

## 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).

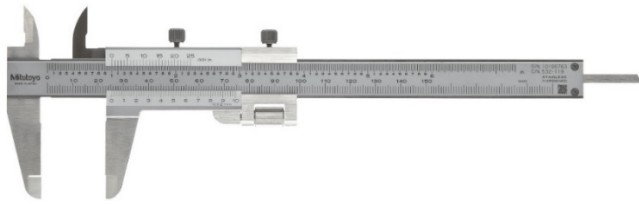


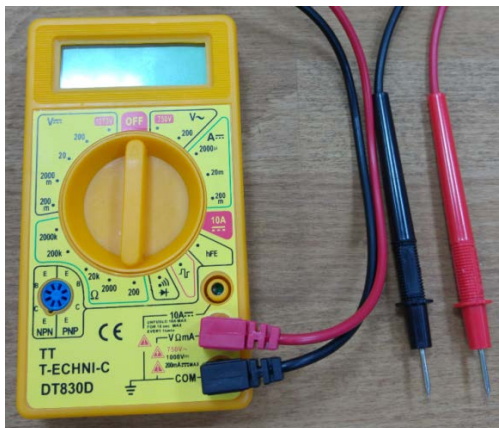
Figure 1. A vernier caliper.

- **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/ $\Omega$ /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  $\Omega$ ) 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.

## Lab 4. Error in Measurement-Statistical Calculations

- **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 1<sup>st</sup> digit and 2<sup>nd</sup> digit. Third band color determines the multiplier value where the fourth band color reveals the tolerance.

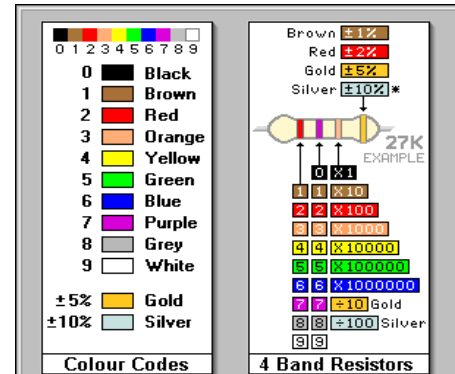


Figure 4. Resistor Calculation Chart.

- **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.

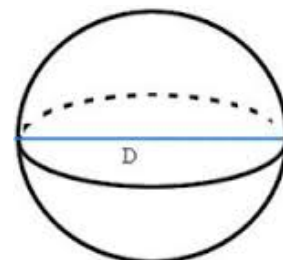
No.	Resistance ( $\Omega$ )
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

True Value ( $\Omega$ )



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		



## Lab 4. Error in Measurement-Statistical Calculations

### Homeworks

1. In introduction section, briefly describe purpose of the experiment.
2. In method section, briefly describe the used materials and measurement procedures.
3. In method section, provide the set of values that you measured for all cases in tables.
4. In results section, calculate the mean bias and root mean square errors for resistance measurement at Instruction 1.
5. In results section, calculate the precision and accuracy for resistance measurement at Instruction 1.
6. In results section, 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. In results section, calculate the precision and accuracy for diameter measurement at Instruction 2 for both vernier caliper and micrometer.
8. In conclusion section, comment on precision and accuracy of resistance measurement with digital multimeter.
9. In conclusion section, compare the effect of vernier caliper and micrometer measurement on precision and accuracy of spherical ball diameter measurement.
10. In conclusion section, comment on effect of users experience on precision and accuracy for electrical and mechanical measurements.

\* You can access report format from website [lcetin.github.io](https://github.com/lcetin)