Lab 4. Error in Measurement-Statistical Calculations

Name-Surname :		**Date** :	
Student No. :		**Group** :	

Tools

ATTENTION! – You must bring your Digital Multimeter. Other equipment and samples will be given during the experiment.

- **Vernier Caliper:** Vernier caliper is a slide type caliper consists of a main scale and a vernier scale. It is used to perform length, depth, inside and outside measurements (Figure 1).
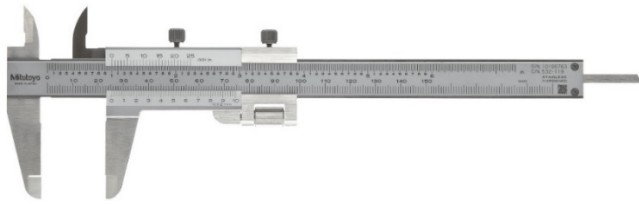

Figure 1. A vernier caliper.

- **Micrometer:** Micrometer provides more accurate measurements (in microns) for small lengths. Figure 2 shows a micrometer caliper with 0.01 mm precision.

Figure 2. A micrometer.

- **Digital Multimeter:** Digital Multimeter is an electronic measuring instrument that can combine several measurement functions in a unit. Ohmmeter function will be used in the scope of this experiment. Red probe is connected to "V/Ω/mA" terminal and black probe is connected to "com" terminal as shown in Figure 3a. In order to measure resistance, switch is configured to ohmmeter section (marked with Ω) as shown in Figure 3b. Ohmmeter section includes a resistance value range. Before measurement, suitable resistance value is selected from value range in ohmmeter section.
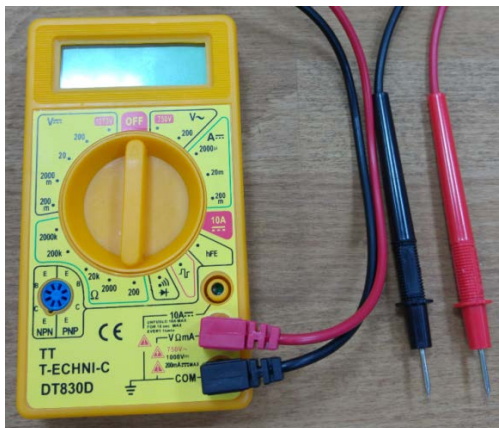
(a)	(b)

Figure 3. a) Connection of probes, b) Configuration of ohmmeter.

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- **Resistor:** Resistance value of a four band resistors can be determined, according to "Resistor Calculation Chart". Each band color corresponds to a number. First and second band color indicate 1st digit and 2nd digit. Third band color determines the multiplier value where the fourth band color reveals the tolerance.
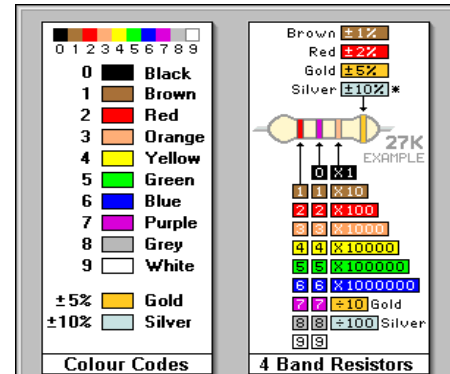

Figure 4. Resistor Calculation Chart.

- **Spherical Ball**

Figure 5. Spherical Balls

Instructions

1. Determine the true value of the resistor, according to "Resistor Calculation Chart". Then, measure ten pieces of the same resistors. Fill the table with your results.
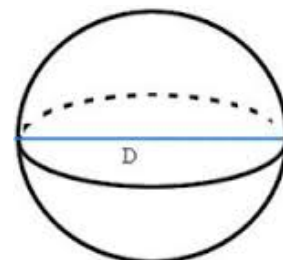
No.	Resistance (Ω)
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

True Value (Ω)

2. Make ten measurement for the diameter of the spherical ball first with vernier caliper, then micrometer. Then, fill the table with your results.

No.	Vernier Caliper (mm)	Micrometer (mm)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

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Homeworks

1. Briefly describe purpose of the experiment.
2. Briefly describe the used materials and measurement procedures.
3. Provide the set of values that you measured for all cases in tables.
4. Calculate the mean bias and root mean square errors for resistance measurement at Instruction 1.
5. Calculate the precision and accuracy for resistance measurement at Instruction 1.
6. Determine mean, average absolute deviation, sample standard deviation, sample variance, relative standard deviation, median and mode for diameter measurement at Instruction 2 for both vernier caliper and micrometer.
7. Calculate the precision and accuracy for diameter measurement at Instruction 2 for both vernier caliper and micrometer.
8. Comment on precision and accuracy of resistance measurement with digital multimeter.
9. Compare the effect of vernier caliper and micrometer measurement on precision and accuracy of spherical ball diameter measurement.
10. Comment on effect of users experience on precision and accuracy for electrical and mechanical measurements.

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