Exercises on High Voltage Engineering (May 15, 2025)

Lecture: High Voltage Measurement (2)

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**Exercise 7-8: 有一台电容分压器，若在低压臂**𝑪𝟐**上并联一个高阻**𝑹𝟐**，试证明：在测电压时， 所测到的低压臂电压**𝑼𝟐**的幅值，会比无**𝑹𝟐(𝑹𝟐 → ∞)**时小**[𝟓𝟎/(𝝎𝑪𝟐𝑹𝟐)𝟐]%**，相位领先**𝐭𝐚𝐧−𝟏(𝟏/𝝎𝑹𝟐𝑪𝟐)**，其中**𝝎**为被测电压的角频率。**

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**Exercise 7-9: 高压充气标准电容器有什么功用？**

(1) As the high-voltage arm of a capacitive voltage divider, it is used to measure the peak value, RMS value, or waveform of AC voltage. Recently, it has also been developed for measuring impulse voltage.

(2) It serves as a standard capacitor in high-voltage Schering bridges, which are used to measure the dielectric loss factor and capacitance of capacitors, bushings, cables, etc.

(3) As a coupling capacitor, it works in conjunction with partial discharge measurement instruments to detect partial discharges in transformers, bushings, etc., as well as high-frequency interference voltages.

(4) As a component of a differential-integral measurement system, it can be used to measure lightning impulse voltages.

**Exercise 7-11: 一台低阻尼串联阻容分压器，高压臂电容为 300pF，阻尼电阻**𝑹𝟏𝒅 = 𝟑𝟖𝟎𝛀**， 高压臂分布电阻为 80Ω，被测电压为 1000kV，射频电缆的波阻抗**𝒁𝟎 = 𝟓𝟎𝛀**，电缆输出端的电压设为 2kV，然后经电阻分压器二次分压，把信号电压输到数字示波器上。请：**

**（1）按教材图 7-21（P208）求**𝑪𝟐**和**𝑹𝟐**的值；**

## （2）按教材图 7-19（P207）配置电缆的匹配电阻，并画出总测量接线图。

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**Exercise 7-12: 请总结在交流、直流、雷电冲击和操作冲击高电压下，可以个采用什么类型的分压器。**

High Voltage : Resistive divider, Capacitive divider, RC divider

DC High Voltage : Resistive divider

Lightning Impulse HV: Resistive divider, Capacitive divider, RC divider

Switching Impulse HV: Capacitive divider, RC divider

**Exercise 7-13: “反击”是高电压领域的常用术语，请举例说明反击的含义。**

The phenomenon where a high-current flow through grounding resistance causes the ground potential of low-current measurement devices/instruments to rise.

Examples: Lightning backflashover: When a powerful lightning current flows into the ground, the ground potential at the strike point surges instantaneously, creating a reverse overvoltage between the transmission line and the ground.

**Supplementary Exercise 1:** Suppose there is a high-voltage resistor divider, with the overshoot *β* on its step response wave is almost zero, and the theoretical step response (with the actual zero point as the origin) time *T*=0.2μs. If this divider is used to measure the impulse short-wave voltage *u*1(*t*)=*A*[exp(-*αt*)-exp(-*βt*)], where *α*=0.235μs-1 and *β*=1.85μs-1, please calculate:

1. The measured voltage waveform *u*2(*t*)=?
2. By how many microseconds is the time *t*m at which *u*2(*t*) reaches its peak amplitude delayed compared to the time *t*1m at which *u*1(*t*) reaches its peak amplitude?
3. What is the relative measurement error of the peak amplitude of the impulse voltage?

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