A

PROJECT REPORT ON

COMPUTER PROGRAMMING AND THERMODYAMMIC

SUBMITTED TO
DEPARTMENT OF SCIENCE AND TECHNOLOGY

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Project Completion Certificate

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Research Project Report

Declaration:

I Miss Priyanka Bajirao Scholar hereby declare that the details mentioned above are true to the best of my knowledge and I solely be held responsible in case of any discrepancies found in the details mentioned above.

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Content

1.introduction:-

Computer Organization

Computer organization deals with the hardware components of a computer system. It includes Input / Output devices, the Central Processing Unit, storage devices and primary memory. It is concerned with how the various components of computer hardware operate. It also deals with how they are interconnected to implement an architectural specification. The term computer organization looks similar to the term computer architecture. But, computer architecture deals with the engineering considerations involved in designing a computer. On the other hand, Computer Organization deals with the hardware components that are transparent to the programmer.

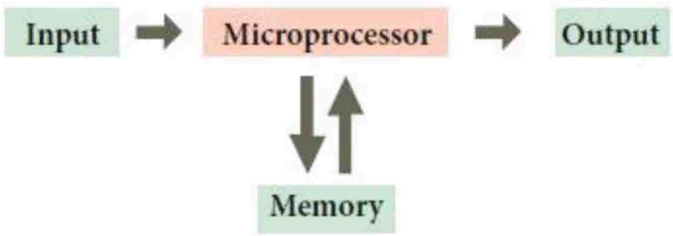


Figure 3.1 A Microprocessor - Based System

2.Definition (computer)

A **computer** is an electronic device that manipulates information, or data. It has the ability to **store**, **retrieve**, and **process** data. You may already know that you can use a computer to **type documents**, **send email**, **play games**, and **browse the Web**. You can also use it to edit or create **spreadsheets**, **presentations**, and even **videos**.

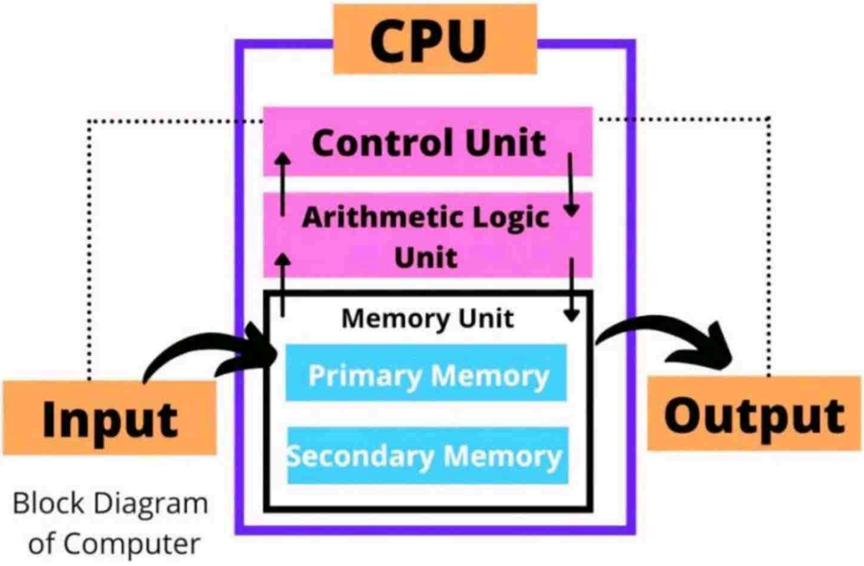
3.Block Diagram of a Computer

Input

All the data received by the computer goes through the input unit. The input unit comprises different devices like a mouse, keyboard, scanner, etc. In other words, each of these devices acts as a mediator between the users and the computer.
The data that is to be processed is put through the input unit. The computer accepts the raw data in binary form. It then processes the data and produces the desired output.

The 3 major functions of the input unit are-

- Take the data to be processed by the user.
- Convert the given data into machine-readable form.
- And then, transmit the converted data into the main memory of the computer. The sole purpose is to connect the user and the computer. In addition, this creates easy communication between them.



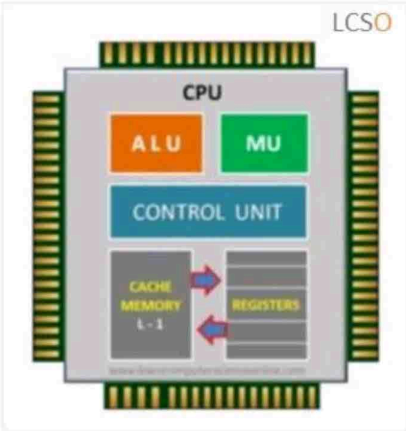
CPU – Central Processing Unit

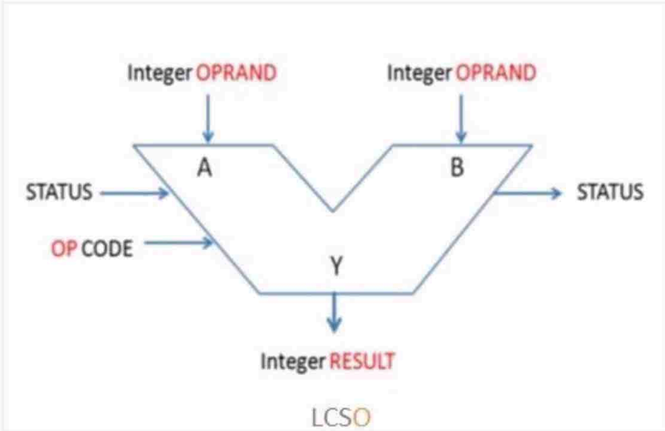
Central Processing Unit or the CPU, is the brain of the computer. It works the same way a human brain works. As the brain controls all human activities, similarly the CPU controls all the tasks.

