

Oefenopgaven EE1320 Meettechniek – college 1: Inleiding meten en meetsystemen¹

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Regtien: opgaven 1.8, 1.9, 7.6, 7.7

1.3 An experiment results in the following empirical relation:

$$f = \frac{1}{2Lr} \sqrt{\frac{F}{\rho}} \quad (1-5)$$

With the following quantities: f : frequency, F : Force, L : length, ρ : specific mass and r : radius. Can this empirical relation be correct?

Select the correct answer:

- Yes, because the units match
- No, because the units do not match
- Yes, because a resonance frequency is always described by a square root function
- No answer possible due to insufficient specification

1.4 Express the unit of electrostatic capacitance, C [F], in SI- units. Capacitance is related to charge and voltage via the expression: $Q = C \times V$, $[C] = [F][V]$. Moreover, electric charge buildup is equal to the product of charging current and time:

$Q = I \cdot t$, $[C] = [A][s]$. Finally, the unit of mechanical power is equal to that of electrical power: $[V][A] = [N][m][s]^{-1}$.

¹ Het merendeel van de weergegeven opgaven is afkomstig uit

R.F. Wolffenbuttel, "Measurement of Electrical and Non-electrical quantities", editie 2010.

2.2 The following specifications are listed for an instrument:

- Temperature drift: $0.01\%/^{\circ}\text{C}$
- Time stability: $0.1\%/ \text{month}$
- Operating temperature range between -10°C and 60°C .

Calculate the reproducibility of a measurement if only once every three months a calibration is performed at 20°C (the calibration is assumed to be perfectly accurate and the time elapsed since the last calibration is assumed to be unknown).

An instrument is used to measure a voltage of about 7.2 V . It is composed of a 4-digit indicator with 9.999 full-scale. The inaccuracy is specified at 0.2% full scale + 0.5% indication.

2.3 Calculate the resolution of this instrument.

2.4 Also calculate the inaccuracy of this instrument.

The following specifications are listed for an instrument:

- Temperature drift: $0.04\%/^{\circ}\text{C}$
- Time stability: $0.1\% / \text{month}$
- Operating temperature range between 0°C and 30°C .

2.5 Select the most convenient calibration temperature and calculate the maximum calibration interval for a reproducibility specification at 1% .