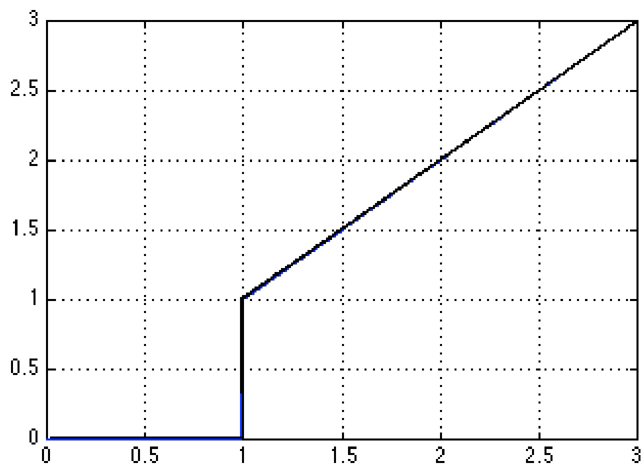
REVIEW QUESTIONS
EE-202
Exam I

MULTIPLE CHOICE.

1. The mathematical expression of the time function (note that the function continues as an increasing straight line beyond the right edge of the graph) given below is:

(a) $r(t)$ (b) $tu(t-1)$ (c) $r(t-1) + u(t)$
(d) $(t-1)u(t-1)$ (e) $r(t) - r(t-1)$ (f) $r(t) - u(t-1)$
(g) Something else



2. Recall that $e \approx 2.7$. The Laplace Transform of $e^{-t}u(t-2)$ has the form $\dfrac{Ae^{-2s}}{s+1}$ where A is closest to:

(a) 3 (b) 1 (c) 1/3 (d) 1/9 (e) 9
(f) –1/9 (g) Something else

3. The Laplace transform of $\sin(\frac{\pi}{6}t)\delta(t-1)$ is $A(s)e^{-s}$ where $A(s)$ is:

(a) $\sin\left(\frac{\pi}{6}\right)e^{-s}$ (b) $\sin\left(\frac{\pi}{6}\right)$ (c) $\dfrac{\pi/6}{s^2 + (\pi/6)^2}$ (d) $\dfrac{\pi/6}{(s+1)^2 + (\pi/6)^2}$

(e) $\sin(0)$ (f) $\sin\left(\frac{\pi}{6}\right)\dfrac{e^{-s}}{s}$ (g) Something else

4. A partial fraction expansion is given by

$$\frac{8}{(s+2)^2(s+4)} = \frac{A}{s+2} + \frac{B}{(s+2)^2} + \frac{C}{s+4}$$

Then A is:
(a) –2 (b) 2 (c) –4 (d) 4 (e) 0
(f) 0.5 (g) Something else

5. The inverse Laplace Transform of $\dfrac{3s^2+4s+5}{s^2+2s+5}$ is $K\delta(t)+\left[Ae^{-t}\cos(2t)+Be^{-t}\sin(2t)\right]u(t)$ where B is:

(a) 5 (b) 2.5 (c) –2 (d) –4
(e) –5 (f) 2 (g) Something else

6. The Laplace Transform of $f(t)$ is given as $F(s)=\dfrac{1-e^{-s}}{s}$. Then, the Laplace Transform of $\dfrac{df(t)}{dt}$ with $f(0^-)=3$ is:

(a) $-3-e^{-s}$ (b) $-1-e^{-s}$ (c) $-4-e^{-s}$ (d) $-2-e^{-s}$

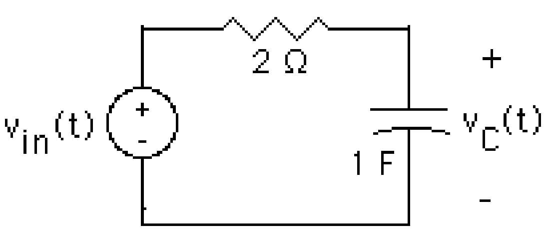
(e) $\dfrac{1-e^{-s}}{s^2}-3$ (e) $\dfrac{1-e^{-s}}{s^2}-\dfrac{3}{s}$ (g) Something else

7. For the same $f(t)$ as Problem 6, the Laplace Transform of $tf(t)$ is $\dfrac{A+B(s)e^{-s}}{s^2}$ where $B(s)$ is:

(a) 1 (b) –s (c) s (d) $1-s$ (e) 1+s
(f) –(1+s) (g) Something else

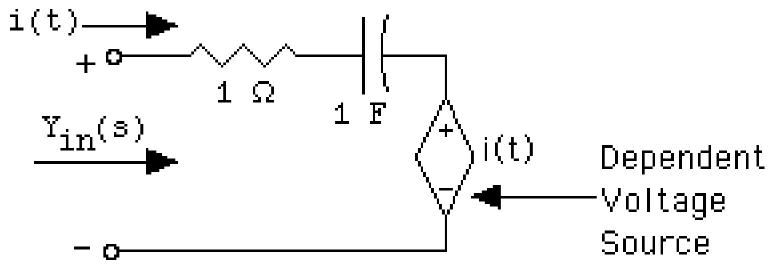
8. The circuit given below has differential equation $\dfrac{d}{dt}v_C(t)+0.5v_C(t)=0.5v_{in}(t)$ with $v_{in}(t)=10\delta(t)$ and $v_C(0^-)=5$ V. Then $v_C(t)=Ae^{-Bt}u(t)$ where A is:

