編號： 179

國立成功大學 109 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：0210，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. (10%) Fig. 1 shows a rectifier ammeter, which has the following components: PMMC instrument with FSD = 100 μA and Rm = 0.5 kΩ; current transformer with Ns = 400 and Np =5; diodes with VF~ 0.6V; meter series resistance Rs = 160 kΩ; transformer shunt secondary resistance R_L = 80 kΩ. (a) Calculate the level of transformer primary current for instrument FSD **(in rms)**. (b) If we want to measure Iac **(rms)** = 1.6A, please calculate the value of R_L.

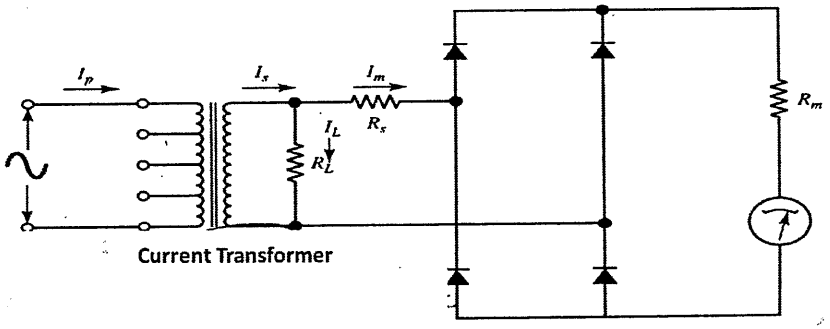


Fig. 1

2. (10%) Explain the terminologies or the difference of the following terms:
   (a) Null measurement; (b) Difference between accuracy and precision; (c) Theoretical errors; (d) What is the difference between Reliability and Repeatability?

3. (20%) A Wheatstone bridge which serves as an ohmmeter is shown in Fig. 2.
   (a) Fig. 3 shows the Thevenin equivalent circuit. Express I_G with V_{RS}, Rm, P, Q, R, and S (I_G=?)
   (b) The relative error of resistor P, Q, and S is 1%, 0.5%, and 1.25%, respectively. What is the relative error of the ohmmeter?
   (c) If the minimal adjustable resistance of resistor S is ΔS, what is the sensitivity defined by resistor S (ΔR_1)?
   (d) Prove that sensitivity ΔR_2 caused by the minimum current of galvanometer could be represent as

$$\Delta R_2 = \frac{\Delta V_{RS}(P+R)^2}{PE - \Delta V_{RS}(P+R)}$$

   (e) What is the sensitivity of this ohmmeter? If E decreases, how will the sensitivity change?

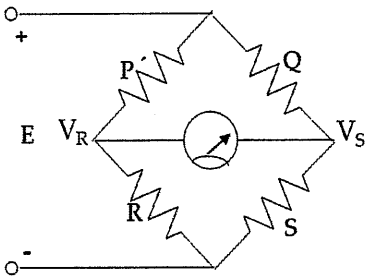
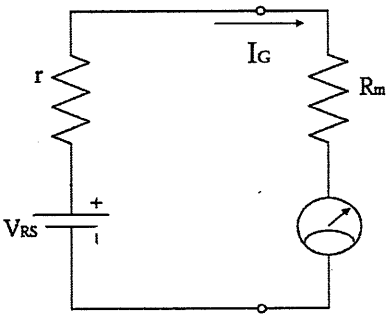


Fig. 2



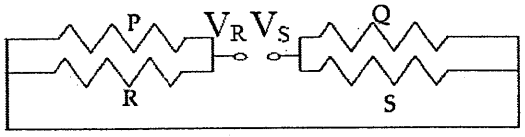


Fig. 3

4. (10%) Derive the equation below for Series-Parallel ohmmeter (with voltage meter) in Fig. 4. The resistance (R_2) is in series with the battery (E) and is parallel connection with the unknown resistance (R_x): (assume $R_2 << R_m+R_1$)

