※ 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%) Successive measurements of the temperature in a container over a period of time produce the following 15 data: 28.05, 27.10, 24.65, 23.85, 24.34, 25.78, 25.5, 26.01, 24.85, 24.50, 24.15, 23.95, 23.25, 24.05, and 24.35 (unit: °C). Please calculate their average and median values.

2. (10%) Please explain the working principle of a hot-wire ac ammeter, as shown in Fig. 1.
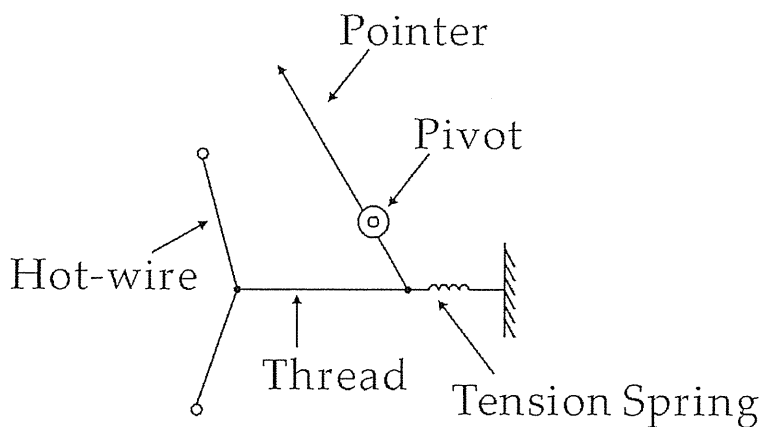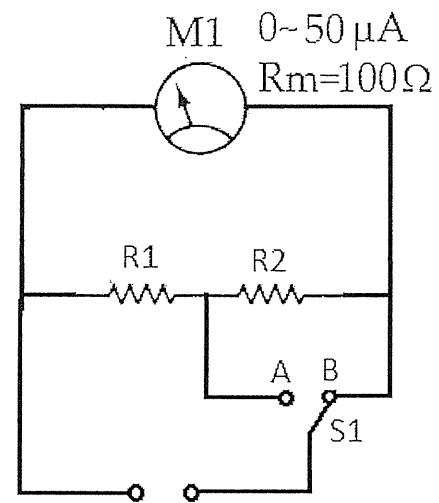

Fig. 1

Fig. 2

3. (20%) As shown in Fig. 2, a permanent magnet moving coil (PMMC) meter with I_{FSD}=50 μA and R_m=100 Ω is used to design a multi-range ammeter with ranges of 1 mA and 10 mA. (a) When the range of the multi-range ammeter is set to 10 mA, which position (i.e., position A or B) should the switch S1 be connected to? (8%) (b) Please find the values of resistance R1 and R2. (12%)

4. (10%) In high-speed digital systems, simple passive circuit elements like wires, cables, and chip PCB interconnections can significantly affect signal quality. Hence, proper termination is needed to maximize signal quality and minimize the effects of signal reflections. There are three common forms of line termination, including parallel, series, and differential terminations. Please explain what the parallel and series terminations are.

5. {15%}(a) Please explain the advantages of electronic multimeter (EMM) over volt-ohm-milliammeter (VOM) in aspects of sensitivity and input impedance (5%). (b) As shown in Fig. 3, given that the measured E ＝ 7.5 V, I_m(FSD) ＝ 1 mA, V_P＝+5V, V_{GS} ＝ −5 V, R_s＋R_m＝1 kΩ, and the switch turns to the third position (10-V), please find the voltage (V) across the emitters of Q_1 and Q_2(5%). (c) What is the current through the meter? (5%)
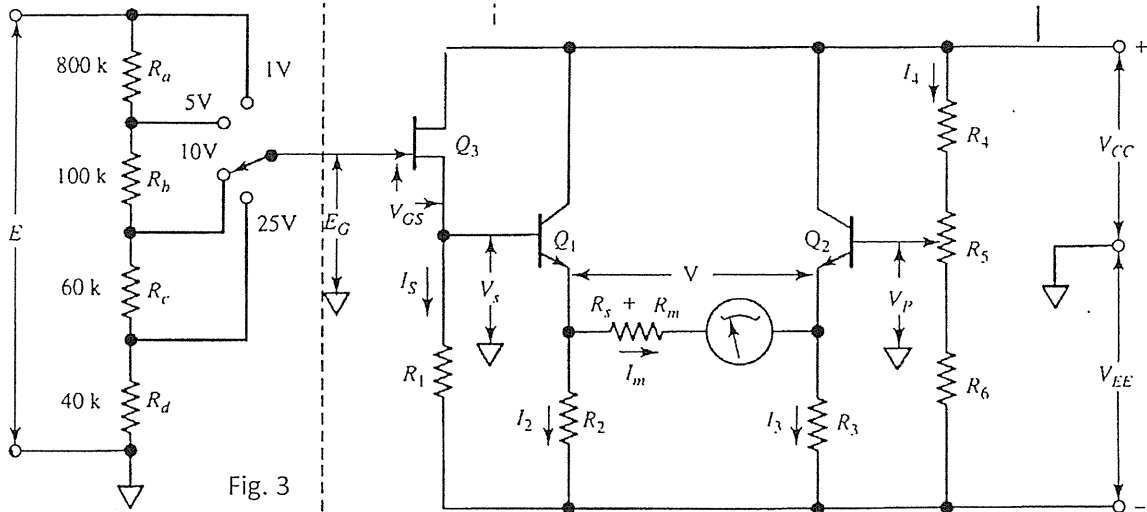
Fig. 3