(a) 20 (b) 15 (c) 10 (d) 5 (e) 0
(f) –10 (g) Something else



9. For the circuit given below, the input admittance is $K + \dfrac{A}{s+B}$ where A is:

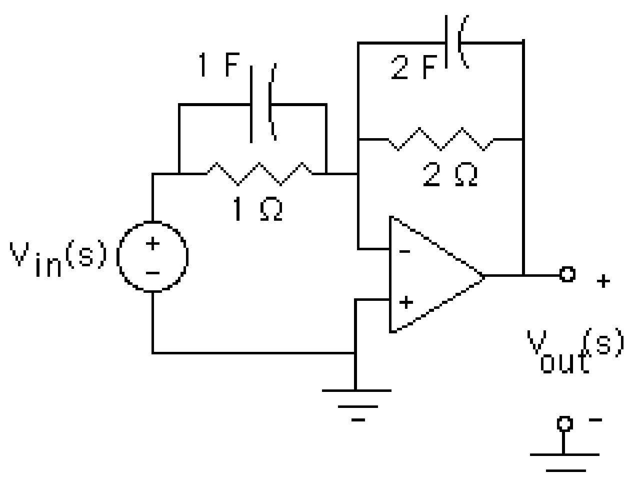
(a) 1 (b) –0.25 (c) –1 (d) –1.25
(e) –0.5 (f) 0.5 (g) Something else



10. The transfer function of the circuit below is:

(a) $-\dfrac{s+1}{2s+0.5}$ (b) $-\dfrac{s+1}{2s+2}$ (c) $-\dfrac{2s+0.5}{s+1}$ (d) $\dfrac{2s+2}{s+1}$

(e) $\dfrac{s+1}{2s+0.5}$ (f) $-\dfrac{2s+2}{s+1}$ (g) Something else

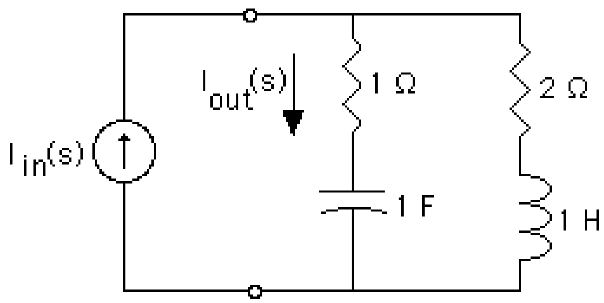


11. The transfer function of the circuit below is:

(a) 1 (b) $s/(s+1)$ (c) $s/(s+1) + 1/(s+2)$

(d) $\dfrac{s}{s(s+2)+(s+1)}$ (e) $\dfrac{s(s+2)}{s(s+2)+(s+1)}$

(f) $\dfrac{(s+1)}{s(s+2)+(s+1)}$ (g) Something else

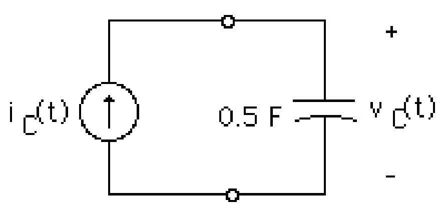


12. For the circuit below, recall that $v_C(t) = \dfrac{1}{C}\int_{-\infty}^{t} i_C(q)dq$. If $I_C(s) = \dfrac{0.5}{s}$ and $V_C(s) = \dfrac{1}{s^2} + \dfrac{2}{s}$, then

$v_C(0^-) =$:

(a) 1 (b) 2 (c) –1 (d) –2 (e) 0.5

(f) –0.5 (g) Something else



13. For the circuit below, the values of R (in Ω) and C (in F) that make the input admittance

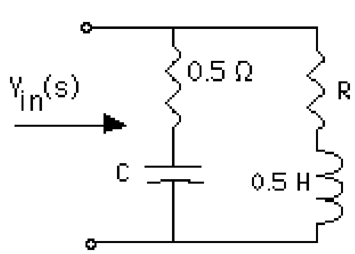
$$Y_{in}(s) = \frac{4}{2s+1} + \frac{4s}{2s+1}$$

are:

(1) R = 1, C = 4 (2) R = 4, C = 0.25 (3) R = 4, C = 4

(4) R = 0.25, C = 0.25 (5) R = 0.5, C = 2 (6) R = 0.25, C = 4

(7) none of above

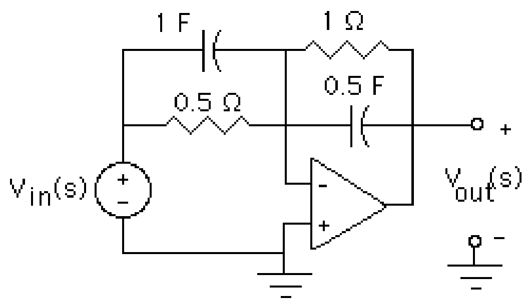


14. The transfer function for the following op amp circuit is:

(1) $-\dfrac{s+0.5}{0.5s+1}$ (2) $-\dfrac{0.5s+1}{s+0.5}$ (3) $\dfrac{s+0.5}{0.5s+1}$

