LABORATORY REPORT

A laboratory report is the responsibility of an individual. Data may be secured by a team of two students, but under no circumstances may a student use data belonging to a different team. The lab supervisor must initial all data collected in the lab before the student leaves the lab.

A sample format of a laboratory report is as follows:

Name:.....
Study group No.
Date:.....

Experiment No.: ....
Title of the experiment:.....

A laboratory report consists of the following parts:

1. **Purpose of the experiment** - a short statement of the object of the experiment.
2. **List of apparatus** - identify all measuring apparatus. List the name of apparatus and manufacturer, model number and serial number (if available). Specify the range of values covered, the least count of the scale and the instrumental limit of error.
3. **Data** - all measurements must be recorded directly into the laboratory notebook. Data should not be taken on scrap paper and then recopied into the report. Data should be presented in a table whenever possible. Place the units of the measured quantities at the top of the data columns.
4. **Computations outline** - state all formulas. Identify all symbols. Substitute one set of data into each different formula. Number the steps followed in such a way that your approach may be easily understood. Calculate the error. Pay special attention to the error of indirect measurements.
5. **Graphs** - when graphs are required draw them carefully in ink. The axis should be clearly labelled.
6. **Results and conclusions** - list the numerical results as found in the computation outline. When stating results, express answers in powers of ten with proper units and range of error. Pay attention to your number of significant figures. Compare your experimental result with the accepted value. State the percentage of deviation. Discuss the value of a particular result as indicated by error analysis. Discuss the meaning of your graphical results. This discussion is an individual task. No team partner should copy another team member's work.

By requiring adherence to this standard report form, the laboratory is preparing the student for future professional work: almost all industrial and academic research teams have fairly rigid rules for reports of various types, and engineers are expected to follow the ground rules.
The laboratory report must be submitted to the instructor for inspection and grading at the next scheduled laboratory meeting following the performance of the experiment.

GRAPHING

Graphing is one of the most important engineering and scientific techniques. Engineers and scientists are generally most interested in quantitative types of graphs, which show the relation between two variables in the form of a curve. Depending on the problem, graphing is done on millimetre rectangular coordinate paper, semi-log, log-log or other forms of paper.

After suitable graph paper has been selected, the requirements for good graphing are:

I. Choice and labelling of the coordinates scales.
II. Plotting of the points representing the data.
III. Fitting a curve to the plotted points.
IV. Preparation of the title.

I. Choice and labelling of the coordinates scales.

Choice of the coordinates scales:

- The independent variables are plotted as abscissas to the X-axis and the dependent variables as ordinates parallel to the Y-axis. The independent variable is altered by steps, and the value of the dependent variable is determined for each value of the independent variable.
- The scale is chosen so that one block = 1, 2, 5, 10 units. Do not use 3, 7, 9 etc. units. A graph should be easily readable.
- Scales are not drawn along the boundary between graph and margin.
- Do not place scales at the top of the graph.
- If possible, place scales in such a way that they can be seen when the graph is bound.
- Scales are usually numbered so that the resultant curve is not confined to a small area of the graph. It is not essential for every graph to contain the point (0,0), but if a zero is a significant point, it should appear.
- Inspect the data carefully, and number the scales in such a way that each variable begins (when plotting the points) near the lowest and highest values in the data.
- In choosing scales be sure to consider the limit of error of the points being plotted. The smallest graphical division should be less than or at the worst equal to the limit of error of the points being plotted.
- Whenever possible, curves should have a geometrical slope approaching unity. This slope depends only on the scales chosen and is a pure number. By establishing a geometrical slope of unity the precision of the plotted points is improved.

Any abnormal spread of the data can be seen easily. Conversely, the use of slopes of less than unity will conceal variations that might be important. However the geometrical slope is not the same as the actual slope of the function. The actual slope requires consideration of the units plotted along each axis.

- The use of semi-log and log-log paper should be avoided when precision is important.

Labelling of the coordinates scales:

- Label coordinates along each axis. Give quantity and units.
- Do not label every block. Label every second, fourth, fifth or tenth block.

II. Plotting of the points representing the data.

- Experimentally determined points can be located by using crosses „+". The length of the vertical bar corresponds to the error of the measurement in the y direction, while the width of the horizontal bar has a similar function in the „x" direction.
- Points can also be located by other symbols, e.g. a small circle or a square.
- When more than one curve is drawn, distinguish between them by using different symbols, dotted or broken lines, or different coloured inks.

III. Fitting a curve to the plotted points.

- Although normally not shown on a graph, each plotted point falls within an „error rectangle". This „error rectangle" is composed of the ± range of the numerical error for the quantity plotted as an abscissa (independent variable) along the x-axis and for the quantity plotted as an ordinate (dependent variable) along the y-axis. Consequently, each point has an error range extending in both the x and y directions.
- Curves should be drawn near enough to the points to fall into the area which would be formed by the „error rectangle".
- If one or even two points are quite far from the apparent curve, then check the experimental data to see if a mistake has been made. If none appears, the point may, in general, be disregarded.

V. Preparation of the title.

- The title should be placed within the margin of the graph paper in a position where it does not interfere with the curve.
- The title must include an accurate description of the purpose of the graph.