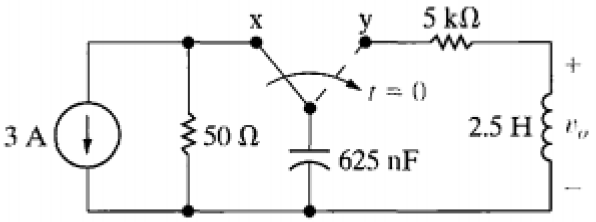
Sohag University
Faculty of Engineering
Electrical Engineering Department

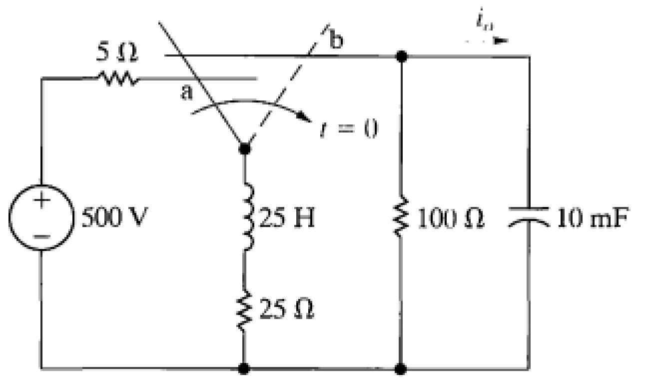
Electric Circuits Theory (2)
Second Year
SHEET NO 6

Q1) The switch in the circuit shown in Fig.P1 has been in position x for a long time. At t=0, the switch moves instantaneously to position y .

a) Construct an S-domain circuit for t>0.
b) Find V_0
c) Find v_0.



Q2) The make-before-break switch in the circuit in Fig.P2 has been in position a for a long time. At t=0, it moves instantaneously to position b Find i_0 for t>0.



Q3) There is no energy stored in the circuit in Fig.P3 at $t=0^-$

a) Use the mesh current method to find i_0.
b) Find the time domain expression for v_0.
c) Do your answers in (a) and (b) make sense in terms of known circuit behavior? Explain.

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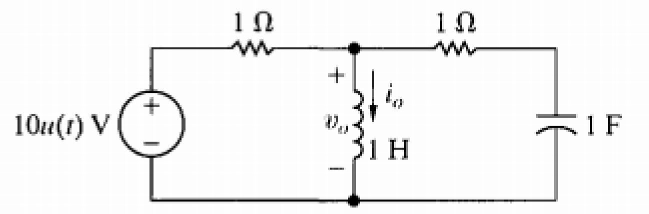
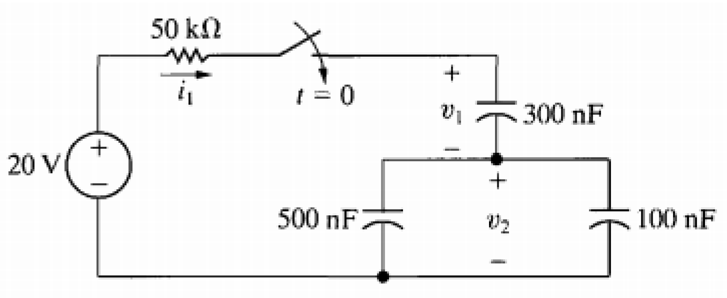
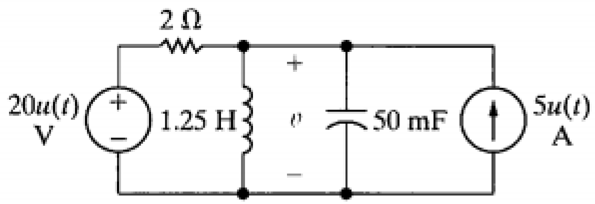


Q4) There is no energy stored in the capacitors in the Circuit in Fig.P4 at the time the switch is closed.

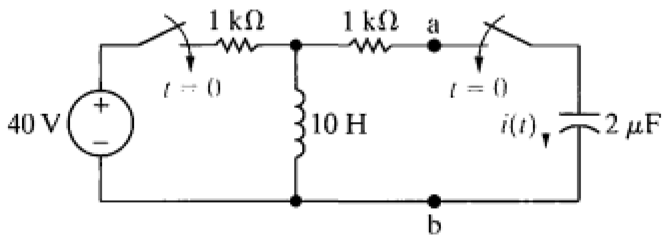
a) Construct the s-domain circuit for t>0.
b) Find I_1,V_1 and V_2.
c) Find i_1 ,v_i,and v_2 .
d) Do your answers for i_1 ,v_i,and v_2 make sense in terms of known circuit behavior? Explain.