(4) $\dfrac{s+1}{0.5s+1}$ (5) $-\dfrac{s+1}{0.5s+1}$ (6) –2

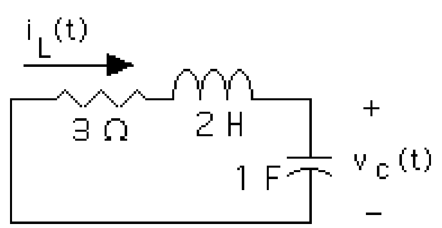
(7) none of above



15. In a circuit shown below, the initial conditions are $i_L(0^-)=1$ amp and $v_C(0^-)=2$ volt. If $i_L(t)=ae^{-0.5t}u(t)+be^{-dt}u(t)$ then a is:

(1) 1 (2) 2 (3) 3 (4) 4

(5) –4 (6) –3 (7) –1



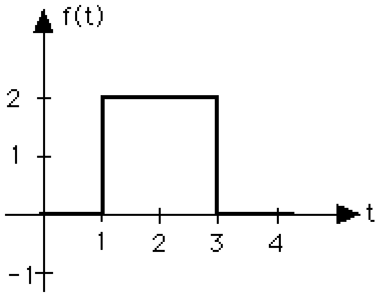
16. The Laplace transform of f(t) = 2cos(t + 1) δ(t – 1) + 2cos(t – 1) δ(t + 1) is:

(1) $2e^{s}\dfrac{s}{s^2+1}$ (2) $2\left[e^{s}+e^{-s}\right]\dfrac{s}{s^2+1}$ (3) $2\cos(2)e^{-s}+2\cos(-2)e^{s}$

(4) $2\cos(2)e^{-s}$ (5) $2\cos(-2)e^{s}$ (6) $2e^{-(s+1)}\dfrac{s+1}{(s+1)^2+1}$

(7) None of above

17. The Laplace transform of



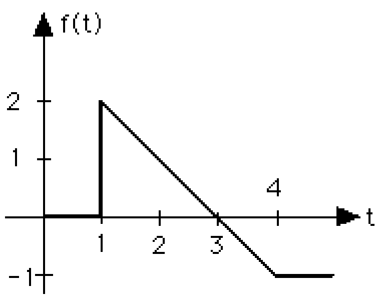
is:

(1) u(t) – u(t –2) (2) $e^{-s}u(t-1)-e^{-3s}u(t-3)$ (3) $e^{-s}-e^{-3s}$

(4) $\dfrac{1-e^{-3s}}{s}$ (5) $\dfrac{e^{s}-e^{3s}}{s}$ (6) $\dfrac{e^{-s}-e^{-3s}}{s}$

(7) None of above

18. The Laplace transform of



is:

(1) $F(s)=\dfrac{e^{-s}}{s}-\dfrac{e^{-s}}{s^2}+\dfrac{e^{-4s}}{s}$ (2) $F(s)=\dfrac{2e^{-s}}{s}-\dfrac{e^{-s}}{s^2}+\dfrac{e^{-4s}}{s}$

(3) $2\left[\dfrac{e^{-s}}{s}-\dfrac{e^{-s}}{s^2}+\dfrac{e^{-4s}}{s}\right]$ (4) $2\left[\dfrac{e^{-s}}{s}-\dfrac{e^{-s}}{s^2}+\dfrac{e^{-4s}}{s^2}\right]$

(5) $F(s)=\dfrac{2e^{-s}}{s}-\dfrac{e^{-s}}{s^2}+\dfrac{e^{-4s}}{s^2}$ (6) $\dfrac{2e^{-s}}{s}-\dfrac{2e^{-s}}{s^2}+\dfrac{e^{-4s}}{s^2}$

(7) None of above

19. The output of a circuit has Laplace transform $V_{out}(s)=\dfrac{16}{s^3(s+2)}$ then

$$v_{out}(t)=Ae^{-2t}u(t)+Bu(t)+\textit{other terms}$$

where A =:

(1) 8 (2) 2 (3) –2 (4) 4 (5) –4

(6) 16 (7) None of above

20. Referring again to problem 19 above, the value of B is:

(1) 8 (2) 2 (3) –2 (4) 4 (5) –4
(6) 16 (7) None of above

21. The transfer function $H(s) = \dfrac{V_{out}(s)}{V_{in}(s)}$ associated with the integro-differential equation

$$v_{out}^{'}(t) + 4v_{out}(t) + 4\int_{0^-}^{t} v_{out}(q)dq = 2v_{in}^{'}(t) - 8\int_{0^-}^{t} v_{in}(q)dq$$

is:

(1) $\dfrac{s^2+4s+4}{s^2-4}$ (2) $\dfrac{s^2+4s+4}{2s^2-8}$ (3) $\dfrac{2s-8}{s+4+\frac{4}{s}}$

(4) $\dfrac{s+4+\frac{4}{s}}{2s-8}$ (5) $\dfrac{2s-8}{s^2+4s+4}$ (6) $\dfrac{2s^2-8}{s^2+4s+4}$

(7) None of above

22. For a > 0, the Laplace transform of $f(t) = 2e^{(t+a)}\delta(t-a) + 2e^{(t-a)}\delta(t+a)$ is:

(1) $2e^{2a}$ (2) $2e^{2a} + 2e^{-2a}$ (3) $2e^{-2a}$
(4) $2e^{-a(s-2)}$ (5) $2e^{a(s-2)}$ (6) $2e^{-a(s-2)} + 2e^{a(s-2)}$
(7) None of above

