Thermodynamic system

Thermodynamics involves studying various systems. The word has its greek origin representing heat (therme) and power (dynamis). A thermodynamic system is to some extent a fixed pre-defined part of the universe which interacts with its surrounding in various manners; thermally, chemically or mechanically. A system may be described in terms of a region of space or a quantity of matter. The region that isolates the system from its surroundings is designated boundary. This boundary can be imaginary/real and/or fixed/movable. Through this, work or heat can be transferred from the surrounding to the system or vice versa. One may picture the surrounding as the rest of the universe, however, it is also valid to consider the surrounding as something in a position that enables exchange of energy and/ or matter with the system. In other words, the surrounding does not necessarily need to be considered as a whole entity but the matter that is in contact with the system under study.

There are three types of thermodynamic systems that can be distinguished according to the kind of interactions and energy exchange taking place between the system and its surrounding. We designate a system which can interchange mass and energy as an open system. A boundary allowing this type of exchange is considered to be permeable. A closed system can only exchange energy but not matter. On the other hand, a system where no interaction occurs (no heat,work or matter exchange) with its surrounding is designated as isolated system .

Open system: hot water placed in a open container In this example, transfer of heat is noticeable as well as mass in the form of steam occurs between the system and surrounding.

Closed system: hot water in a sealed kettle In this example, transfer of heat is noticeable since the hot water can get cooled down as heat is lost to the surroundings. The mass, however, remains constant.

Isolated system: hot coffee in an insulated thermo flask In this example, transfer of heat and mass are not possible

System	Exchanges with surrounding	Total amount of energy	Example
Open	Energy & Matter	Does not remain constant	Solution kept in an open flask
Closed	Only energy	Does not remain constant	Solution kept in a sealed flask
Isolated	Neither energy nor matter	Remains constant	Solution in a thermos flask