Pulse & Digital Circuits Practice Paper-I,
(On Linear wave Shaping)

① A d.c voltmeter indicates 1.5 V when measuring a square wave with a peak-to-peak amplitude of 5 V. Calculate the positive and negative peak amplitudes of the square wave.

Ans :- positive peak amplitude = 4 V, and
Negative peak amplitude = −1 V

② Determine the highest harmonic at the output of an amplifier which has an upper cut-off frequency of 1 MHz
(a) when a 10 KHz square wave is applied as input and
(b) when the input is a 150 KHz square wave.

Ans :- (a) 100 th (b) 6 th

③ A 1 KHz square wave having zero rise time and zero tilt is applied to an amplifier and is reproduced with $t_R = 350$ ns and tilt = 5%. Determine the upper and lower 3-dB frequencies of the amplifier.

Ans :- $f_1 = 15.9155$ Hz ; $f_2 = 1$ MHz

④ Calculate the lowest square wave frequency that can be passed by an amplifier with a lower cut-off frequency of 1 Hz if the output tilt is not to exceed 1%

Ans :- 314.16 Hz

⑤ An amplifier has a bandwidth extending from 10 Hz to 50 KHz. Calculate the rise time and tilt that may be expected on the output when a 5 KHz square wave is applied as input.

Ans :- $t_R = 7\ \mu s$; % tilt = 0.62832%

⑥ A 10V step is switched on to a 22 KΩ resistor in series with a 300 pF capacitor. Calculate the rise time of the capacitor voltage, the time required for the capacitor to charge to 63.2% of its maximum charge, and the time for capacitor to become completely charged.

Ans :- 14.52 μs , 6.6 μs , 33 μs

(7) A 5V pulse with a width Of 100 μs is applied to a series RC circuit with R = 27 kΩ and C = 0.1 μF. Determine the amplitude Of e_c at the end Of the pulse.

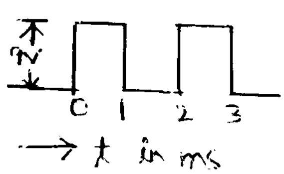
Ans :- 0.1818 Volt.

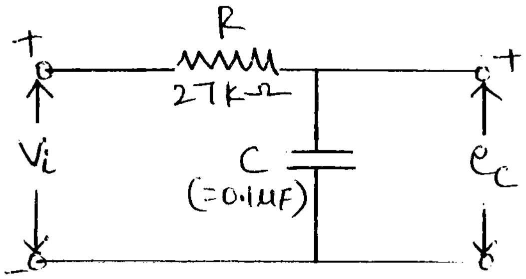
(8) An amplifier has an input coupling capacitor Of 30 μF and an input resistance Of 20 kΩ. Determine the lowest square wave frequency that can be applied as an input, if the output tilt is not to exceed 5% (Ans : 16.67 Hz)

(9) An oscilloscope displays a 5 Hz square wave form with a 6% tilt. The signal input has no tilt and is coupled to the oscilloscope via a 4.7 μF capacitor. Calculate the oscilloscope input resistance.

Ans :- 354.61 kΩ (or) 0.35461 MΩ

(10) For the circuit and input shown in the figure, determine e_c at t = 2.5 ms and sketch the output waveform. Also sketch the settled waveform Of e_c.





Ans :- At t = 2.5 ms, e_c = 3.1198 ms

(11) A square wave whose peak-to-peak value is 1 volt extends ± 0.5 V with respect to ground. The duration Of the positive section is 0.1 sec and Of the negative section is 0.2 sec. If this waveform is impressed upon an RC differentiating circuit whose time constant is 0.2 sec, what are the steady state maximum and minimum values Of the output waveform?

Ans :- Max. Value V_1 = 0.81368 V

Min. Value V_2 = −0.50647 V.

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(12) A 10Hz symmetrical square wave whose peak-to-peak amplitude is 2V is impressed upon a high pass circuit whose lower 3-dB frequency is 5Hz. Calculate and sketch the output waveform. In particular, what is the peak-to-peak amplitude? (Ans: 3.3116V)

(13) An RC differentiator circuit is driven from a 500Hz symmetrical square wave of 10V peak-to-peak. Calculate and sketch the output voltage under steady state if RC = 1 msec. Sketch also the input on the same time axis. Ans: (2.6895 Volt, -2.6895 Volt)

(14) A 1KHz symmetrical square wave of ±10V is applied to an RC circuit having 1ms time constant. Calculate and plot the output for the RC configuration as (a) High pass circuit (b) low pass circuit.
Ans:- (a) +7.5508 Volts (b) +2.45 Volts.