ALU – Arithmetic Logic Unit

The Arithmetic Logic Unit is made of two terms, arithmetic and logic. There are two primary functions that this unit performs.

1. Data is inserted through the input unit into the primary memory. Performs the basic arithmetical operation on it. Like addition, subtraction, multiplication, and division. It performs all sorts of calculations required on the data. Then sends back data to the storage.
2. The unit is also responsible for performing logical operations like AND, OR, Equal to, Less than, etc. In addition to this it conducts merging, sorting, and selection of the given data.



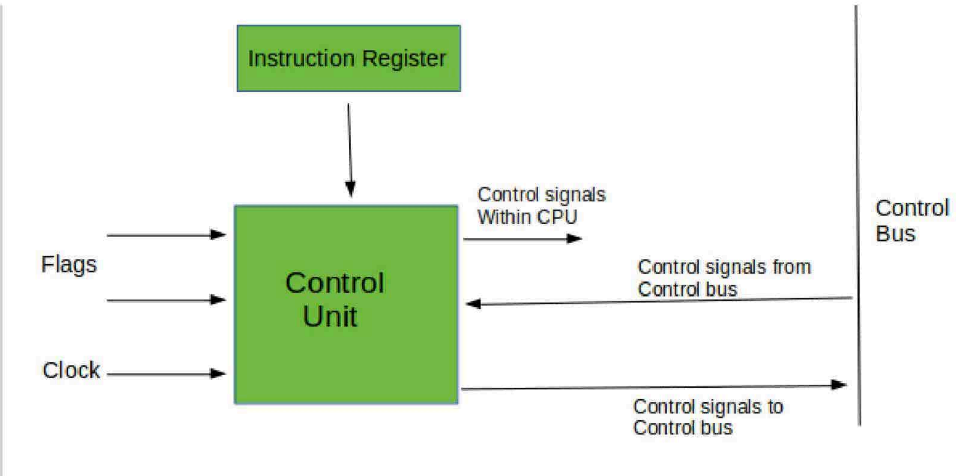


CU– Control Unit

The control unit as the name suggests is the controller of all the activities/tasks and operations. All this is performed inside the computer.

The memory unit sends a set of instructions to the control unit. Then the control unit in turn converts those instructions. After that these instructions are converted to control signals.

These control signals help in prioritizing and scheduling activities. Thus, the control unit coordinates the tasks inside the computer in sync with the input and output units



Block Diagram of the Control Unit

Memory Unit

All the data that has to be processed or has been processed is stored in the memory unit. The memory unit acts as a hub of all the data. It transmits it to the required part of the computer whenever necessary.

The memory unit works in sync with the CPU. This helps in faster accessing and processing of the data. Thus, making tasks easier and quicker.

There are two types of computer memory

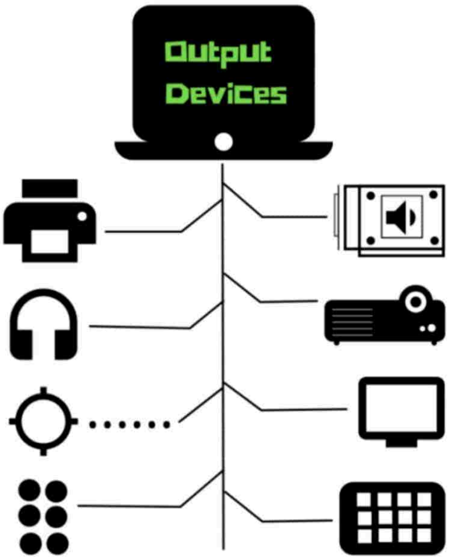
1. **Primary memory** – This type of memory cannot store a vast amount of data. Therefore, it is only used to store recent data. The data stored in this is temporary. It can get erased once the power is switched off. Therefore, is also called temporary memory or main memory.

   RAM stands for Random Access Memory. It is an example of primary memory. This memory is directly accessible by the CPU. It is used for reading and writing purposes. For data to be processed, it has to be first transferred to the RAM and then to the CPU.

2. **Secondary memory** – As explained above, the primary memory stores temporary data. Thus it cannot be accessed in the future. For permanent storage purposes, secondary memory is used. It is also called permanent memory or auxiliary memory. The hard disk is an example of secondary memory. Even in a power failure data does not get erased easily.

Output

There is nothing to be amazed by what the output unit is used for. All the information sent to the computer once processed is received by the user through the output unit. Devices like printers, monitors, projectors, etc. all come under the output unit.
The output unit displays the data either in the form of a soft copy or a hard copy. The printer is for the hard copy. The monitor is for the display. The output unit accepts the data in binary form from the computer. It then converts it into a readable form for the user.



