國立臺北大學 108 學年度日間學士班轉學生招生考試試題

系　　別：電機工程學系日間學士班 3 年級

科　　目：電子電路

☐可 ☑不可使用計算機

1. (10%) For the circuit shown in Fig. 1, specify the resistance R that will cause current i_b to be 1.33mA by the method of Thévenin theorem.

2. (15%) For the 2nd order circuit shown in Fig. 2, find the complete response $v(t)$, including both the components of natural response and forced response, of the circuit for $t > 0$ when $v(0) = 9\text{V}$ and $i_L(0) = 0\text{A}$.

3. (10%) Wheatstone bridge based circuits are often applied in sensor devices and offer possible ways to transfer resistive sensor measurements into electrical signals. A Wheatstone bridge based Op-amp circuit, shown as Fig. 3, was devised to transfer the resistive sensor R_1 to the output voltage v_o. Determine the value of v_o when $R_1 = 10\text{k}\Omega$.

4. (15%) While V_C denotes the DC component of the output voltage, v_o and v_i denote the AC components of the output and input voltages. Determine the small-signal voltage gain $A_v = v_o/v_i$ of the BJT amplifier shown in Fig. 4. Assume the thermal voltage $V_T = 25\text{mV}$, $V_{BE} = 0.7\text{V}$, $\beta = 100$.

5. (10%) Determine the output voltage v_o of the circuit shown in Fig. 5. Assume the threshold voltage of the NMOS transistor $V_{TH} = 1\text{V}$, its transconductance parameter $k_n = \mu_n C_{ox}(W/L) = 1\text{mA/V}^2$, and neglect the channel-length modulation effect $\lambda = 0$.

6. (20%) Determine the small-signal voltage gain A_v of the MOS amplifier shown in Fig. 6. The transistor has $V_{TH} = 3\text{V}$, $k_n = \mu_n C_{ox}(W/L) = 0.25\text{mA/V}^2$ and $\lambda = 0.02\text{V}^{-1}$, and assume that the coupling capacitors C_1 and C_2 are sufficiently large to shorten the AC signals at their frequencies of interest, and $A_v \cong -g_m R_L'$ where R_L' is AC equivalent resistance.

7. (10%) For the Op-Amp differentiator shown in Fig. 7, show the relation between the input and output as:

$$V_{out} = -RC\frac{dV_{in}}{dt}$$

8. (10%) Suppose the sinusoidal voltage and current across an circuit component are $v(t) = V_m \cos(\omega t + \theta_V)$ and $i(t) = I_m \cos(\omega t + \theta_I)$, respectively. Show the average power (over a complete period) delivered to the component is

