# 國立臺灣大學 105 學年度碩士班招生考試試題



1.

(a) (10%) Please draw a representative voltage-current characteristic curve of a typical diode.

(b) (15%) Fig. 1(a) shows a regulated voltage supply circuit in which the Zener diode operates in the reverse breakdown region and has a V-I characteristic of $I_D$ (mA) = 10 $V_D$ (V)+90. Design the value of R1 to achieve $V_{out}$ = 10V, given $V_{in}$ = 24V and $R_L$ (load resistance)= 6 kΩ. What is the percentage change in Zener current $I_D$ if the load current is changed to 0 (no load condition)?

(c) (15%) Following (b), use the circuit shown in Fig. 1(b) to design R1 and R2 to achieve $V_{out}$ = 10V, given the condition of $V_{in}$ = 24V, $R_L$ = 6 kΩ and β = 100 for the transistor. What is the percentage change in Zener current $I_D$ if the load current is changed to 0 (no load condition)?

(d) (16%) Assume the Zener diode has an ideal characteristic curve, that is, a vertical line at $V_D = -10$V with $I_D \leq -10$mA. Calculate the maximum power dissipated by the Zener diode in the circuit shown in Fig. 1(a) and Fig. 1(b), respectively, for the condition of $R_L$ = 6 kΩ ~ ∞, $V_{in}$ = 20V~24V, $V_{out}$ = 10V and β=100 for the transistor.

(e) (10%) Discuss the advantage(s) of the circuit shown in Fig. 1(b) compared to the one shown in Fig. 1(a).

2. Fig. 2(a) shows a Wheatstone bridge circuit for measuring small changes in resistance. Assume R2=R3=$R_0$−ΔR, R1=R4=$R_0$+ΔR, and $V_S$ = 5V. A capacitor C is added in order to reduce the effect of noise ($V_{noise}$).

(a) (16%) Derive the frequency response of $V_{out}/V_S$ where $V_{out} = V_b - V_a$ as a function of the angular frequency ω, and find the capacitor value to achieve a cutoff frequency of 300 Hz given $R_0$=300Ω and ΔR=1.5Ω.

(b) (18%) Assume $V_{noise}$, shown in Fig. 2(b), is an ideal square-wave pulse with duration of 1 ms and a peak voltage of 1V, $R_0$=300Ω and ΔR=1.5Ω. Calculate and draw the transient response of $V_{out}$ for t = 0~2 ms.

Fig. 1

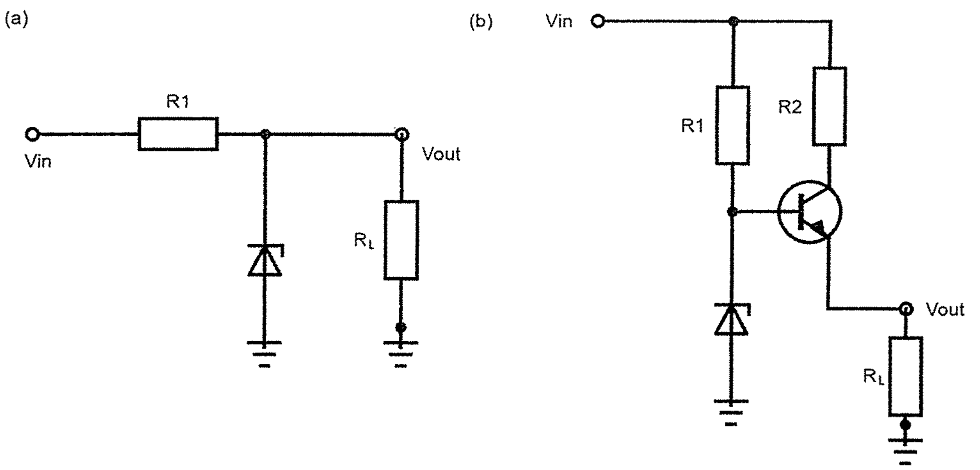
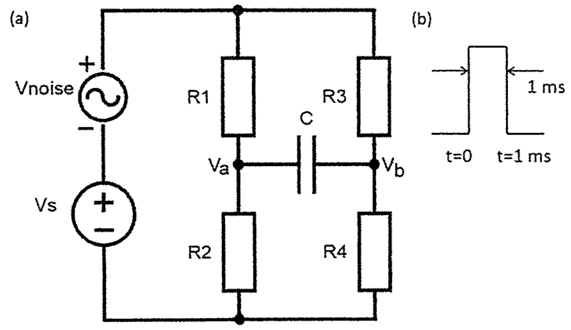



Fig. 2

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