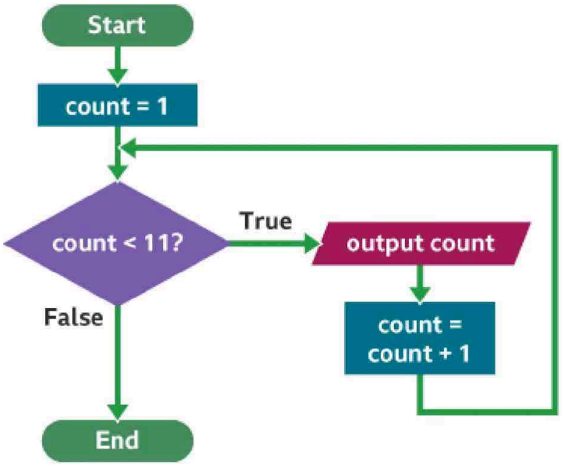
4. Flowcharts

A flowchart is a diagram that shows an overview of a program. Flowcharts normally use standard symbols to represent the different types of instructions. These symbols are used to construct the flowchart and show the step-by-step solution to the problem. Flowcharts are sometimes known as flow diagrams.

Symbol	Name	Usage
	Line	Represents the flow from one component to the next
Process	Process	An action
Input/Output	Input/Output	An input or output
Decision	Decision	A yes/no/true/false decision
Start/Stop	Terminal	The start or end of the process

Common flowchart symbols

Flowcharts can be used to plan out programs. This simple flowchart maps out an algorithm for a program that prints the numbers 1 to 10:



5. Advantages and disadvantages of using flowcharts

Designing an algorithm using a flowchart has advantages because:

- it is easy to see how a program flows
- flowcharts follow an international standard - it is easy for any flowchart user to pick up a diagram and understand it

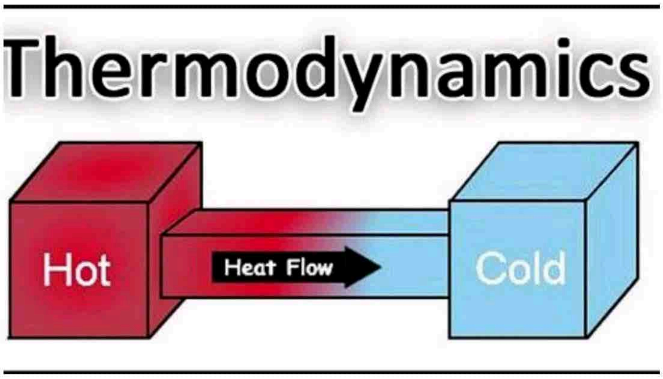
Flowcharts also have their disadvantages:

- with a large program, the diagrams can become huge and therefore difficult to follow
- any changes to the design may mean a lot of the diagram has to be redrawn

6. Introduction (thermodynamic)

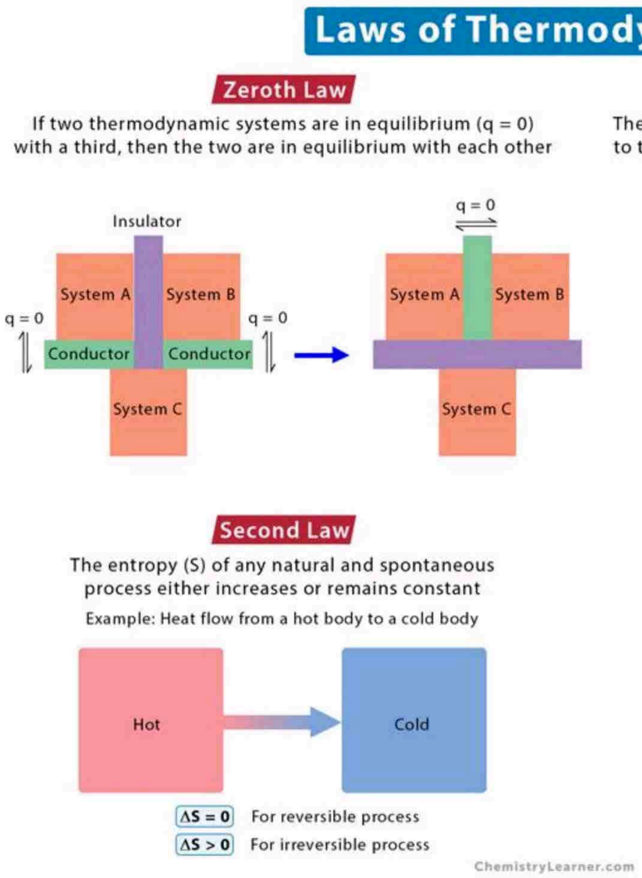
Thermodynamics is a branch of physics which deals with the energy and work of a system. As mentioned on the gas properties slide, thermodynamics deals only with the large scale response of a system which we can observe and measure in experiments. In aerodynamics, the thermodynamics of a gas obviously plays an important role in the analysis of propulsion systems but also in the understanding of high speed flows. The first law of thermodynamics defines the relationship between the various forms of energy present in a system (kinetic and potential), the work which the system can perform and the transfer of heat. The law states that energy is conserved in all thermodynamic processes.

thermodynamics, science of the relationship between heat, work, temperature, and energy. In broad terms, thermodynamics deals with the transfer of energy from one place to another and from one form to another. The key concept is that heat is a form of energy corresponding to a definite amount of mechanical work.