6. {20%} Use an impedance analyzer to measure a crystal resonator whose equivalent circuit has [C_P=4 pF, L_s= 3 mH, R_S = 6 Ω, and C_S=12 fF] (subscription S/P means 'Series'/'Parallel'), but only one of amplitude or phase responses is found in Fig. 4. (a) Between the frequency of (f_a, f_b), which component dominates the overall impedance? C_P, R_S, C_S, or L_S? (4%) (b) Which is the mode of the f_b resonant frequency, series or parallel resonant frequency? (3%) (c) Please calculate both the resonant frequencies of f_b and f_a. (8%); (d) Please plot the other missed response (if phase, notice the signs of the phase). (5%)
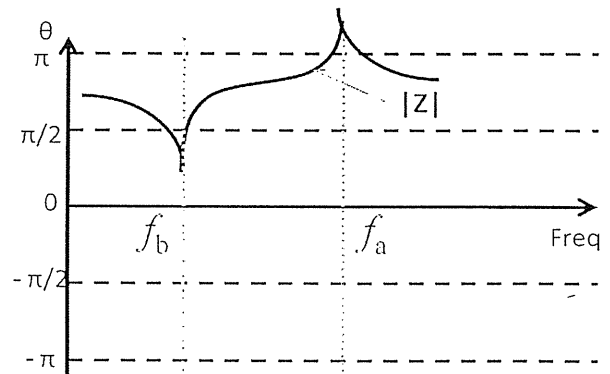

Fig. 4

7. {15%} The function of this circuit is designed as a full-wave rectifier in Fig. 5. Some parts of components are missed. (a) Use the components below [forward or reverse diodes, open circuit (O.C.), short circuit (S.C.), resistor] to correct those missed $D_1/D_2/D_3$ and indicate the V+ or V- ports of the OP-Amp. Please plot the complete circuit. (5%) (b) Analyze the 'negative' cycle and indicate which diodes are ON and which are OFF(5%). (c) If the gain of the 'positive' cycle is $5v_i$, (R_3= 10 kΩ), please calculate the values of R_1 and R_2(5%).
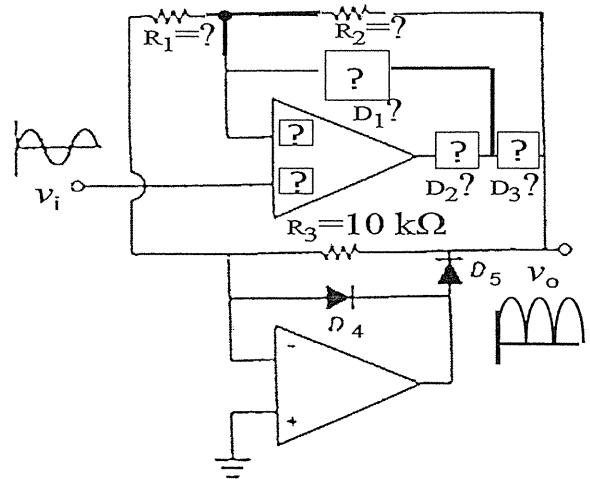

Fig. 5