Final Exam PMS 20 aug 2007 9:00-12:00

(1) The results of an earlier PMS exam are summarized in Figure 1. The solid line gives the, appropriatly scaled, normal distribution with mean $\langle x \rangle = 4,90$

$$p(x) = \frac{1}{\sigma_x \sqrt{2\pi}} e^{\left(-\frac{(x-\langle x \rangle)^2}{2\sigma_x^2}\right)}$$

a) estimate, or calculate, the standard deviation σ_x of the grades (make clear how you arrived at your answer

b) Comment on the correctness, c.q. usefulness, of the standard deviation in this particular case.

c) Determine the scaling factor between $p(x)$ and the solid curve in Figure 1.

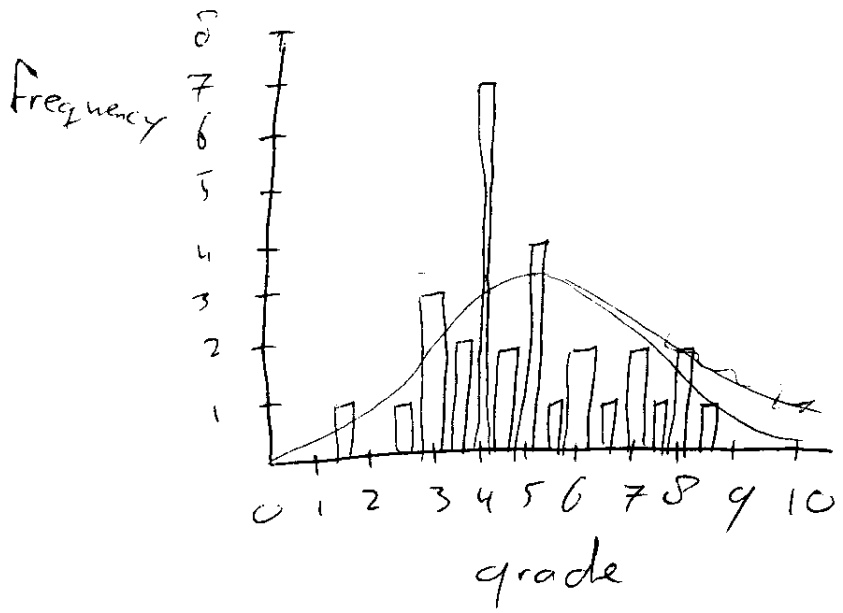

Figure 1.

(2) Discuss the following terms and their definitions:

a) Precision
b) Accuracy
c) Resolution
d) Sensitivity

(3) A temperature measurement system consists of a metal-oxide thermistor in a Wheatstone bridge followed by an analog display. The three subsystems are described by the following equations:

$$R(T) = R_0 \cdot e^{\beta\left(\frac{1}{T} - \frac{1}{T_0}\right)}$$

$$V(R) = \left[\frac{R_1}{R_1 + R} - r\right] \cdot V_s$$

$$\Theta(V) = a_1 + a_2 \cdot V$$

	mean	σ
R_0	10 kΩ	33 Ω
β	3000 k	25 k
T_0	300 k	0 k
R_1	9 kΩ	0 kΩ
r	0,79	0
V_s	12 V	0,01 V
a_1	353 k	1 k
a_2	18 k/V	0 k/V

a) The determine the mean value of the instrument reading for an input temperature of 350 k

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b) The determine the standard deviation of the instrument reading for an input temperature of 350k

(4)

A pressure sensor with build-in current transmitte (characterized by its Norton equivalent circuit: current source i_N with shunt resistance R_N) is read out by a recorder with load resistance R_L. The capacitive coupling to a nearby power cable and earth plane can be described by the capacitors C_1, C_2, C_3 and C_4, as shown in Figure 2.

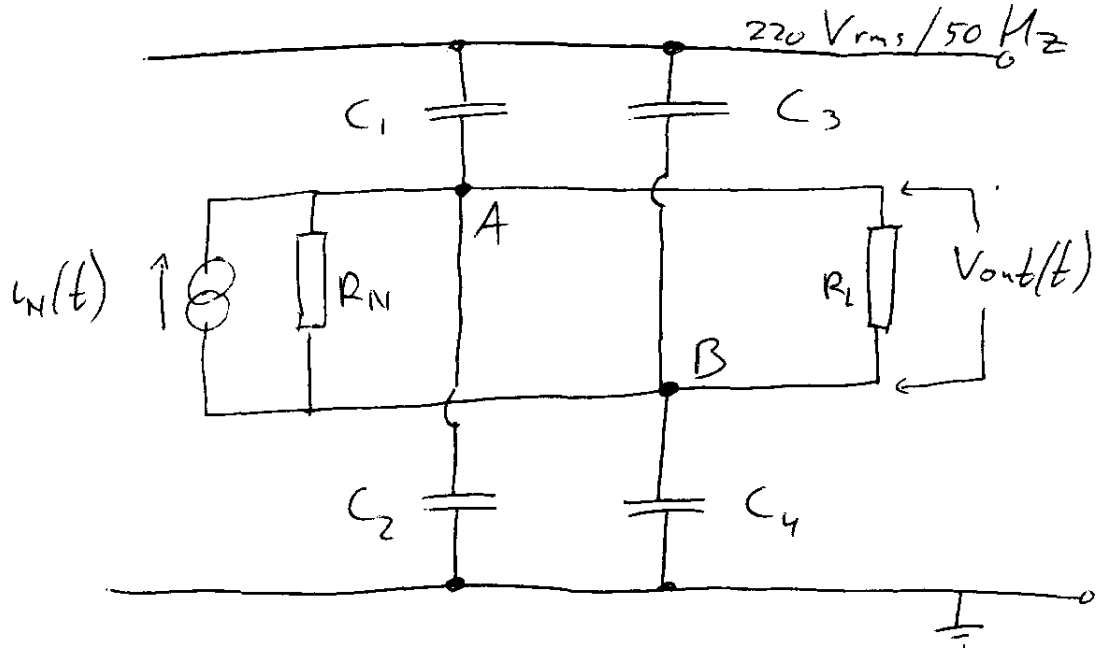

Figure 2. $R_N = 100\,k\Omega$; $R_L = 1\,k\Omega$; $C_1 = 50\,pF$
$C_2 = 55\,pF$; $C_3 = 80\,pF$; $C_4 = 85\,pF$

Assume for a moment that $i_N \approx 0\,A$

a) Express the common mode and series mode voltages (rms) seen by the recorder in terms of the voltages at point A and B (V_A and V_B, respectively)
b) Derive an expression for the common mode voltage, and evaluate it numerically.
c) Derive an expression for the series mode voltage (rms) seen by the recorder, and evaluate it numerically.
d) Discuss strategies for reduction of the capacitive coupling.

End of Exam