7.Laws of thermodynamics

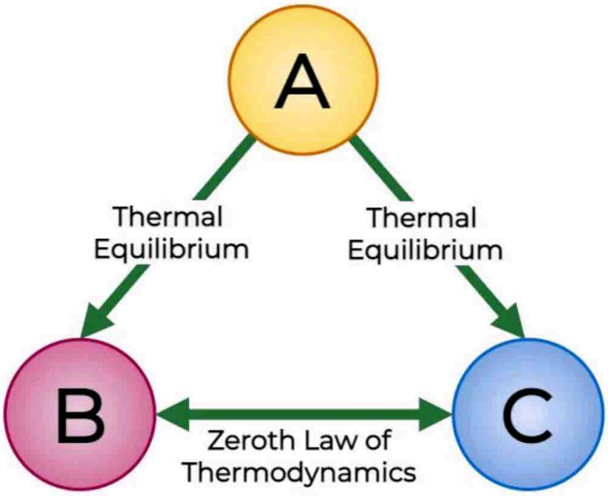
laws of thermodynamics, four relations underlying thermodynamics, the branch of physics concerning heat, work, temperature, and energy and the transfer of such energy.



8. The zeroth law of thermodynamics

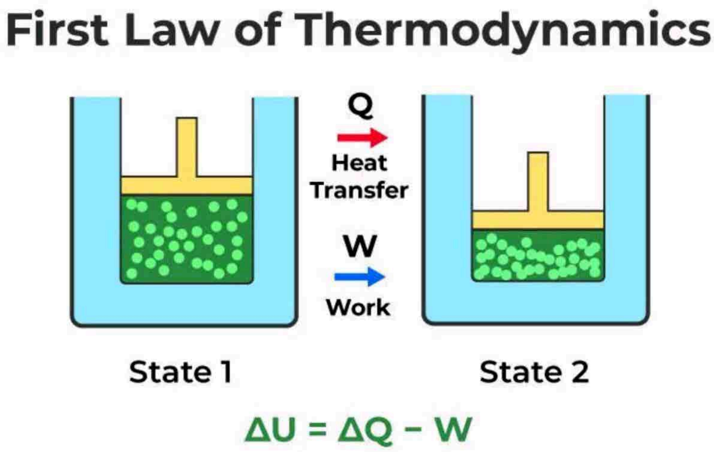
The first and second laws were formally stated in works by German physicist Rudolf Clausius and Scottish physicist William Thomson about 1860. The third law was developed by German chemist Walther Nernst from 1906 to 1912. However, scientists realized that one additional law was needed to fully describe energy changes in systems. This “law” was a basic understanding that was always considered to be true but needed to be formally stated. Because the other three laws were already numbered and the additional law is the foundation for the other three, it was dubbed the zeroth law of thermodynamics by Ralph Fowler in the 1930s.

The law states that if two bodies are each in thermal equilibrium with a third body, they must also be in equilibrium with each other. This means that if two objects are at the same temperature and they are in thermal equilibrium with another object, then this third object is also at the same temperature as the other two objects. This property makes it meaningful to use thermometers as the “third body” and to define a temperature scale.



9. The first law of thermodynamics

Within an isolated system, the total energy of the system is constant, even if energy has been converted from one form to another. (This is another way of stating the law of conservation of energy: that energy cannot be created or destroyed but merely converted from one form to another.) If the system is not isolated, the change in a system's internal energy ΔU is equal to the difference between the heat Q added to the system from its surroundings and the work W done by the system on its surroundings; that is, $\Delta U = Q - W$.



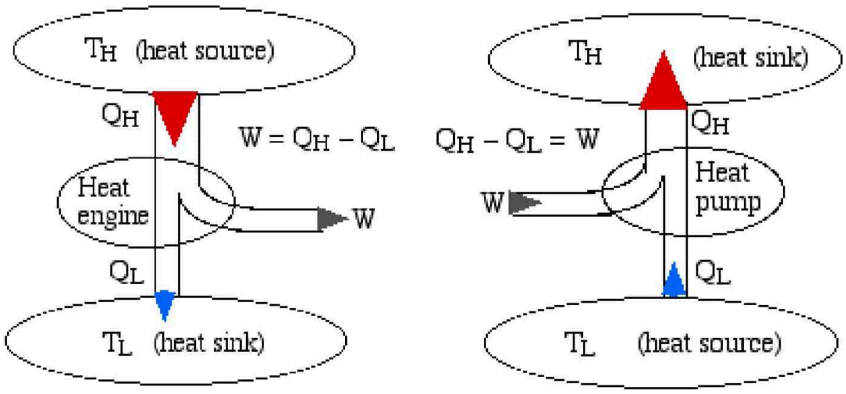
10. The second law of thermodynamics

Heat does not flow spontaneously from a colder region to a hotter region; or, equivalently, heat at a given temperature cannot be converted entirely into work. Consequently, the entropy (measure of the disorder of the material) of a closed system, or heat energy per unit temperature, increases over time toward some maximum value. Thus, all closed systems tend toward an equilibrium state in which entropy is at a maximum and no energy is available to do useful work.

CARNOT THEOREM

Sadi Carnot a French physicist, mathematician and engineer who gave the first successful account of heat engines, the Carnot cycle, and laid the foundations of the second law of thermodynamics).

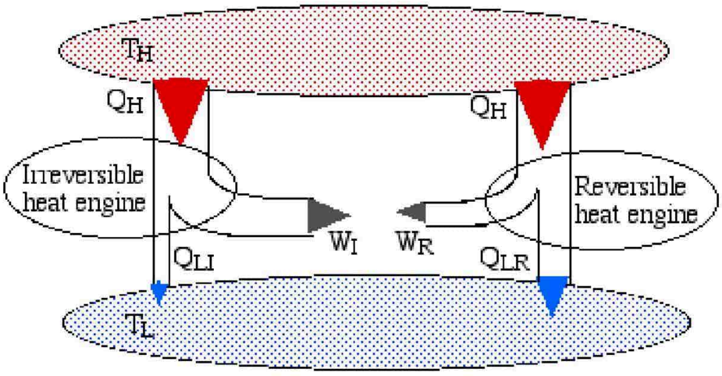
We represent a heat engine and a heat pump cycle in a minimalist abstract format as in the following diagrams. In both cases there are two temperature reservoirs T_H and T_L, with $T_H > T_L$.



