Indian Institute of Technology Hyderabad

Electrical Engineering Department

Indian Institute of Technology (IIT) Hyd

EE2400 - Analog Electronics

February 23, 2024

Time: 1.5 hour | *T2 Examination* | Maximum Marks: 20

Instructions:

1. Mention units with numerical values.
2. Make suitable assumptions, if required.

Constant values (use if not specified in question) - Planck's constant (h) = 6.626×10^{-34} Jule-sec, Boltzmann constant (k) = 1.38×10^{-23} Jule/K, Room Temperature = 300 K, Thermal voltage (v_t) at room temp = 26mV, Speed of light (c) = 3×10^{8} m/s, Intrinsic concentration (n_i) at room temperature (cm^{-3}) = 1.5×10^{10} for Si, dielectric constant of vacuum $\epsilon_0 = 8.85\times10^{-11}$ F-cm^{-1}, $\epsilon_{Si} = 12\epsilon_0$, $\epsilon_{Sio_2} = 4\epsilon_0$, Mean life time of charge carriers (τ = 1 ns). $\mu_n C'_{ox}$ for 180nm CMOS tech node silicon nMOST = $300\mu A/V^2$, $\mu_p C_{ox}$ for 180 nm CMOS tech node silicon pMOST = $60\mu A/V^2$. $|V_{th,p}| = V_{th,n} = 0.5$V (if required), Oxide thickness $t_{ox} = 10\ nm$.

1. a Find the gain of the operation amplifier shown in (1) in both inverting and non-inverting configurations.

   b Find the output in the circuit shown in (2), prove your answer with derivation. Mention all the assumptions.

   c The circuit shown in (3) is an integrator or differentiator? What is the use of the 500ohm resister and 1pF capacitance. What will be the input frequency range for which the given circuit will work properly.

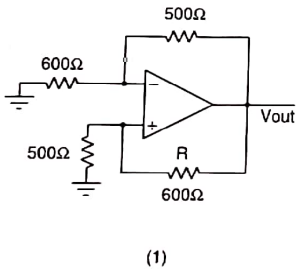
   d Find small signal input gain for (a) and (b) part of (4). What is the use of R1 = 1kohm resister. Comment about the lineality of both. Which one is better?

   e What is the minimum bandwidth (-3dB) of the opamp based system shown in (5) to respond properly for the signal mentioned. Find the use of Roc and its best value for this system.

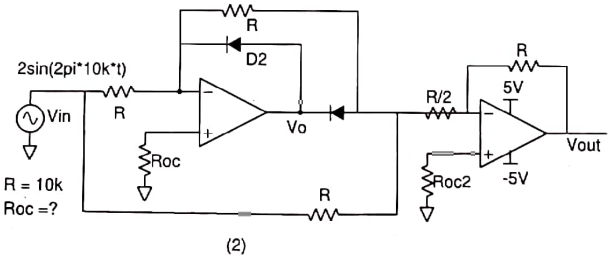
   f Consider an ideal low-pass filter and find the output wavefrom for system shown in (6), where input is a perfect squarewave of a fundamental time period of 100us and DC value = 0. Prove your answer mathematically.

   g Find the oscillation frequency for the oscillator shown in (7). Also find the relation between R1 and R2 for sutained oscillations.

[20]



(1)



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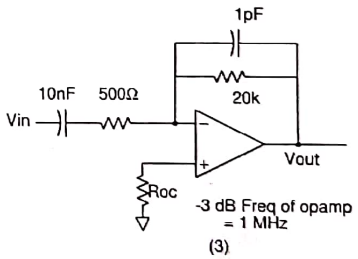
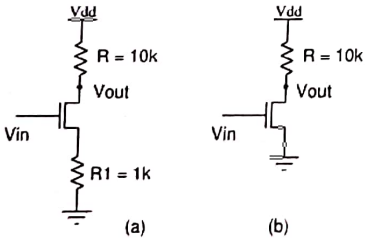
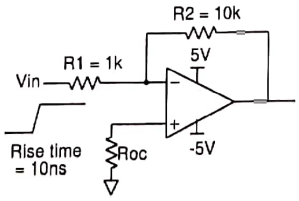


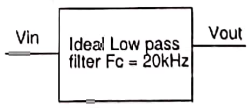
(3)



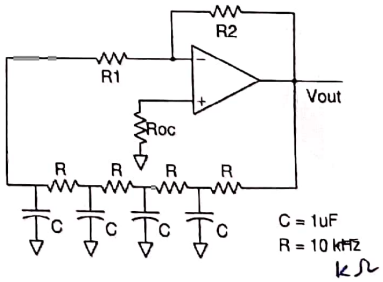
(4)



(5)



(6)



(7)

Figure 1:

Scanned with OKEN Scanner