國立台灣科技大學九十六學年度碩士班招生試題

系所組別： 電子工程系碩士班乙一組、乙二組、乙三組

科　　目： 電子學

總分100分

1. (15%) Fig-1 shows a circuit for an analog voltmeter of very high input resistance that uses an inexpensive moving-coil meter. The voltmeter measures the voltage V applied between the op amp's positive-input terminal and ground. Assuming that the moving coil produces full-scale deflection when the current passing through it is 100μA.
   (a) Find the value of R such that full-scale reading is obtained when V is +10V.
   (b) Does the meter resistance shown affect the voltmeter calibration? Explain your answer.
2. (15%) Fig-2 shows a scheme for coupling and amplifying a high-frequency pulse signal. The circuit utilizes two MOSFETs whose bias details are not shown and a 50-Ω coaxial cable. Transistor Q1 operates as a CS amplifier and Q2 as a CG amplifier. For proper operation, transistor Q2 is required to present a 50-Ω resistance to the cable. This situation is known as "proper termination" of the cable and ensures that there will be no signal reflection coming back on the cable. When the cable is properly terminated, its input resistance is 50 Ω. What must g_{m2} be? If Q1 is biased at the same point as Q2, what is the amplitude of the current pulses in the drain of Q1? What is the amplitude of the voltage pulses at the drain of Q1? What value of R_D is required to provide 1-V pulses at the drain of Q2?
3. (20%) The amplifier shown in Fig-3 has R_{sig}=R_L=1 kΩ, R_C=1 kΩ, R_B=47 kΩ, β=100, C_μ=0.8 pF, and f_T=600 MHz.
   (a) Find the dc collector current of the transistor.
   (b) Find g_m and r_π.
   (c) Neglecting r_o, find the midband voltage gain from base to collector (neglect the effect of R_B).
   (d) Use the gain obtained in (c) to find the component of R_{in} that arises as a result of R_B. Hence find R_{in}.
   (e) Find the overall gain at midband.
   (f) Find C_{in}.
   (g) Find f_H.

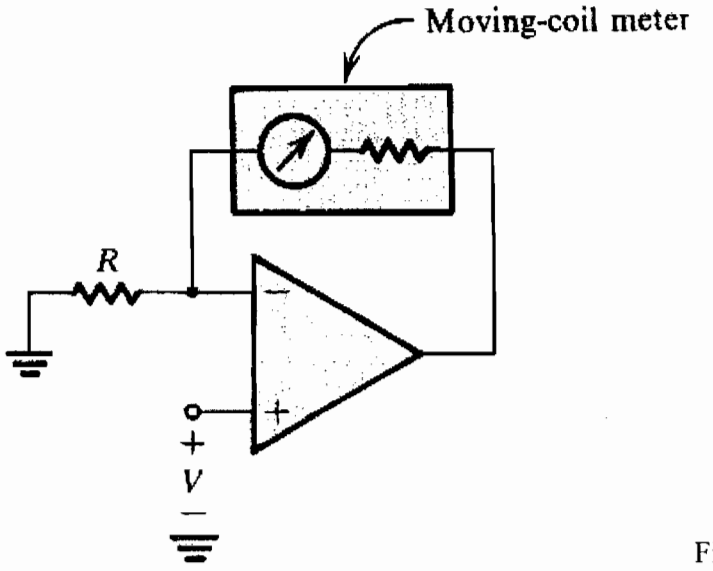

Fig-1

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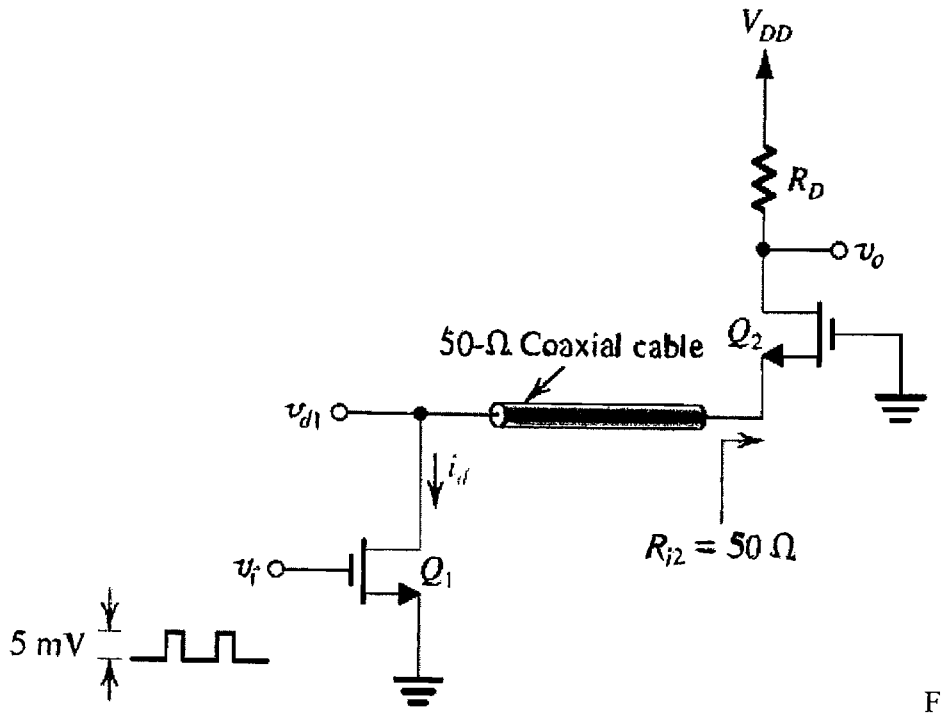