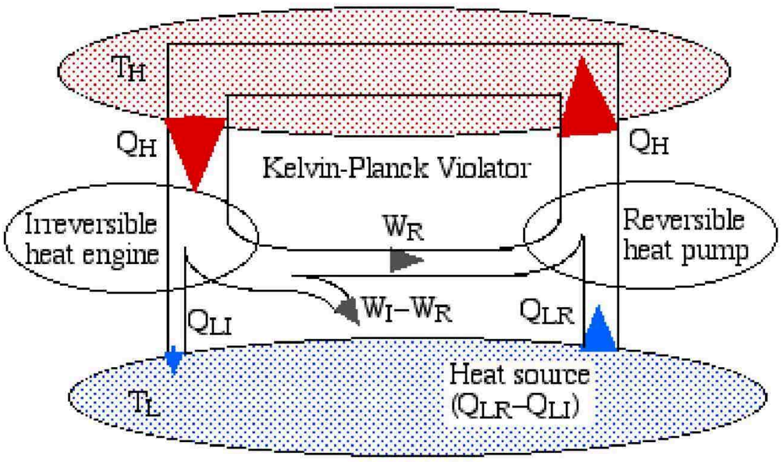
Carnot's theorem, also known as Carnot's rule, or the Carnot principle, can be stated as follows:

No heat engine operating between two heat reservoirs can be more efficient than a reversible heat engine operating between the same two reservoirs.

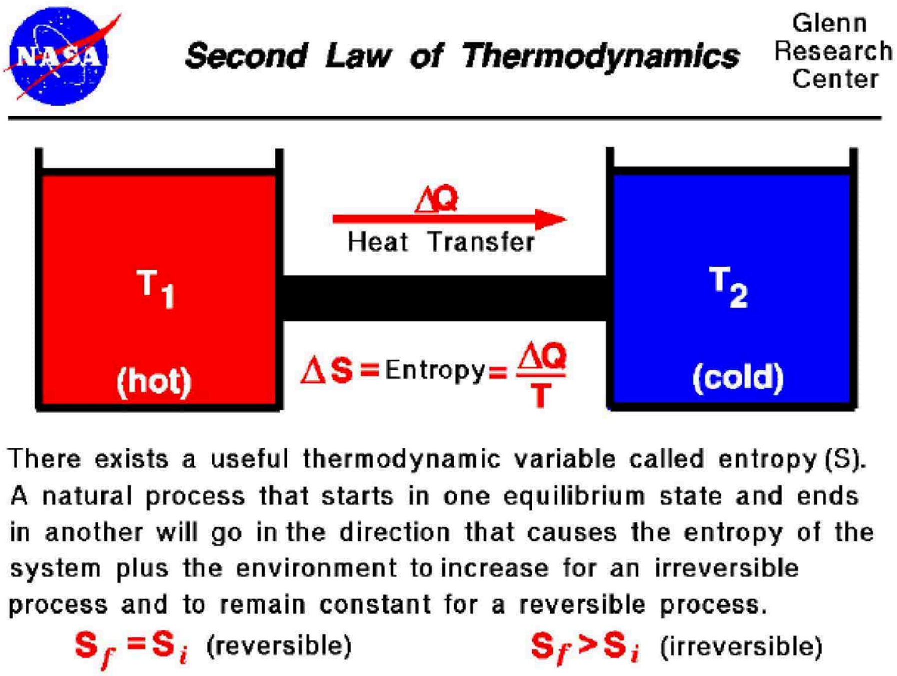
The simplest way to prove this theorem is to consider the scenario shown below, in which we have an irreversible engine as well as a reversible engine operating between the reservoirs T_H and T_L, however the irreversible heat engine has a higher efficiency than the reversible one. They both draw the same amount of heat Q_H from the high temperature reservoir, however the irreversible engine produces more work W_I than that of the reversible engine W_R.



Note that the reversible engine by its nature can operate in reverse, ie if we use some of the work output (W_R) from the irreversible engine in order to drive the reversible engine then it will operate as a heat pump, transferring heat Q_H to the high temperature reservoir, as shown in the following diagram:

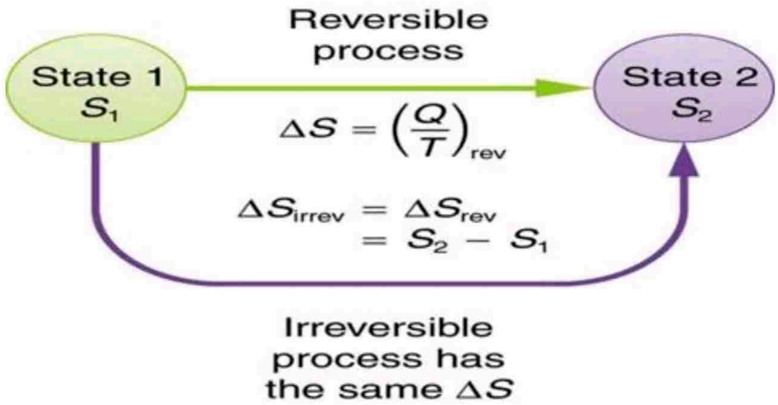


Notice that the high temperature reservoir becomes redundent, and we end up drawing a net amount of heat (Q_{LR} - Q_{LI}) from the low temperature reservoir in order to produce a net amount of work (W_I - W_R) - a Kelvin-Planck violator - thus proving Carnot's Theorem.