23. The output of a circuit has Laplace transform $V_{out}(s) = \dfrac{64}{s^3(s+2)}$ with

$$v_{out}(t) = Ae^{-2t}u(t) + Bu(t) + other - terms$$

the value of B is:

(1) –8 (2) 2 (3) –4 (4) 4 (5) 8
(6) –16 (7) 32

24. Suppose $L\{f(t)\} = -\ell n\left[\dfrac{s}{s+2}\right]$. Then $L\{tf(t)\}$ is:

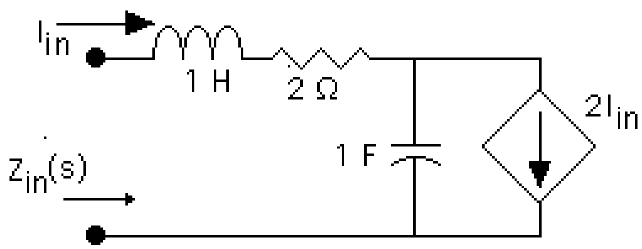
(1) $\dfrac{1}{s} + \dfrac{1}{s+2}$ (2) $\dfrac{1}{s+2} - \dfrac{s}{(s+2)^2}$ (3) $\dfrac{-1}{s+2} + \dfrac{s}{(s+2)^2}$
(4) $\dfrac{1}{s} - \dfrac{1}{s+2}$ (5) $-\dfrac{1}{s} + \dfrac{s}{(s+2)^2}$ (6) $\dfrac{1}{s} - \dfrac{s}{(s+2)^2}$
(7) $\dfrac{s+2}{s}$ (8) None of above

25. The Thevenin equivalent admittanace $Y_{in}(s)$ of the circuit below is:

(1) $s+2+\frac{3}{s}$ (2) $s+2-\frac{1}{s}$ (3) $s+2+\frac{1}{s}$

(3) $\frac{1}{s}+0.5-s$ (4) $\frac{1}{s}+0.5+3s$ (5) $\frac{1}{s}+0.5+s$

(6) $s+2-\frac{3}{s}$ (7) None of Above

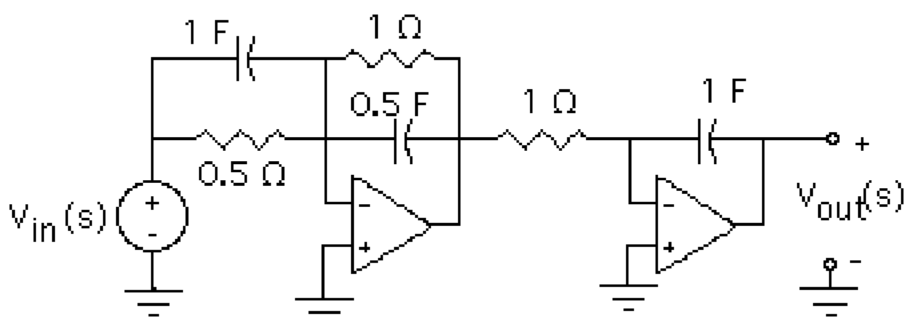


26. The transfer function for the following op amp circuit is:

(1) $\frac{(s+2)}{s(0.5s+1)}$ (2) $\frac{s(0.5s+1)}{s+2}$ (3) $\frac{0.5s+1}{s(s+2)}$

(4) $-\frac{0.5s+1}{s(s+2)}$ (5) $\frac{-(s+2)}{s(0.5s+1)}$ (6) $\frac{s(s+2)}{2s+1}$

(7) $\frac{s(s+2)}{0.5s+1}$



27. The Laplace Transform of $f(t)$ is given as $F(s)=\frac{1-e^{-(s-a)}}{s-a}$. Then the Laplace Transform of

$e^{-at}tf(t)$ is:

(1) $\frac{1-e^{-(s-a)}}{(s-a)^2}-\frac{e^{-(s-a)}}{s-a}$ (2) $\frac{1-e^{-s}}{s}$ (3) $\frac{1-e^{-s}}{s^2}-\frac{e^{-s}}{s}$

(4) $\frac{1-e^{-s}}{s^2}$ (5) $-\frac{1-e^{-s}}{s^2}$ (6) $\frac{1-e^{-(s-2a)}}{(s-2a)^2}-\frac{e^{-(s-2a)}}{s-2a}$

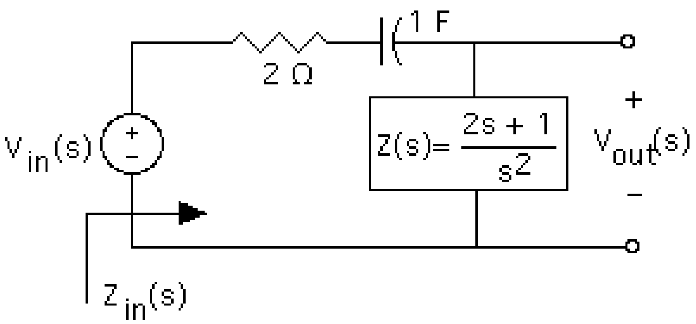
(7) None of above

28. For the circuit below, the admittance $Y_{in}(s)$ =:

(1) $\dfrac{2s^2+3s+1}{s^2}$ (2) $0.5+s+\dfrac{s^2}{2s+1}$ (3) $\dfrac{1}{2+s+\dfrac{s^2}{2s+1}}$