Fig-2

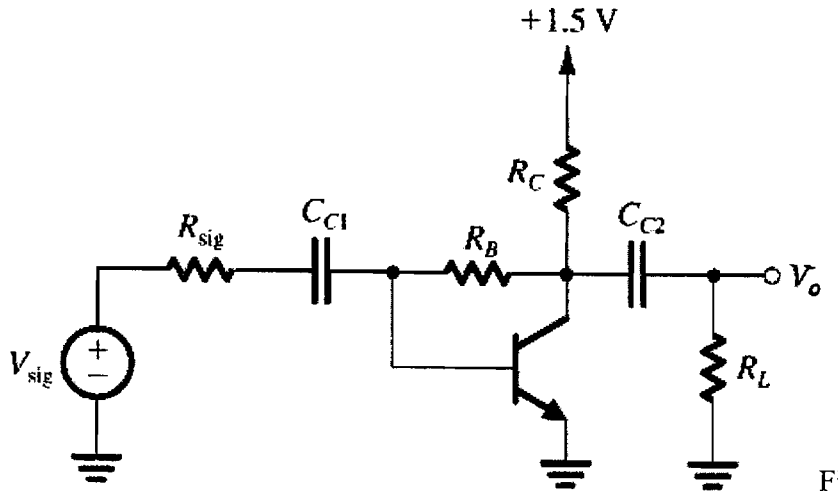

Fig-3

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4. Please find the loop gain function T(jω), the frequency of oscillation, and the R_2/R_1 required for oscillation for the circuit in Figure 4. (20%)

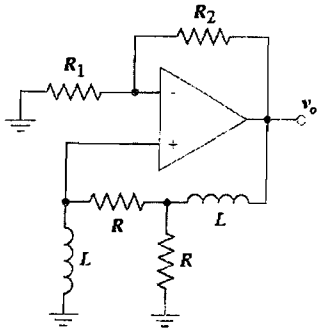

Figure 4

5. Consider the circuit shown in Figure 5. Please derive the relationship between the load current I_o and the input voltage V_i. (10%)

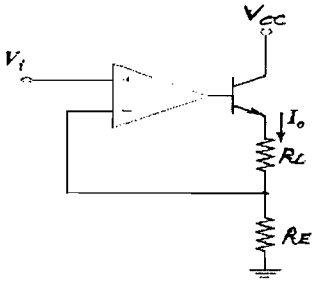

Figure 5

6. Consider an inverting amplifier shown in Figure 6.

(a). Assume the op-amp has a finite open-loop gain A_{oL}, an ideal open-loop input differential resistance, and an ideal output resistance. Please determine the closed-loop voltage gain of the inverting amplifier. (10%)

(b). Assume the op-amp has a finite open-loop gain A_{oL}, a finite open-loop input differential resistance R_i, and a nonzero output resistance R_o. Please determine the closed-loop input resistance R_{if} of the inverting amplifier. (5%)

(c). Assume the op-amp has a finite open-loop gain A_{oL}, a nonzero output resistance R_o, and an infinite input resistance R_i. Please determine the closed-loop output resistance R_{of} of the inverting amplifier. (5%)

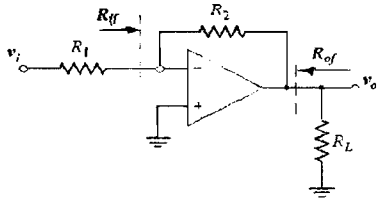

Figure 6