(15) A symmetrical square wave whose average value is zero has a peak-to-peak amplitude of 20Volts and a period of 2μsec. This waveform is applied to a low pass circuit whose upper 3-dB frequency is $1/2\pi$ MHz. Calculate and sketch the steady-state waveform. In particular, what is the peak-to-peak output amplitude?
Ans:- 4.6212 Volt

(16) The ramp shown in the figure is applied to a RC high pass circuit. Draw to scale the output waveform for the following cases
(a) T = 0.2 RC and (b) T = 10 RC
Ans:- (a) 0.90635 αT (b) 0.1 αT

(17) A pulse of 5V amplitude and duration 0.5 msec is applied to a RC high pass circuit with R = 22 KΩ and C = 0.47 μF. Sketch the output waveform and determine the percentage tilt in the output.
Ans:- % tilt = 4.7206 %

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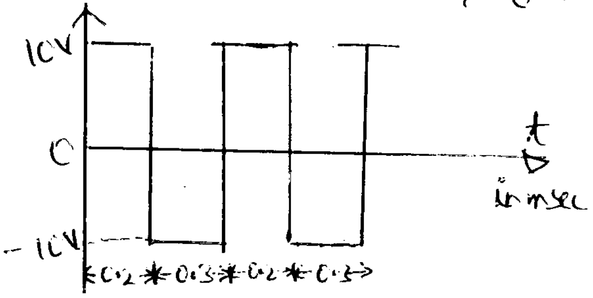
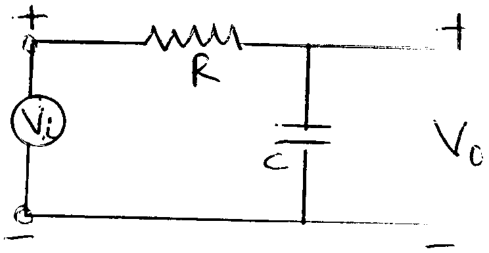
(18) The input waveform shown in figure is applied to a LP RC circuit at $t = 0$. Sketch the output voltage waveform starting from $t = 0$ to $t = 1\,ms$. The circuit uses $R = 100\,\Omega$, $C = 0.1\,\mu F$. The input signal source resistance $= 1\,k\Omega$. Assume initial capacitor voltage is zero. (Ans: 6.7536 V, 6.93142 V, −8.9044 V, −8.89273 V)

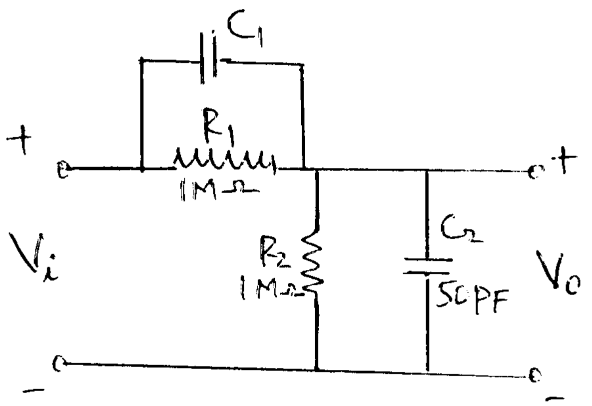


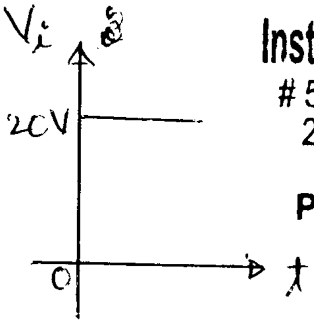


(19) A symmetrical square wave of ±5V at a frequency of 5 kHz is applied to a HP RC circuit with a cut-off frequency of 20 kHz. Sketch the steady-state input and output voltage waveforms. Calculate the steady state output voltage levels (Ans: 10V, 0V)

(20) The pulse from a high voltage generator (a magnetron) rises linearly for 0.05 μsec and then remains constant for 1 μsec. The rate of rise of the pulse is measured with a RC differentiating circuit whose time-constant is 250 psec. If the positive output voltage from the differentiator has a maximum value of 50 V, what is the peak voltage of the generator? (10 kV)

(21) Compute and draw to scale the output waveform for $C_1 = 50\,PF$, $C_1 = 75\,PF$ and $C_1 = 25\,PF$. The input is a 20 V step.





