# Examples to be solved

Example 3.1. A thermometer reads 73.5°C and the true value of the temperature is 73.15°C. Determine the error and the correction for the given thermometer.

Example 3.2. A temperature transducer has a range of 0°C to 100°C and an accuracy of ±0.5 percent of full scale value. Find the error in a leading of 55°C.

Example 3.3 A pressure gauge of range 0.20 bar is said to have an error of ±0.25 bar when calibrated by the manufacturer. Calculate the percentage error on the basis of maximum scale value. What would be the possible error as a percentage of the indicated value when a reading of 5 bar is obtained in a test?

Example 3.4 A pressure gauge having a range of 1000 $kN/m^2$ has a guaranteed accuracy of 1 percent of full scale deflection (i) What would be the possible readings for a true value of 100 $kN/m^2$? (ii) Estimate the possible readings if the instrument has an error of 1% of the true value.

Example 3.5 The pressure at a remote point has been measured by a system comprising a transmitter, a relay and a receiver element. The specified accuracy limits are :

Transmitter : within ±0.2%
Relay : within ±1.1%
Receiver : within ±0.7%

Estimate the maximum possible error and the root-square accuracy of the measurement system.

Example 3.6 Following data is taken while calibrating a bourdon gauge with a dead weight gauge tester :

| Actual Pressure $Kg_f/cm^2$ | 5 | 10 | 15 | 20 | 25 | 30 | 25 | 20 | 15 | 10 | 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Gauge Reading $Kg_f/cm^2$ | 4.5 | 9.6 | 14.2 | 18.0 | 22.5 | 28.0 | 26.0 | 21.0 | 16.2 | 11.4 | 7.0 |

Draw the calibration, the error and the correction curves. Make suitable comments on your results.

Example 3.7 A spring scale requires a change of $15kg_f$ in the applied weight to produce a 2 cm change in the deflection of the spring scale. Determine the static sensitivity.

Example 3.8 Explain the following statements:
(i) A galvanometer has a sensitivity specified of 15 mm/μA.
(ii) An automatic balance has a quoted sensitivity of 1 vernier division/0.1 mg.

Example 3.9 A measuring system consists of a transducer, an amplifier and a recorder, and their individual sensitivities are stated as follows:

Transfer sensitivity K1 = 0.25 mV/ °C
Amplifier gain K2 = 2.5 V/mV
Recorder sensitivity K3 = 4 mm/V

What would be the overall sensitivity of the measuring system?

Example 3.10 A pressure measuring system consists of a piezoelectric transducer, a charge amplifier and a ultra violet charge recorder. The sensitivities of these elements are stated as follows:
Piezoelectric transducer, K1 = 8.5 pC/bar
Charge amplifier, K2 = 0.004 V/pC
Ultraviolet charge recorder, K3 = 20 mm/V
What would be the deflection on the chart due to a pressure change of 30 bar?

Example 3.11 How resolution is reckoned for the analogue and digital read out devices?

Example 3.12 A force transducer measures a range of 0-150 N with a resolution of 0.1 percent of full scale. Find the smallest change which can be measured.

Example 3.13. Distinguish between threshold and resolution (or discrimination). The pointer scale of a thermometer has 100 uniform divisions, full scale reading is 200°C and 1/10$^{th}$ of a scale division can be estimated with a fair decree of accuracy. Determine the resolution of the instrument.

Example 3.14 When a step input of 100 $kg_f/cm^2$ is applied to a pressure gauge, the pointer swings to pressure of 102.5 $kg_f/cm^2$ and finally comes to rest at 101.3 $kg_f/cm^2$. Determine the overshoot of the gauge reading and express it as a percentage of the final reading. Also calculate the percentage error of the gauge.

Example 3.15 The dynamic performance of a thermocouple in a protective sheath has been described by the following differential equation:

$$25\frac{d\theta_o}{dt} + 2.5\theta_o = 1.25x10^{-5}\theta_i$$

where $\theta_o$ is the output volts and $\theta_i$ is the input temperature in $^oC$. Determine the time constant and the static sensitivity of the thermocouple.