Q5) The energy stored in the circuit shown is zero at the instant the two sources are turned on. Using superposition principle in S-domain **Find the expression for v when t>0.**



Q6) The two switches in the circuit shown in Fig.P6 Operate simultaneously. There is no energy stored in the circuit at the instant the switches close. Find i(t) for t ≥0^+ By first finding the s-domain Thevenin equivalent of the circuit to the left of the Terminals a,b



Q7) The op-amp in the circuit shown in Fig.P7 is ideal. There is no energy stored in the capacitors at Instant the circuit is energized.

a) Find v_0 if v_{g1}=40u(t) V and v_{g2}=16u(t) V.
b) How many milliseconds after the two voltage sources are turned on does the op-amp saturate?

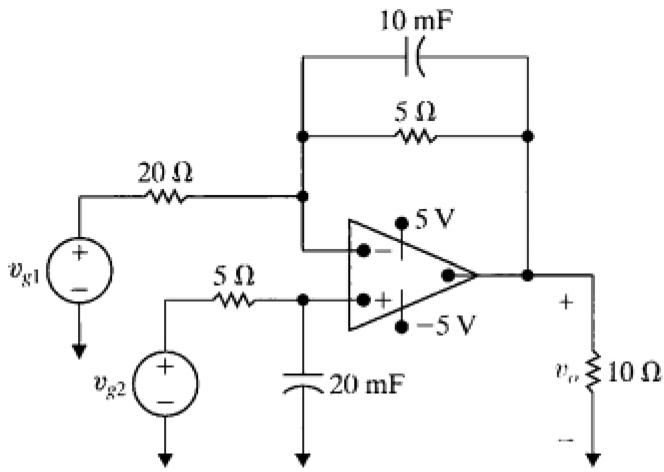


TABLE 12.1 An Abbreviated List of Laplace Transform Pairs

Type	$f(t)\ (t > 0-)$	$F(s)$
(impulse)	$\delta(t)$	1
(step)	$u(t)$	$\frac{1}{s}$
(ramp)	t	$\frac{1}{s^2}$
(exponential)	e^{-at}	$\frac{1}{s+a}$
(sine)	$\sin \omega t$	$\frac{\omega}{s^2+\omega^2}$
(cosine)	$\cos \omega t$	$\frac{s}{s^2+\omega^2}$
(damped ramp)	te^{-at}	$\frac{1}{(s+a)^2}$
(damped sine)	$e^{-at}\sin \omega t$	$\frac{\omega}{(s+a)^2+\omega^2}$
(damped cosine)	$e^{-at}\cos \omega t$	$\frac{s+a}{(s+a)^2+\omega^2}$

TABLE 12.2 An Abbreviated List of Operational Transforms

Operation	$f(t)$	$F(s)$
Multiplication by a constant	$Kf(t)$	$KF(s)$
Addition/subtraction	$f_1(t) + f_2(t) - f_3(t) + \cdots$	$F_1(s) + F_2(s) - F_3(s) + \cdots$
First derivative (time)	$\frac{df(t)}{dt}$	$sF(s) - f(0^-)$
Second derivative (time)	$\frac{d^2f(t)}{dt^2}$	$s^2F(s) - sf(0^-) - \frac{df(0^-)}{dt}$
nth derivative (time)	$\frac{d^nf(t)}{dt^n}$	$s^nF(s) - s^{n-1}f(0^-) - s^{n-2}\frac{df(0^-)}{dt} - s^{n-3}\frac{df^2(0^-)}{dt^2} - \cdots - \frac{d^{n-1}f(0^-)}{dt^{n-1}}$
Time integral	$\int_0^t f(x)\,dx$	$\frac{F(s)}{s}$
Translation in time	$f(t-a)u(t-a), a > 0$	$e^{-as}F(s)$
Translation in frequency	$e^{-at}f(t)$	$F(s+a)$
Scale changing	$f(at), a > 0$	$\frac{1}{a}F\left(\frac{s}{a}\right)$
First derivative (s)	$tf(t)$	$-\frac{dF(s)}{ds}$
nth derivative (s)	$t^nf(t)$	$(-1)^n\frac{d^nF(s)}{ds^n}$
s integral	$\frac{f(t)}{t}$	$\int_s^\infty F(u)\,du$

TABLE 12.3 Four Useful Transform Pairs

Pair Number	Nature of Roots	$F(s)$	$f(t)$
1	Distinct real	$\frac{K}{s+a}$	$Ke^{-at}u(t)$
2	Repeated real	$\frac{K}{(s+a)^2}$	$Kte^{-at}u(t)$
3	Distinct complex	$\frac{K}{s+\alpha-j\beta} + \frac{K^*}{s+\alpha+j\beta}$	$2\|K\|e^{-\alpha t}\cos(\beta t+\theta)u(t)$
4	Repeated complex	$\frac{K}{(s+\alpha-j\beta)^2} + \frac{K^*}{(s+\alpha+j\beta)^2}$	$2t\|K\|e^{-\alpha t}\cos(\beta t+\theta)u(t)$

Note: In pairs 1 and 2, K is a real quantity, whereas in pairs 3 and 4, K is the complex quantity $|K|\angle\theta$.

TABLE 13.1 Summary of the s-Domain Equivalent Circuits

TIME DOMAIN | FREQUENCY DOMAIN