(4) $\dfrac{s^2}{2s^2+3s+1}$ (5) $\dfrac{s^2+s}{2s+1}$ (6) $\dfrac{2s+1}{s^2+s}$

(7) None of above



29. For the circuit of problem 7, if $v_{in}(t) = 4\delta(t)$ V, then $v_{out}(t)$ equals (in volts):

(1) $\left(4e^{-t} - 2e^{-0.5t}\right)u(t)$ (2) $2u(t) + tu(t)$ (3) $2\delta(t) + u(t)$

(4) $4e^{-t}u(t)$ (5) $\delta(t) + 0.5e^{-0.5t}u(t)$

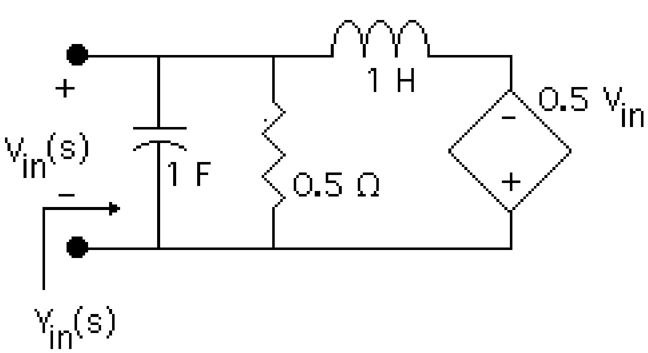
(6) $16\delta(t) + 8u(t)$ (7) none of the above

30. The Thevenin equivalent admittanace $Y_{in}(s)$ of the circuit below is:

(1) $s+2+\dfrac{0.5}{s}$ (2) $s+2+\dfrac{1.5}{s}$ (3) $s+2+\dfrac{1}{s}$

(3) $\dfrac{1}{s}+0.5+s$ (4) $\dfrac{1}{s}+0.5+1.5s$ (5) $\dfrac{1}{s}+0.5-0.5s$

(6) $s+2-\dfrac{1.5}{s}$ (7) None of Above

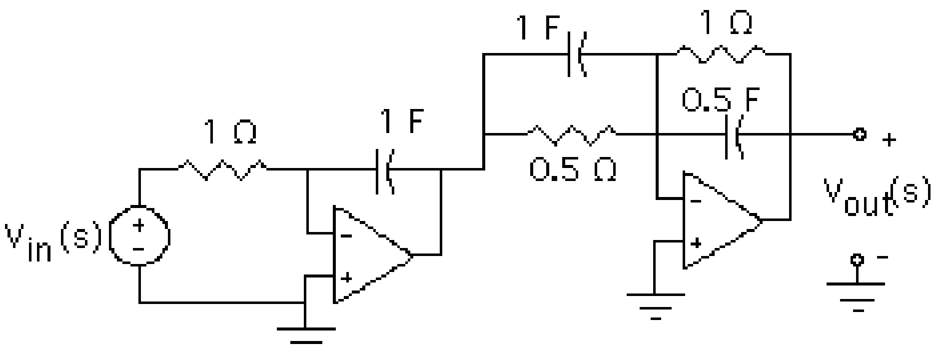


31. The transfer function for the following op amp circuit is:

(1) $\frac{s+0.5}{s(0.5s+1)}$ (2) $\frac{0.5s+1}{s(s+0.5)}$ (3) $\frac{-s-0.5}{s(0.5s+1)}$

(4) $\frac{s+1}{s(0.5s+1)}$ (5) $\frac{s+1}{s(0.5s+1)}$ (6) $\frac{2}{s}$

(7) $\frac{-2}{s}$



32. Suppose

$$L\{f(t)\} = \ell n\left[\frac{s+3}{s+5}\right].$$

Then $L\{tf(t)\}$ is:

(1) $-\frac{s+5}{s+3}$ (2) $\frac{1}{s+5}-\frac{s+3}{s+5}$ (3) $\frac{1}{s+5}-\frac{s+3}{(s+5)^2}$

(4) $-\frac{1}{s+3}+1$ (5) $-\frac{1}{s+3}+\frac{1}{s+5}$ (6) $-\frac{1}{s+3}-\frac{1}{s+5}$