ENTROPY CHANGE IN IRRAVERSIBLE AND IN AN IRREVERSIBLE PROCESS

The second law states that there exists a useful state variable called entropy. The change in entropy (delta S) is equal to the heat transfer (delta Q) divided by the temperature (T). For a given physical process, the entropy of the system and the environment will remain a constant if the process can be reversed. If we denote the initial and final states of the system by "i" and "f", Sf = Si (reversible). An example of a **reversible process** would be ideally forcing a flow through a constricted pipe. (Ideal means no boundary layer losses). As the flow moves through the constriction, the pressure, temperature and velocity would change, but these variables would return to their original values downstream of the constriction. The state of the gas would return to its original conditions and the change of entropy of the system would be zero. The second law states that if the physical process is **irreversible**, the entropy of the system and the environment must increase; the final entropy must be greater than the initial entropy.



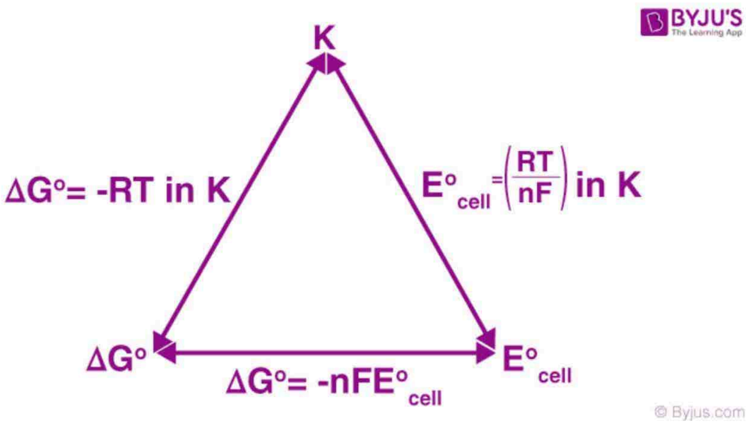
11. The third law of thermodynamics

The entropy of an isolated system approaches a constant value as the temperature of the system approaches absolute zero (−273.15 °C, or −459.67 °F). In practical terms, this theorem implies the impossibility of attaining absolute zero, since as a system approaches absolute zero, the further extraction of energy from that system becomes more and more difficult

Nernst heat theorem

The **Nernst heat theorem** was formulated by Walther Nernst early in the twentieth century and was used in the development of the third law of thermodynamics.

The Nernst heat theorem says that as absolute zero is approached, the entropy change Δ*S* for a chemical or physical transformation approaches 0. This can be expressed mathematically as follows:



Another way of looking at the theorem is to start with the definition of the Gibbs free energy (G), $G = H - TS$, where H stands for enthalpy. For a change from reactants to

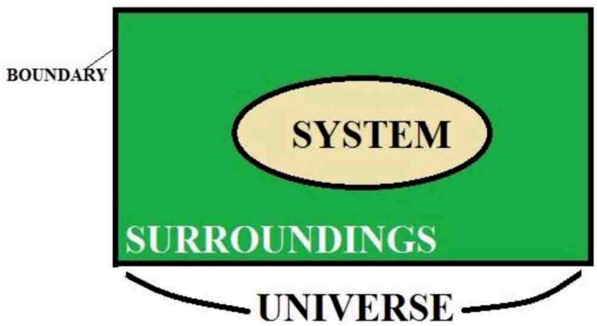
products at constant temperature and pressure the equation becomes .

In the limit of $T = 0$ the equation reduces to just $\Delta G = \Delta H$, as illustrated in the figure shown here, which is supported by experimental data.[2] However, it is known from thermodynamics that the slope of the ΔG curve is $-\Delta S$. Since the slope shown here reaches the horizontal limit of 0 as $T \to 0$ then the implication is that $\Delta S \to 0$, which is the Nernst heat theorem.

The significance of the Nernst heat theorem is that it was later used by Max Planck to give the third law of thermodynamics, which is that the entropy of all pure, perfectly crystalline homogeneous materials in complete internal equilibrium is 0 at absolute zero.

12. TYPES OF THERMODYNAMICAL SYSTEM

A thermodynamic system is defined as a fixed mass in a region of space under consideration to analyze a problem.
Let also understand the terms system, surrounding, and boundary.



The system is defined as the region or quantity of matter which is taken into consideration for analysis.

Surroundings: Surrounding is the region located outside the system. There is a boundary between the surroundings and system which keeps them separated from each other.

Note: The system and surroundings together make up the universe.

It is a surface in which the system is contained and separated from the surroundings. It can be movable or fixed.

13. Classification of Thermodynamic System:

Thermodynamic systems can be classified into three categories on the basis of heat and mass transfers between the system and the surroundings:

1. **Closed system**
2. **Open system and**
3. **Isolated system**

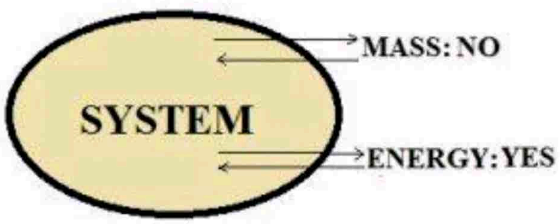
Closed system:

In this type of system, the transfer of mass does not take place across the system boundary. However, energy transfer can place in the form of heat or work.

