)
```



7.69

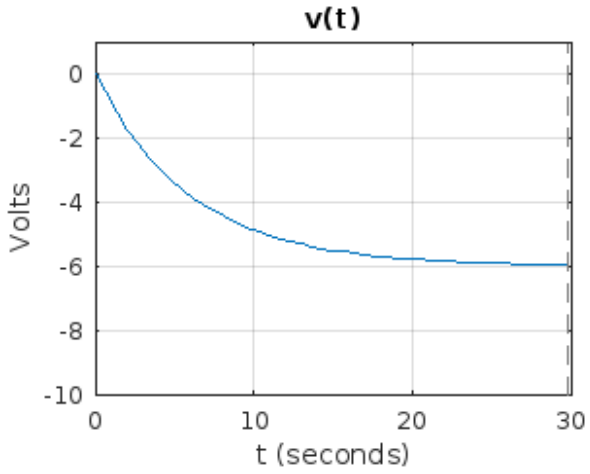
```
clear all
syms Vin Vout s t
Vout = solve((0-Vin)/10000 + (0-Vout)/120000 + (0-Vout)*s*25e-3 == 0, Vout) %
H(s) = simplify(Vout/Vin)
clf
figure(69)
tmax = 100000;
% Plot the input and output
vin(t) = ilaplace(4/s);
vout(t) = ilaplace(H(s)*(4/s))
fplot(vin(t), [0,tmax])
hold on
fplot(vout(t), [0,tmax]), grid
axis([0, tmax, -50, 5])
legend('Vin','Vout')
title('Response to 4 u(t)'); xlabel('t (seconds)'); ylabel('Volts')
```

Vout =

```
-(12*Vin)/(3000*s + 1)


H(s) =

-12/(3000*s + 1)


vout(t) =

48*exp(-3.3333e-04*t) - 48
```

8.39

```
clear all
syms Vin60 Vin30 Va s t
Va = solve(Va/20 + (Va-Vin60)/30 + (Va-Vin30)/(s*0.25+(1/(0.5*s)))== 0, Va)
V(s) = (Va-Vin30)*(1/(0.5*s))/(s*0.25+(1/(0.5*s)))
% We could separate this via superposition, but going right to the answer: clf
figure(39)
tmax = 30;
% Find and plot the output
v(t) = ilaplace(subs(V(s),{Vin60,Vin30}, {60/s, 30/s}))
fplot(v(t), [0,tmax]), grid
axis([0, tmax, -10, 1])
title('v(t)'); xlabel('t (seconds)'); ylabel('Volts')


Va =

(2*Vin60*s^2 + 240*Vin30*s + 16*Vin60)/(5*s^2 + 240*s + 40)


V(s) =

-(2*(Vin30 - (2*Vin60*s^2 + 240*Vin30*s + 16*Vin60)/(5*s^2 + 240*s + 40)))/
(s*(0.2500*s + 2/s))


v(t) =

6*exp(-24*t)*(cosh(23.8328*t) + 1.0070*sinh(23.8328*t)) - 6
```



8.71

```
clear all
syms Iin13 Vin39 Va Vb s t
[Va, Vb] = solve(Va/6 - Iin13 + (Va-Vb)*s*0.4 == 0,...
Vb/20 + (Vb-Va)*s*0.4 + (Vb-Vin39)/(s+6) == 0, Va, Vb)
% We could separate this via superposition, but going right to the answer: clf
figure(71)
tmax = 30;
% Find and plot the output
v(t) = ilaplace(subs(Vb,{Iin13,Vin39}, {13/s, 39/s}))
fplot(v(t), [0,tmax]), grid
axis([0, tmax, 20, 70])
title('v(t)'); xlabel('t (seconds)'); ylabel('Volts')
```

Va =

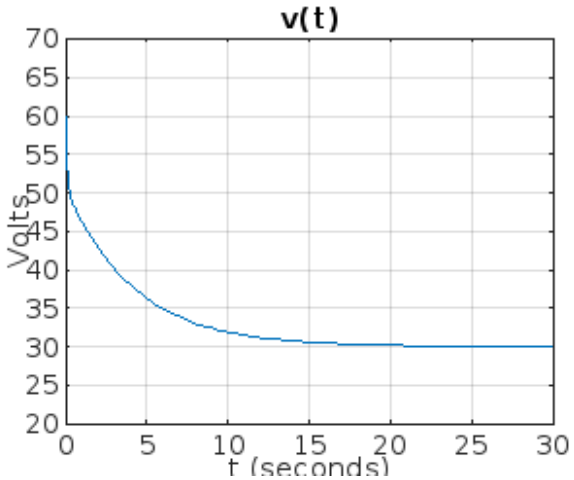
(30(26*Iin13 + 49*Iin13*s + 8*Vin39*s + 8*Iin13*s^2))/(52*s^2 + 557*s + 130)*

Vb =

(20(5*Vin39 + 72*Iin13*s + 12*Vin39*s + 12*Iin13*s^2))/(52*s^2 + 557*s + 130)*

v(t) =

*30*exp(-5.3558*t)*(cosh(5.1171*t) + 0.3777*sinh(5.1171*t)) + 30*



16.81

```
clear all
syms r c l va io vin s
va = solve(-vin/r-va*c*s,va)
io = va/(l*s)
T(s) = io/vin
```

```
va =

-vin/(c*r*s)
```

```
io =

-vin/(c*l*r*s^2)
```

```
T(s) =

-1/(c*l*r*s^2)
```

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