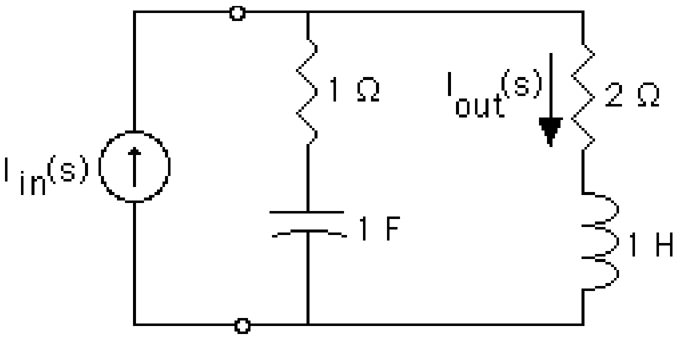
(7) None of above

33. The transfer function of the circuit below is:

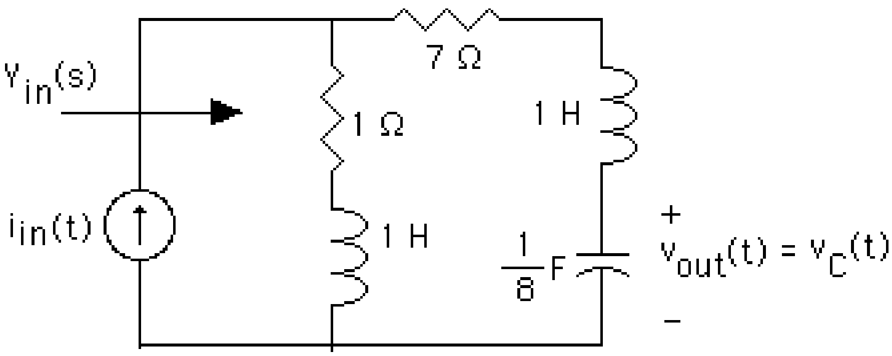
(1) $\frac{s+2}{s+1}$ (2) $\frac{s(s+2)}{s+1}$ (3) $s/(s+1) + 1/(s+2)$

(4) $\frac{s}{s(s+2)+(s+1)}$ (5) $\frac{s(s+2)}{s(s+2)+(s+1)}$

(6) $\frac{(s+1)}{s(s+2)+(s+1)}$ (7) None of the above



Workout Problem (40 points): Consider the circuit



(a) (7 points) Execute a source transformation in the s-domain, so that the circuit in the s-domain is a pure series circuit. Simplify and clearly draw the new circuit.

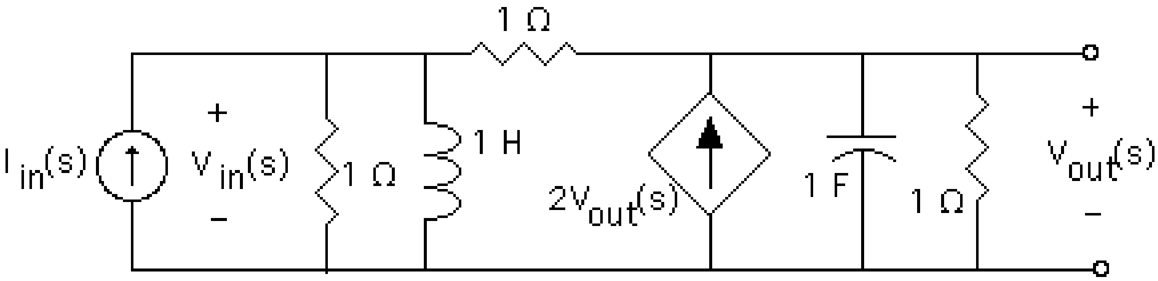
(b) (11 points) Find a simplified expression for the transfer function $H(s) = \dfrac{V_{out}(s)}{I_{in}(s)}$; express the denominator polynomial as a product of its factors.

(c) (3 pts) Suppose all initial conditions on the circuit are zero and $i_{in}(t) = 2te^{-t}u(t)$ A (possibly generated by a lightening spike). Compute $I_{in}(s)$.

(d) (15 points) Find an expression for $V_{out}(s)$ and compute the associated partial fraction expansion.

(e) (4 points) Compute $v_{out}(t)$.

Workout Problem (50 points): Consider the circuit



This problem is to be solved using nodal analysis.

(a) (5 pts) Draw the equivalent frequency domain circuit assuming $i_L(0^-)=1$ A and $v_C(0^-)=1$ V.

(b) (10 pts) Write two nodal equations for the circuit of part (a) in terms of the voltages $V_{in}(s)$ and $V_{out}(s)$ and of course the input and initial conditions. SIMPLIFY. Put equations in Matrix form.

(c) (8 pts) Determine the transfer function $H(s)=\dfrac{V_{out}(s)}{I_{in(s)}}$ of the circuit.

(d) (3 pts) Find the impulse response h(t) of the circuit.

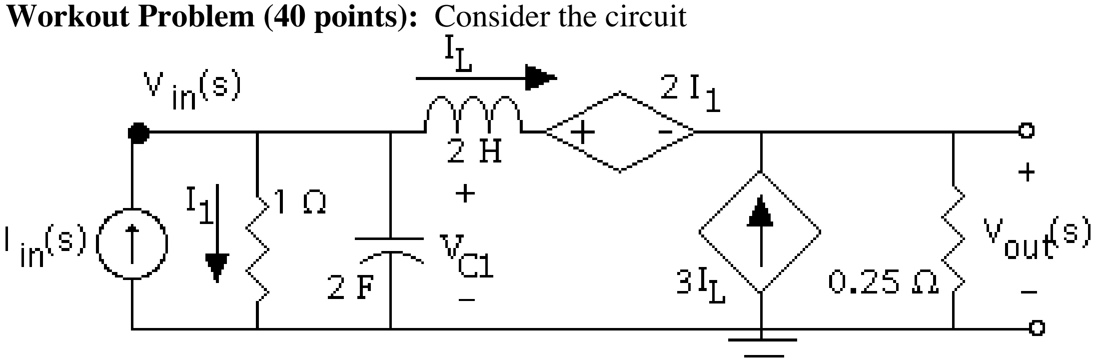
(e) (10 pts) If $i_{in}(t)=4te^{-t}u(t)$ A find the zero-state response $v_{out,zs}(t)$.