For example, We have a piston-cylinder arrangement.

The volume of gas is 1 m^3, and the mass is 3 kg. The boundary is closed i.e. gas can't escape out of the cylinder into the atmosphere, When the cylinder is heated from below, the piston moves upwards. The gas in the cylinder heats up and transfers work in the form of piston movement.

However, the mass remains constant as only expansion is taking place. Thus, we can say that this is a closed system.

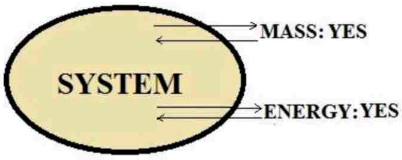


Open system:

In this type of system, the transfer of energy, as well as mass, takes place across the boundary of a system.

For example: Heating a pan.

When a pan containing water is kept on a stove and heated, water molecules get evaporated and convert into steam. Thus, mass transfer is taking place. Water gets evaporated and water can be added to the pan. Heat energy is transferred to the water by the gas flame and heat energy is also lost to the surroundings. Hence, we can say that this is an open system.

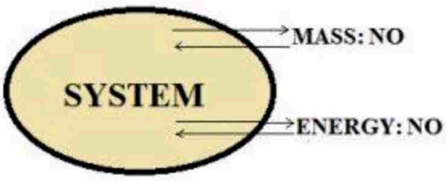


Isolated system:

If there is no mass and energy transfer between the system and the surroundings, then such a system is said to be an isolated system.

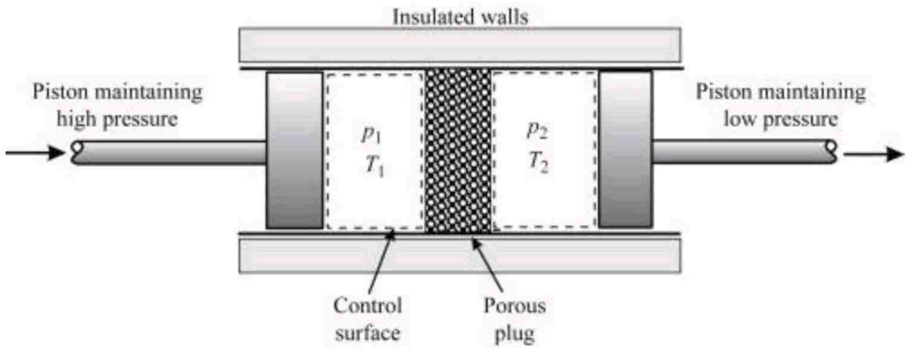
Example: A thermos flask.

When a liquid is poured inside the thermos flask whether it is hot or cold, the flask is built in such a way that it maintains the temperature of the liquid present in it. It does not allow the transfer of mass and energy because the lid is closed so nothing comes in and nothing goes out of the flask. So, we can conclude that the thermos flask is an isolated system.



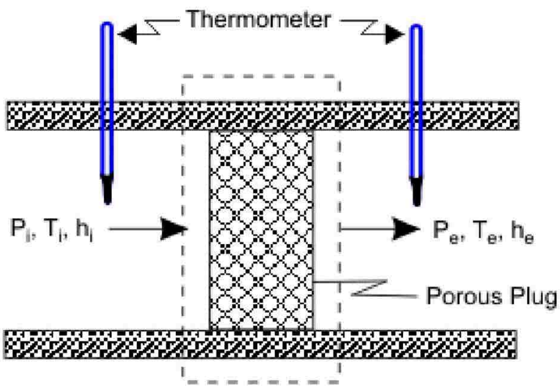
14. JOULE –THOMSON EFFECT

Joule-Thomson effect, also called **Joule-Kelvin effect**, the change in temperature that accompanies expansion of a gas without production of work or transfer of heat. At ordinary temperatures and pressures, all real gases except hydrogen and helium cool upon such expansion; this phenomenon often is used in liquefying gases. The phenomenon was investigated in 1852 by the British physicists James Prescott Joule and William Thomson (Lord Kelvin). The cooling occurs because work must be done to overcome the long-range attraction between the gas molecules as they move farther apart. Hydrogen and helium will cool upon expansion only if their initial temperatures are very low because the long-range forces in these gases are unusually weak.



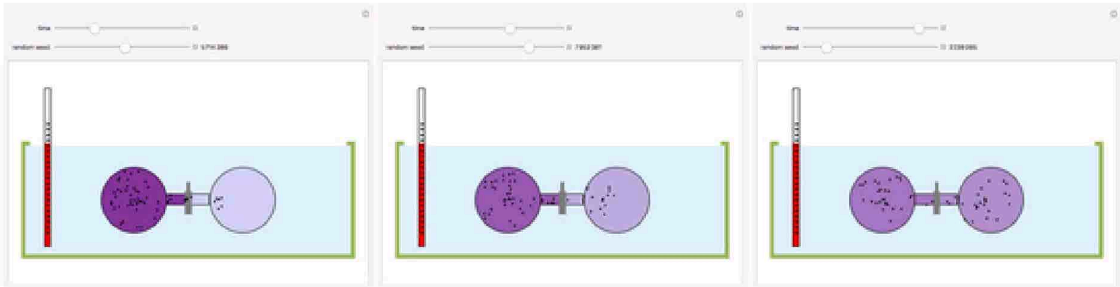
15. THOMSON POROUS PLUG EXPERIMENT

The porous plug experiment was designed to measure temperature changes when a fluid flows steadily through a porous plug which is inserted in a thermally insulated, horizontal pipe. The apparatus used by Joule and Thomson is shown Figure



Joule free expansion

In 1843, Joule did this simple experiment to show that the internal energy of a gas is a function of temperature, independent of pressure or volume. When the gas in the left sphere initially flows without resistance into the vacuum of the right sphere, no work is performed and no heat is transferred. Thus the temperature remains constant. It is now understood that this result is accurate only for an ideal gas.