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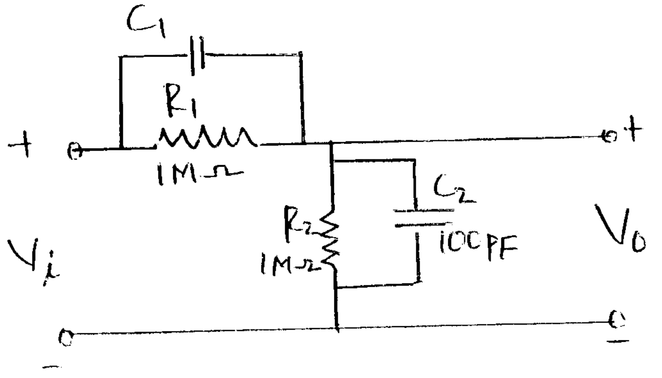
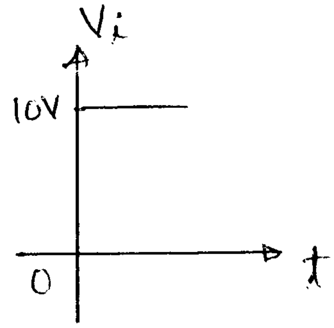
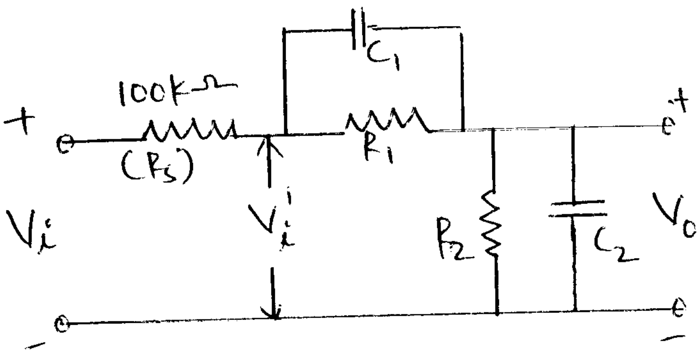
Ans: (a) when $C_1 = 50\,PF$, $V_o(0^+) = V_o(\infty) = 10V$, (b) $C_1 = 75\,\mu F$, $V_0 = 12V$
(c) when $C_1 = 25\,PF$, $V_o(\infty) = V_o(0^+) = 6.6667\,V$

(22) For the attenuator circuit shown in the figure, calculate and plot to scale the output for the cases (a) $C_1 = 50\,pF$ and (b) $C_1 = 150\,pF$. The input V_i is a step of 10 V. (Ans: (a) 5 V, (b) 5 V)





(23) The input V_i in the circuit shown is a 20 V step. Calculate and plot to scale the output voltage.



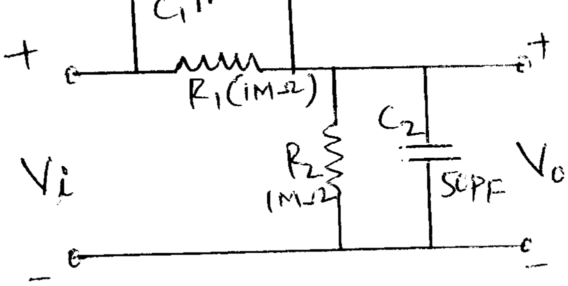
$C_1 = C_2 = 50\,pF$

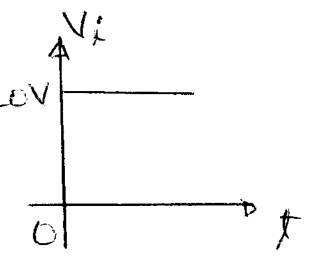
$R_1 = R_2 = 1\,M\Omega$

$V_i = 20\,V$ step

Ans: (a) at $t = 0^+$, $V_c = 0$, (b) $t = \infty$, $V_R = 19.04762$ Volt.

(24) Compute and draw to scale the output waveform for $C = 50\,pF$, $C = 75\,pF$ and $C = 25\,pF$, if the input is a 20 V step for the following circuit.





(25) The pulse from a high voltage generator (a magnetron) rises linearly for 0.05 μsec and then remains constant for 1 μsec. The rate of rise of the pulse is measured with an RC differentiating circuit whose time-constant is 250 psec. If the positive output voltage from the differentiator has a max. value of 50 V, what is the peak voltage of the generator?

(26) An ideal 1 μsec pulse is fed to a low-pass circuit. Calculate and plot the output waveform under the following conditions: The 3dB frequency is (a) 10 MHz (b) 1 MHz (c) 0.1 MHz

Ans: (a) $V_0 = V$ (b) $V_0 = 0.98V$ (c) $V_0 = 0.46642V$.

(27) A 10 Hz square wave is fed to an amplifier. Calculate and plot the output waveform under the following conditions: The lower 3dB frequency is (a) 0.3 Hz (b) 3 Hz (c) 30 Hz

Ans: (a) $V_0 = 0.84764V$ (b) $T = 0.0531$ sec (c) 0.00533 sec

(28) A symmetrical square wave whose peak-to-peak amplitude is 2V and whose average value is zero is applied to a RC integrating circuit. The time constant is half the period of the square wave. Find the peak-to-peak value of the output voltage. (Ans: 0.92424V)

(29) A square wave whose peak-to-peak amplitude is 2V extents ±1V with respect to ground. The duration of the positive section is 0.1 sec and that of the negative section is 0.2 sec. If this waveform is impressed upon a RC integrating circuit whose time constant is 0.2 S, what are the steady state max. and min. values of the output waveform?

Ans: −0.6273 Volt, 0.01298 Volt.

(30) Prove that a RC circuit behaves as a reasonably good integrator, if RC >> T, where T is the period of an input sinusoid $E_m \sin \omega t$.