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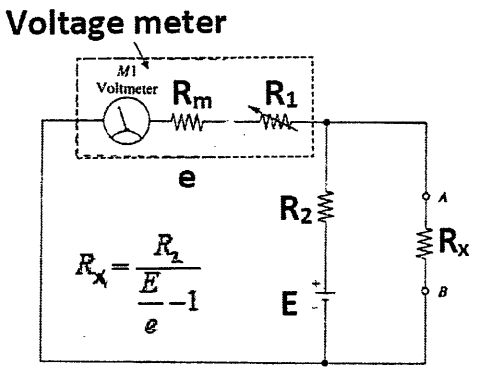

Fig. 4

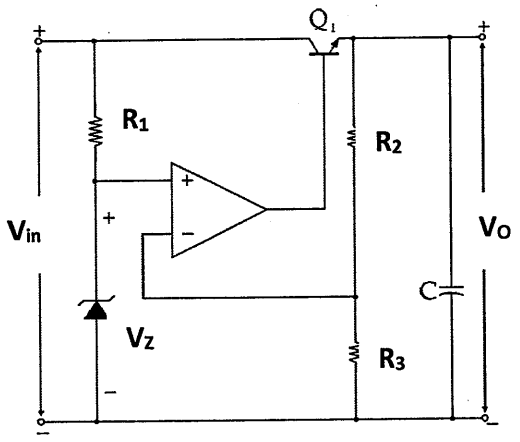

Fig. 5

5. (20%) Fig. 5 shows a voltage regulator, where the input voltage (Vin) is 20 V. The breakdown voltage of the Zener diode (V_z) is 4 V when its current is 10 mA, and Vz increases to 4.05 V when its current increases to 20 mA. In addition, $R_2 = 8$ kΩ and $R_3 = 4$ kΩ.
   (a)(6%) Please calculate the dynamic resistance of the Zener diode (i.e., its equivalent resistance at its quiescent operating point).
   (b)(7%) Please calculate its output voltage (Vo) when the current of the Zener diode is 10 mA.
   (c)(7%) Please caculate the value of R_1 to make Vz = 4 V.

6. (10%) Fig. 6 shows the block diagram of a Decimal Counting Unit (DCU), and a basic Decimal Counting Assembly (DCA) consists of three DCU elements. Hence, a DCA is 3-bit, and the maximal number that a 3-bit DCA can show is 999. Then, if a digital meter is said to have 3½ bit, what is the maximal number that it can show?

7. (20%) Fig. 7 shows the circuit of an electronic voltage meter, whose input voltage range is 0-5 V. (a) Please describe how to modify it for increasing the input voltage range to 0-10 V. (b) Please describe how to modify it to become an ohmmeter with its reading linearly proportional to the value of measured resistor.

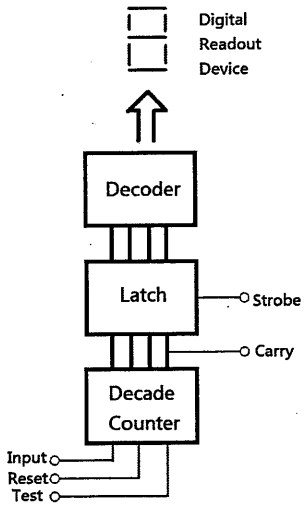

Fig. 6

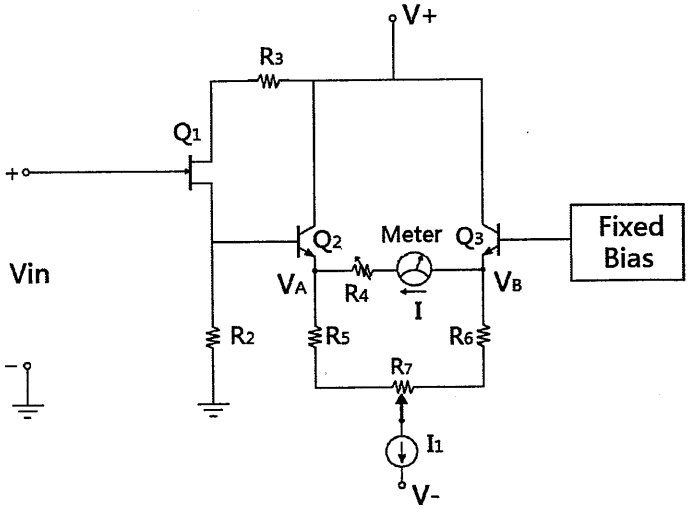

Fig. 7