16. The Future Impacts and Importance of Thermodynamic Computing

Impact of Thermodynamic Computing in Science

Thermodynamic Computing would pave the way for machine learning computing concepts to be aligned with the approach. Hence, stochastic and reversible algorithms would help comprehend the behavior of many predictive models.

Meanwhile, increasing the use of physical devices and components for computation creates an agile system. Therefore making it easier for the systems to be ready to use for the world.

Moreover, it would deal with intractable computational issues. To clarify domains like biology, medicine, ecology, climate, social, etc have limited sources and reach. However, with Thermodynamic Computing complex problems are addressed using a broad approach.

Hence, it would pave the way for various fields like engineering, physics, biology, and social sciences to be united. Therefore, leading a system that would tackle multiple and diverse problems for optimum benefits.

Thermodynamic Computing Impacts Business

Thermodynamic Computing can offer various computational functions. Hence, it could exceed the expectations of efficiency.

As a result, it would manifest self-organization in a computing system. Hence reducing human interference and use of human-specified solutions.

Above all, it can determine the organization's computational capacity. It can study the environment and utilize the resource around for further "intelligence"

Furthermore, it increases the reach for innovative computing technologies. As a result, businesses have the opportunity to build a capable and functionally agile system unique to the requirements and objectives.

Most importantly, it gives opportunities to use more available, efficient, and agile resources at much lower costs.

Certainly, it would help improve the outcomes of most businesses. For instance, medicine, agriculture, defense, security, etc.

As a result, it would also create possibilities for new and innovative businesses. Consequently, creating more impact on job opportunities.

Technological and Social Impacts of Thermodynamic Computing

Consequently, Thermodynamic Computing would have a great influence on the environment. For instance, it would reduce the consumption of energy in each unit of computational task.

It would certainly expand the efficiency of software development. Therefore it would delegate most of the functions of the organizational system into the Thermodynamic Computer.

Most importantly, it would improve the battery life of portable and edge-connected systems and devices.

Likewise, it will optimize the capabilities of small and low-cost computational systems. As a result, giving rise to devices that use perceptual capabilities similar to animal sensory systems.

In addition, decreasing the negative impact of technology on the environment. However, increasing the efficiency of the workforce.

17. QUESSIONNAIRE

What are the Limitations of First Law of Thermodynamics?

The limitations of the First Law of Thermodynamics are:

The first law of thermodynamics fails to give the feasibility of the process or change of state that the system undergoes .It fails to explain the direction of heat flow. It doesn't say the process is a spontaneous or non-spontaneous process.

What is computer programming?

This question may seem obvious, but chances are you will need an answer for this at some point. **Computer programming** is basically a method of instructing computers on what steps to take next to execute a particular set of functions. The overall purpose of computer programming is to develop a concrete and usable product, whether it be a software, webpage or internal system.

Why is program documentation important?

Program documentation includes describing algorithms, coding strategies, designing, testing and proper use of a particular program in written form. This process is important for sharing data with other developers.

What is the zeroth law of Thermodynamics?

The zeroth law of thermodynamics states that if two thermodynamic systems are each in thermal equilibrium with a third system, then they are in thermal equilibrium with each other.

What is heat capacity, and what is specific heat of substance?

Heat capacity is the amount of heat required to change the temperature of a specific amount of matter by 1 degree Celsius.

Specific heat of a substance is the amount of heat required to raise the temperature of 1 gram of substance by 1 degree Celsius.

What is Thermodynamic equilibrium?

Thermodynamic equilibrium is an internal state of a single thermodynamic system or of multiple connected thermodynamic systems, in which there is no net flow of energy either within a system or within the systems.

What is Entropy?

Entropy is a measure of unavailable energy in a closed thermodynamic system that indicates the degree of disorder or uncertainty in a system.

Entropy is usually considered to be a measure of the system's disorder and is a property of the system's state.

Entropy varies directly with any reversible change in heat in the system and inversely with the temperature of the system.

18. Conclusion:

Thermodynamic Computing refers to the computational model that is supported by the laws of Thermodynamics. Therefore, it is a developing understanding of using thermodynamics to utilize limited resources at their full potential.

It is different from Conventional and Quantum. It gives rise to the theory of limiting the use of hardware in technology by effectively utilizing the software.

As a result, creating a system that uses natural elements that could adapt to its physical environment. Therefore, just like nature, it manipulates self-organization and the laws of Thermodynamics

According to Todd Hylton, Professor at University of California San Diego, executive director of its Contextual Robotics Institute and the lead author on a report on Thermodynamic Computing states, “The whole universe organizes itself but our technology does not. Thermodynamics drives organization in the real world. So it should drive technology too”

Thermodynamic Computing promises a great future for businesses and the environment. Hence, it is important to apply and practice Thermodynamics in the field of computing.

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