$$P = \frac{V_m I_m}{2}\cos(\theta_V - \theta_I)$$

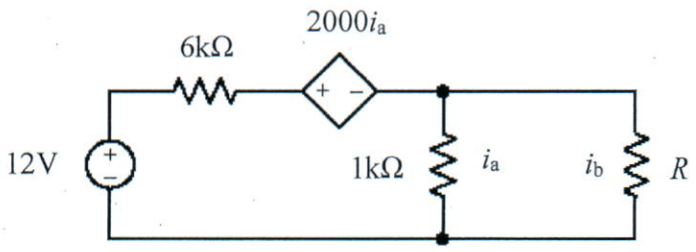

Fig. 1

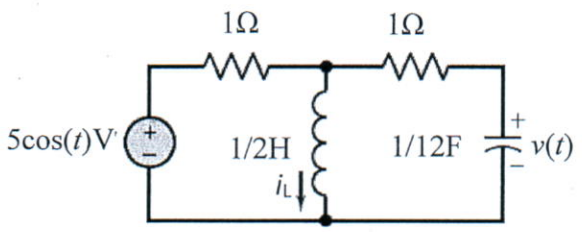

Fig. 2

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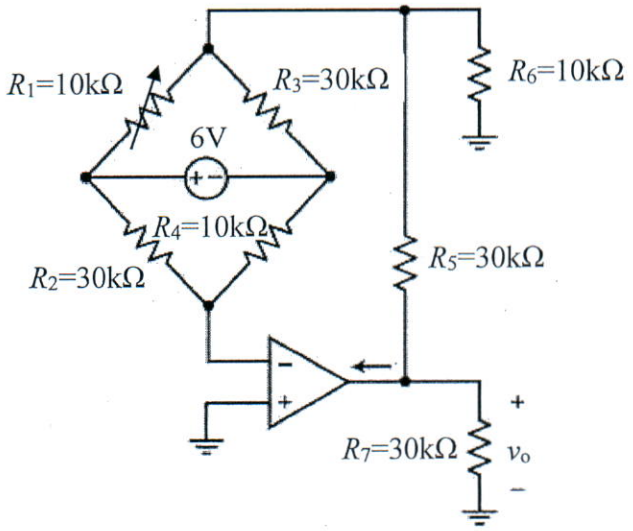

Fig. 3

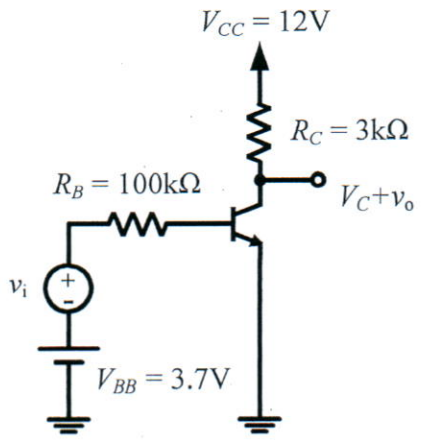

Fig. 4

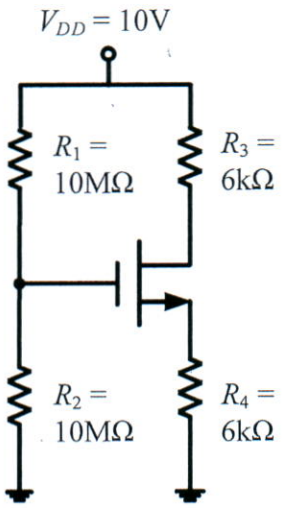

Fig. 5

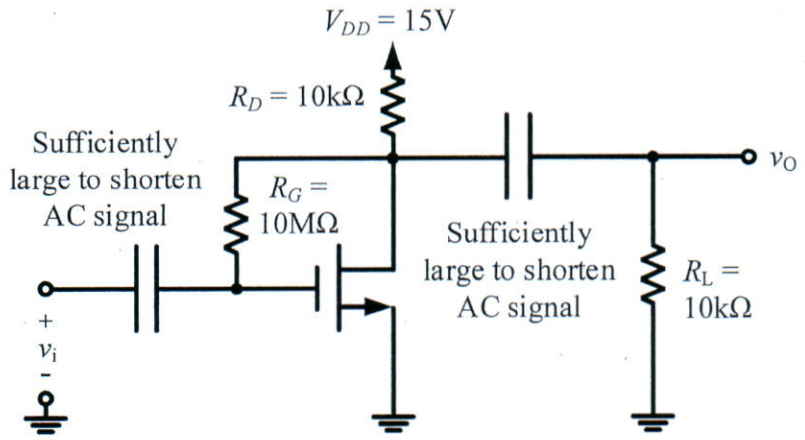

Fig. 6

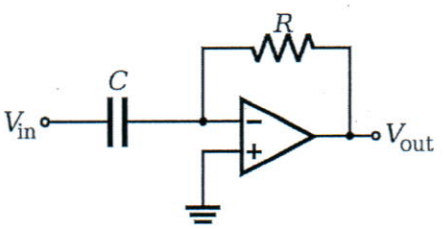

Fig.7

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