(f) (5 pts) Find the response due only to the initial condition on the inductor.

(g) (7 pts) Find the response due only to the initial condition on the capacitor.

(h) (2 pts) Find the complete response. State this in words. There is no need to write out all the equations.

Workout Problem (40 points): Consider the circuit



This problem is to be solved using nodal analysis.

(a) **(3 pts)** Draw the equivalent frequency domain circuit assuming $i_L(0^-)=0$ and $v_{C1}(0^-)=2$ V.

(b) **(11 pts)** Write three nodal equations for the circuit of part (a) only in terms of the voltages $V_{in}(s)$, $V_{out}(s)$, $I_L(s)$, and of course the input and initial conditions. SIMPLIFY EACH EQUATION.

(4 pts) $I_{in}+Cv_{C1}(0^-)=(2s+1)V_{in}+I_L$

(3 pts) $4V_{out}(s) - 3I_L - I_L = 4V_{out}(s) - 4I_L = 0$

(4 pts) $V_{in} - V_{out} = 2sI_L + 2V_{in} \;\Rightarrow\; 0 = V_{in} + V_{out} + 2sI_L$

(c) **(3 pts)** Put equations in Matrix form.

$$\begin{bmatrix} (2s+1) & 0 & 1 \\ 0 & 4 & -4 \\ 1 & 1 & 2s \end{bmatrix} \begin{bmatrix} V_{in} \\ V_{out} \\ I_L \end{bmatrix} = \begin{bmatrix} I_{in} + Cv_{C1}(0^-) \\ 0 \\ 0 \end{bmatrix} = \begin{bmatrix} I_{in} + 4 \\ 0 \\ 0 \end{bmatrix}$$

(d) **(8 pts)** Using Crammer's rule, find the transfer function $H(s) = \dfrac{V_{out}(s)}{I_{in(s)}}$ of the circuit. (If you use something other than Crammer's rule, maximum points is 6.)

(e) **(4 pts)** Find the impulse response h(t) of the circuit.

(f) **(8 pts)** Find the response of the circuit to $i_{in}(t) = -8u(t)$ A assuming the initial conditions are zero.

(g) **(3 pts)** Find the response due only to the initial condition on the capacitor. A simple observation leads to the answer directly.

SOLUTION: (b) and (c)

(4 pts) $I_{in} + Cv_{C1}(0^-) = (2s+1)V_{in} + I_L$

(3 pts) $4V_{out}(s) - 3I_L - I_L = 4V_{out}(s) - 4I_L = 0$

(4 pts) $V_{in} - V_{out} = 2sI_L + 2V_{in} \;\Rightarrow\; 0 = V_{in} + V_{out} + 2sI_L$

$$\begin{bmatrix} (2s+1) & 0 & 1 \\ 0 & 4 & -4 \\ 1 & 1 & 2s \end{bmatrix} \begin{bmatrix} V_{in} \\ V_{out} \\ I_L \end{bmatrix} = \begin{bmatrix} I_{in} + Cv_{C1}(0^-) \\ 0 \\ 0 \end{bmatrix} = \begin{bmatrix} I_{in} + 4 \\ 0 \\ 0 \end{bmatrix}$$

(d)

$$H(s) = \frac{V_{out}}{I_{in}} = \frac{\det \begin{bmatrix} (2s+1) & 1 & 1 \\ 0 & 0 & -4 \\ 1 & 0 & 2s \end{bmatrix}}{\det \begin{bmatrix} (2s+1) & 0 & 1 \\ 0 & 4 & -4 \\ 1 & 1 & 2s \end{bmatrix}} = \frac{-4}{(2s+1)(8s+4) - 4} = \frac{-4}{16s^2 + 16s} = \frac{-1}{4s(s+1)}$$

Alternately, $V_{out} = I_L$ from second equation. Therefore, $-(1+2s)V_{out} = V_{in}$ (third equation) implies

$$I_{in} + Cv_{C1}(0^-) = (2s+1)V_{in} + I_L = -(2s+1)^2 V_{out} + V_{out} = -(4s^2 + 4s)V_{out}$$

The same result follows immediately.

(e)

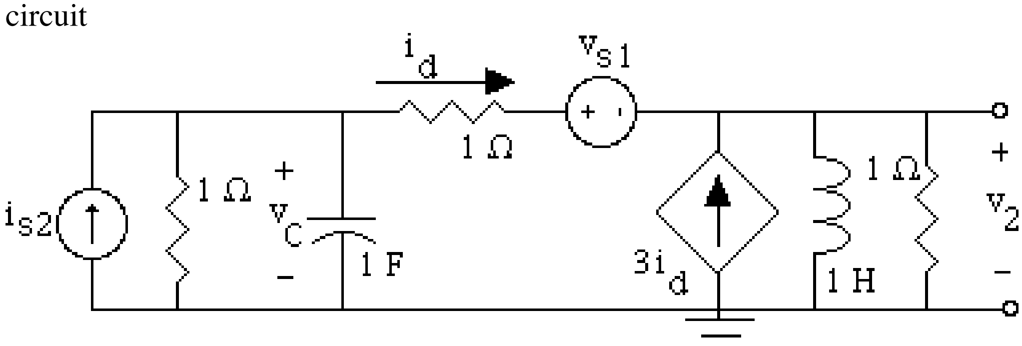
$$H(s) = \frac{-1}{4s(s+1)} = \frac{-0.25}{s} + \frac{0.25}{s+1} \Rightarrow h(t) = 0.25\left(e^{-t} - 1\right)u(t)$$

