Dimensional analysis

- Dimensional analysis is a mathematical technique which makes use of the study of the dimensions for solving several engineering problems. Each physical phenomenon can be expressed by an equation giving relationship between different quantities, such quantities are dimensional and non-dimensional. Dimensional analysis helps in determining a systematic arrangement of the variables in the physical relationship, combining dimensional variables to form non-dimensional parameters. It is based on the principle of dimensional homogeneity and uses the dimensions of relevant ariables affecting the phenomenon.
- Dimensional analysis has become an important tool for analysing fluid flow problems. It is specially useful in presenting experimental results in a concise form.
- Uses of dimensional analysis:
- The uses of dimensional analysis may be summarized as follows:
- 1. To test the dimensional homogeneity of any equation of fluid motion.
- 2. To derive rational formulae for a flow phenomenon.
- 3. To derive equations expressed in terms of nondimensional parameters to show the relative significance
- of each parameter.
- 4. To plan model tests and present experimental results in a systematic manner, thus making it possible to analyse the complex fluid flow phenomenon.
- Advantages of dimensional analysis:
- Dimensional analysis entails the following advantages:
- 1. It expresses the functional relationship between the variables in dimensionless terms.
- 2. In hydraulic model studies it reduces the number of variables involved in a physical phenomenon, generally by three.
- 3. By the proper selection of variables, the dimensionless parameters can be used to make certain logical deductions about the problem.
- 4. Design curves, by the use of dimensional analysis, can be developed from experimental data or direct solution of the problem.
- 5. It enables getting up a theoretical equation in a simplified dimensional form.
- 6. Dimensional analysis provides partial solutions to the problems that are too complex to be dealt with mathematically.
- 7. The conversion of units of quantities from one system to another is facilitated.