編號： 184

國立成功大學 107 學年度碩士班招生考試試題

系　　所：電機工程學系

考試科目：電儀表學

考試日期：0205，節次：2

※ 考生請注意：本試題可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. (20%) Fig. 1 shows the circuit of the analog-to-digital converter (ADC) in a stepper-type digital voltmeter, where the frequency of clock pulses is 1 MHz, the resolution of the digital-to-analog converter (DAC) is 10-bit, and the input voltage range of E_{In} is 0-5V. (a) Please calculate the fastest sampling rate when using this ADC. (10%) (b) For E_{In}=0, the output digital code is 0000000000 by using this ADC. Please calculate the corresponding value of E_{In} when the output digital code is 0100100100. (10%)

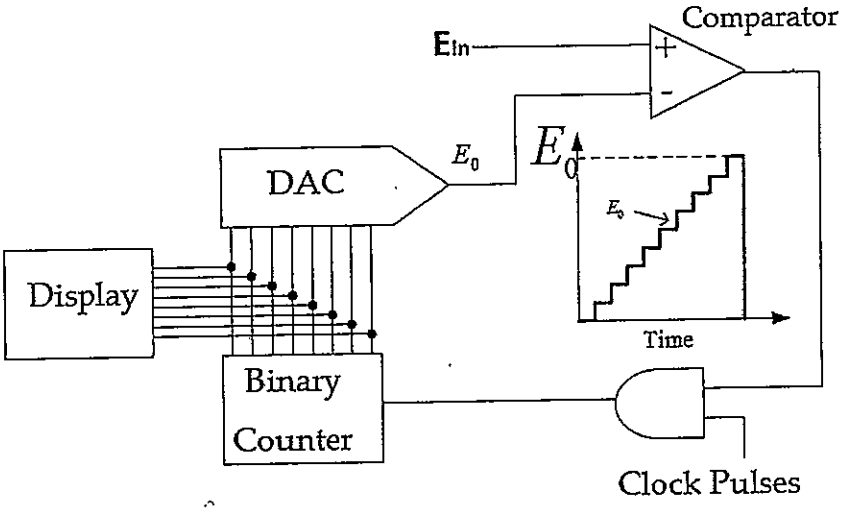

Fig. 1

2. (12%) In a decimal counting unit (DCU), the rolling effect may happen if the circuit is not appropriately designed. Please explain what the rolling effect is, and describe how to eliminate this phenomenon.

3. (18%) As shown in Fig. 2, a Zener diode is used to regulate the output voltage (Vout), where Vin is 8V, R is 50Ω, and the breakdown voltage V_{Z0} and dynamic impedance r_z (i.e., the equivalent resistance in the breakdown region) of the Zener diode is 5 V and 2 Ω, respectively. The desired output voltage (V_{O_goal}) of this circuit is 5V. (a) Please calculate the actual value of Vout when the equivalent load resistance (R_L) is 100 Ω. (8%) (b) Please recalculate the actual value of Vout when R_L is 1 kΩ. (4%) (c) According to the results in (a) and (b), please calculate the load regulation of this circuit. (6%)

[Load regulation $= \frac{\Delta Vout}{V_{O\_goal}} \times \frac{1}{\Delta I_L} \times 100\%$, Unit: %/A]

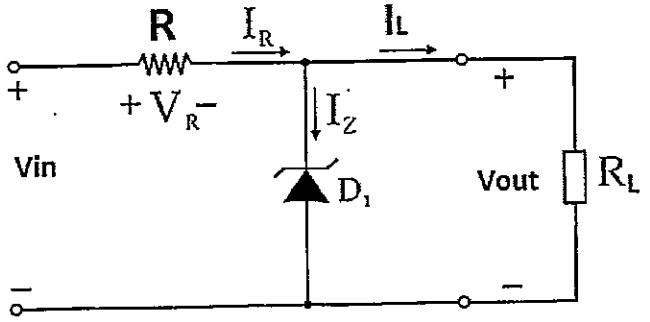

Fig. 2

4. (10%) What value of a multiplier resistor will make a 0-to-100 μA meter with an internal resistance of 1.5 kΩ read (a) 0 to 5V? (5%) (b) 0 to 20V? (5%)

5. (12%) Given A = 6 ± 0.2, B = 3 ± 0.3, C = 1 ± 10%, and D = 3 ± 5%. Please estimate the value of A*B / (C+D) with absolute errors in expression.

6. (16%) Given the meter used is accurate to ±2%. (a) **Prove** that the **accuracies** (i.e., errors of measured resistance) of a series-type ohmmeter (refer to the ohmmeter in Fig. 3) at x full-scale deflection (FSD) and (1- x) FSD are exactly the same (x ranges from 0%~100%). (Hint: you need to express the measured R_x error in function of x). (8%) (b) Determine the errors of unknown resistance Rx at 80% FSD. (8%)

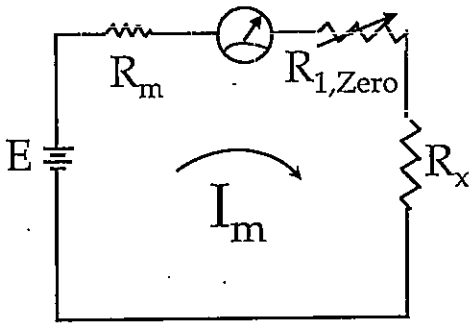

Fig. 3

7. (12%) Please refer to Fig. 4. Assume transmission line Z_o = 50 Ω; discontinuity occurs and is measured at t_0=0; E_i = 2 V. For the circuit terminated with a series R-L (R=25 Ω; L=300 mH) circuit, (a) draw the response of Time-Domain Reflectometer (TDR) measurement results. (4%) (b) Calculate the reflection coefficient at time t_0=0$^+$. (4%) (c) Please evaluate the time (w.r.t. t_0) when the total received voltage (E_i+E_r) is 2.5 V. (4%)

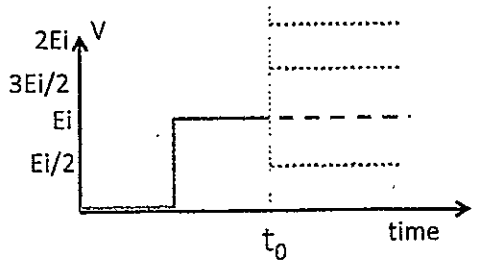

Fig. 4