SNS COLLEGE OF ENGINEERING
Kurumbapalayam(Po), Coimbatore – 641 107
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19CH103– ENGINEERING CHEMISTRY

Unit-3 NANOCHEMISTRY

TOP-DOWN APPROACH

A top-down approach (also known as stepwise design and stepwise refinement and in some cases used as a synonym of decomposition) is essentially the breaking down of a system to gain insight into its compositional sub-systems in a reverse engineering fashion. In a top-down approach an overview of the system is formulated, specifying, but not detailing, any first-level subsystems. Each subsystem is then refined in yet greater detail, sometimes in many additional subsystem levels, until the entire specification is reduced to base elements. A top-down model is often specified with the assistance of "black boxes", which makes it easier to manipulate. However, black boxes may fail to clarify elementary mechanisms or be detailed enough to realistically validate the model. Top down approach starts with the big picture. It breaks down from there into smaller segments.

Top-down and bottom-up are two approaches for the manufacture of products. These terms were first applied to the field of nanotechnology by the Foresight Institute in 1989 in order to distinguish between molecular manufacturing (to mass-produce large atomically precise objects) and conventional manufacturing (which can mass-produce large objects that are not atomically precise). Bottom-up approaches seek to have smaller (usually molecular) components built up into more complex assemblies, while top-down approaches seek to create nanoscale devices by using larger, externally controlled ones to direct their assembly. Certain valuable nanostructures, such as Silicon nanowires, can be fabricated using either approach, with processing methods selected on the basis of targeted applications.

The top-down approach often uses the traditional workshop or microfabrication methods where externally controlled tools are used to cut, mill, and shape materials into the desired shape and order. Micropatterning techniques, such as photolithography and inkjet printing belong to this category. Vapor treatment can be regarded as a new top-down secondary approaches to engineer nanostructures.

BOTTOM-UP APPROACH

A bottom-up approach is the piecing together of systems to give rise to more complex systems, thus making the original systems sub-systems of the emergent system. Bottom-up processing is a type of information processing based on incoming data from the environment to form a perception. From a cognitive psychology perspective, information enters the eyes in one direction (sensory input, or the "bottom"), and is then turned into an image by the brain that can be interpreted and recognized as a perception (output that is "built up" from processing to final cognition).

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In a bottom-up approach the individual base elements of the system are first specified in great detail. These elements are then linked together to form larger subsystems, which then in turn are linked, sometimes in many levels, until a complete top-level system is formed. This strategy often resembles a "seed" model, by which the beginnings are small but eventually grow in complexity and completeness. However, "organic strategies" may result in a tangle of elements and subsystems, developed in isolation and subject to local optimization as opposed to meeting a global purpose.

Bottom-up approaches, in contrast, use the chemical properties of single molecules to cause single-molecule components to
  (a) self-organize or self-assemble into some useful conformation,
  (b) rely on positional assembly.

These approaches utilize the concepts of molecular self-assembly and/or molecular recognition. See also Supramolecular chemistry. Such bottom-up approaches should, broadly speaking, be able to produce devices in parallel and much cheaper than top-down methods, but could potentially be overwhelmed as the size and complexity of the desired assembly increases.