(f)

$V_{out}(s) = H(s)I_{in}(s) = \dfrac{2}{s^2(s+1)} = \dfrac{-2}{s} + \dfrac{2}{s^2} + \dfrac{2}{s+1}$. Hence $v_{out}(t) = 2\left(t - 1 + e^{-t}\right)u(t)$

(g)The transfer function from the IC to V_{out} is the same as from I_{in} to V_{out}. Hence, the response due to the IC is simply $Cv_C(0^-)h(t) = \left(e^{-t} - 1\right)u(t)$

Workout Problem (40 points): Full credit requires a clear organized solution. Consider the circuit



This problem is to be solved using nodal analysis.

(a) (5 pts) Draw the best equivalent frequency domain circuit for nodal analysis accounting for the as yet unknown initial conditions $i_L(0^-)$ and $v_{C1}(0^-)$.

(b) (11 pts) Following the procedure explained in class,write three nodal equations for the circuit of part (a) only in terms of the variables $V_C(s)$, $V_2(s)$, $I_d(s)$, $V_{s1}(s)$, $I_{s2}(s)$, and the initial conditions. SIMPLIFY EACH EQUATION.

(c) (4 pts) Put equations in Matrix form.

(d) (14 pts) Assuming $i_L(0^-) = 0$, $v_{C1}(0^-) = 5$ V, $i_{s2}(t) = 5\delta(t)$ A, and $v_{s1}(t) = 10\delta(t)$ V, use Crammer's rule to find the current $I_d(s)$ and then $i_d(t)$. (If you use something other than Crammer's rule, maximum points are 7.)

(e) (7 pts) Now suppose that $i_L(0^-) = 0$, $v_{C1}(0^-) = 0$ V, $i_{s1}(t) = 0$ A, and $v_{s1}(t) = 10u(t)$ V. Find $v_2(t)$.

Solution: (b)

(3 pts) $I_{s2} + Cv_{C1}(0^-) = (s+1)V_C + I_d$

(4 pts) $-\dfrac{i_L(0^-)}{s} = \left(\dfrac{s+1}{s}\right)V_2 - 4I_d$

(4 pts) $V_C - V_2 = I_d + V_{s1} \Rightarrow V_C - V_2 - I_d = V_{s1}$

(c)

$$\begin{bmatrix} (s+1) & 0 & 1 \\ 0 & \frac{s+1}{s} & -4 \\ 1 & -1 & -1 \end{bmatrix} \begin{bmatrix} V_C \\ V_2 \\ I_d \end{bmatrix} = \begin{bmatrix} I_{s2}(s) + Cv_C(0^-) \\ -\frac{i_L(0^-)}{s} \\ V_{s1}(s) \end{bmatrix}$$

(d) The equations become

$$\begin{bmatrix} (s+1) & 0 & 1 \\ 0 & \frac{s+1}{s} & -4 \\ 1 & -1 & -1 \end{bmatrix} \begin{bmatrix} V_C \\ V_2 \\ I_d \end{bmatrix} = \begin{bmatrix} 10 \\ 0 \\ 10 \end{bmatrix}$$

Hence

$$I_d(s) = \frac{\det \begin{bmatrix} (s+1) & 0 & 10 \\ 0 & \frac{s+1}{s} & 0 \\ 1 & -1 & 10 \end{bmatrix}}{\det \begin{bmatrix} (s+1) & 0 & 1 \\ 0 & \frac{s+1}{s} & -4 \\ 1 & -1 & -1 \end{bmatrix}} = \frac{\frac{10(s+1)^2}{s} - \frac{10(s+1)}{s}}{(s+1)\left[-\frac{s+1}{s} - 4\right] - \frac{s+1}{s}} = \frac{10(s+1)}{-(s+1)\left[\frac{5s+2}{s}\right]}$$

$$= \frac{-10s}{5s+2} = \frac{-2s}{s+0.4} = -2 + \frac{0.8}{s+4} \;\Rightarrow\; i_d(t) = -2\delta(t) + 0.8e^{-0.4t}u(t)$$

(e)

$$V_2(s) = \frac{\det \begin{bmatrix} (s+1) & 0 & 1 \\ 0 & 0 & -4 \\ 1 & \frac{10}{s} & -1 \end{bmatrix}}{\det \begin{bmatrix} (s+1) & 0 & 1 \\ 0 & \frac{s+1}{s} & -4 \\ 1 & -1 & -1 \end{bmatrix}} = \frac{(s+1)4\frac{10}{s}}{-(s+1)\left[\frac{5s+2}{s}\right]} = \frac{-40}{5s+2} = \frac{-8}{s+0.4}$$

Thus $v_2(t) = -8e^{-0.4t}u(t)$ V.