Embedded and ambient systems midterm examination (repeated)

Time available: 60 minutes
Usable aid: ----------
Maximal score: 20 points
Required score to pass: 10 points

1.	We have a resistive bridge circuit with one strain gage sensor (the other resistances are constant). The sensor is far from the bridge circuit. The wires leading to the sensor are made of copper, each having a length of 10 m. The resistivity of the copper at 25 °C is 0.3 Ω/m. The bridge circuit is driven by DC voltage (15 V). The nominal value of the resistances in the bridge is 350 Ω. To minimize the effect of the long wires leading to the sensor we connect the sensor with three wires. Sketch the model of the circuit. Calculate the offset error, if the strain gage has no load (no force). Calculate the gain error (caused by just the wires, not the gain error of the bridge circuit), if the resistance of the strain gage changes 1%.	4 points
2.	There are two resistive sensors in the opposite branches in a resistive bridge circuit. The bridge is driven by DC current. The nominal values of the resistances in the bridge are the same. Sketch the circuit model of the bridge. Denote the direction of the resistance change of the sensors. Derive the output voltage of the bridge. Is it linear with regards to resistance change of the sensor?	2 points
3.	Sketch the architecture of the counter type ADC with feedback structure, and show its working principle on a time diagram. Does do conversion time depend on the signal to be measured?	2 points
4.	Sketch the architecture of the two stage pipelined subranging ADC. Put a ring around the components (and only around those) which are needed for the pipeline operation.	2 points
5.	Sketch the architecture of the Sigma-Delta modulator in a Sigma-Delta ADC (only the modulator!). Denote at every input and output of the blocks, whether the signal is analog or digital. Sketch the linear model of the system!	2 points
6.	How the Signal to Noise and Distortion Ratio is defined (measuring the dynamic properties of ADCs)? Provide the formula, and the meaning of the variables in the formula.	2 points
7.	Sketch the R-2R ladder based DA converter, which provides voltage output using voltage reference.	2 points
8.	Sketch the amplitude specification of a factor 5 decimation filter in the frequency range of 0 .. fs, where fs is the sampling frequency. What is the amplitude specification at $f_s/10$, $f_s/5$, $f_s/2$ and $9f_s/10$?	2 points
9.	How can the speed of processing units (microcontrollers, general purpose processors, DSPs etc.) be increased? Enumerate 4 possibilities.	2 points