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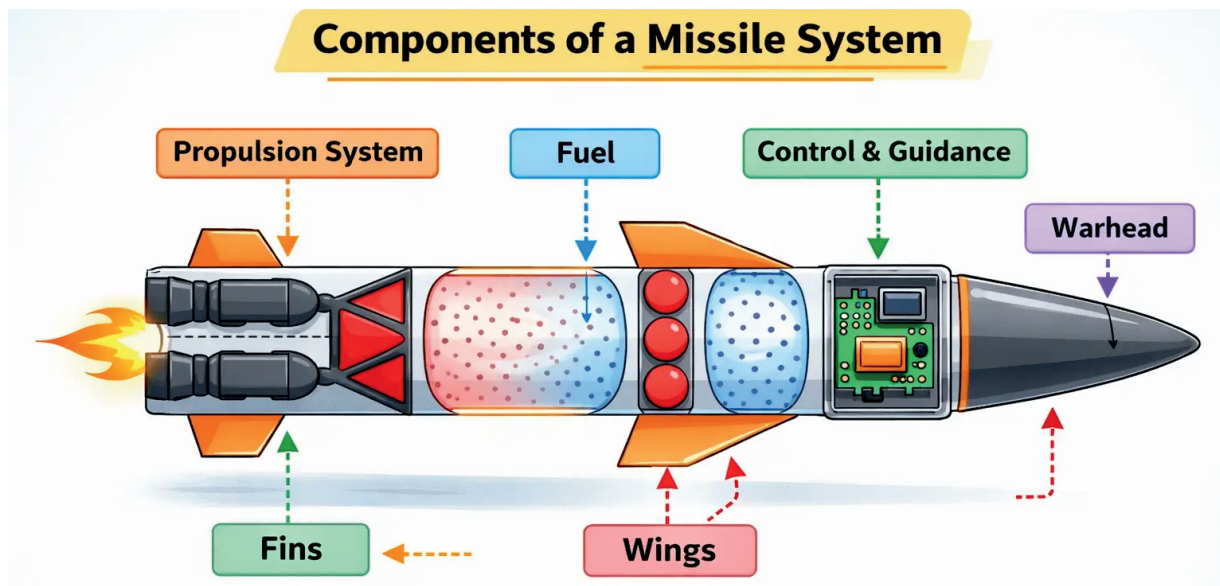
Defence Technology

Basics of Missile System

- A missile is a **guided weapon system** designed to deliver a payload (conventional or nuclear) accurately to a target. Unlike rockets, missiles are equipped with guidance, navigation, and control systems that allow them to correct their trajectory during flight.
- Missiles play both **tactical** and **strategic** roles:
 - **Tactical Role:** Missiles are used on the battlefield against enemy installations, vehicles, or troops.
 - **Strategic Role:** Missiles are primarily meant for nuclear deterrence and long-range strike capability

Components of a Missile System

Components of a Missile System are categorized into five main parts:



2

Space Technology

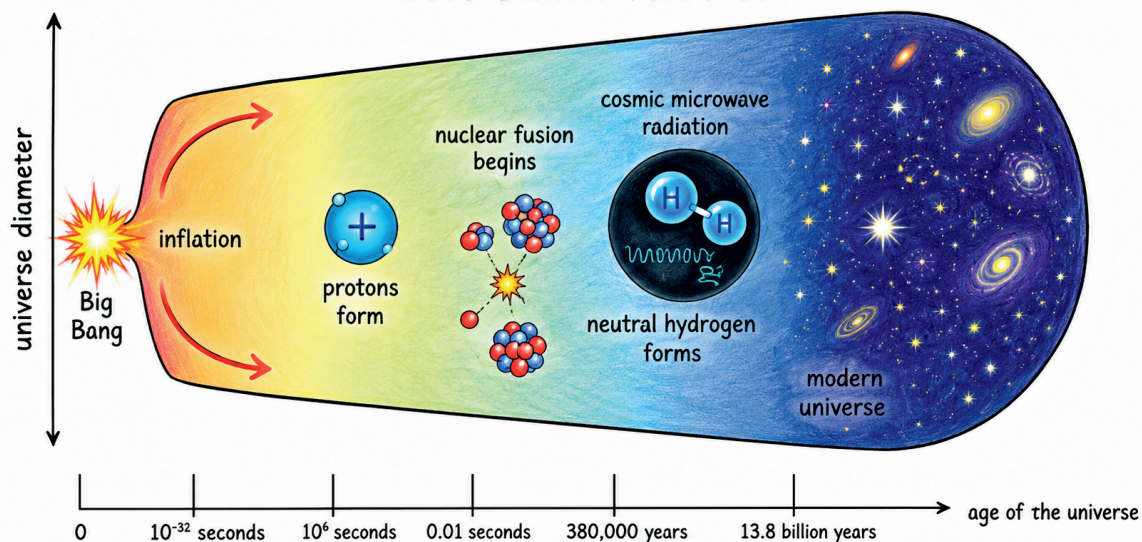
Some Concepts Related to Space

Big Bang Theory

- The Big Bang Theory states that the universe began around **13.8 billion years ago** from an extremely hot, dense, and tiny point called a **singularity** (a point of infinite density and extreme temperature).
- It expanded rapidly (**cosmic inflation**), leading to the formation of matter, energy, galaxies, stars, and planets.
- **Current State:** The universe is **still expanding** today.
- **Evidence Supporting the Theory:** The Big Bang Theory is supported by several lines of evidence:
 - **Cosmic Microwave Background (CMB) Radiation**
 - **Hubble's Law** (observational evidence for the expansion of the universe)
 - **Abundance of Light Elements** (Hydrogen, Helium, etc.).

How Old Is the Universe?

~13.8 Billion Years Old



Introduction

- Nanotechnology involves the manipulation and control of matter at the nanoscale, typically in the **range of 1 to 100 nanometers**. ($1 \text{ nm} = 10^{-9} \text{ m}$).
- The concept behind nanotechnology is a research paper “**There’s Plenty of Room at the Bottom**” by physicist **Richard Feynman** in 1959.
- The **term** nanotechnology was **coined** by Professor **Norio Taniguchi**.

Characteristics of Nanotechnology

- The **properties** of nanomaterials are **different** from those of micromaterials or bulk materials **due to their size and surface effects**.
- Nanoparticles have a **high surface area to volume ratio** compared to bulk materials.
- This characteristic gives them **unique properties**, such as enhanced chemical reactivity, strength, and the ability to absorb more molecules, making them ideal for applications in fields like medicine, electronics, and energy.
- Nanoscale Dimensions:**
 - 1 nanometer** = one billionth of a meter (10^{-9} meters).
 - Comparison:**
 - A sheet of paper is about 100,000 nm thick.
 - A virus (~100 nm), DNA strand (~2 nm in diameter).
 - A single human hair is about 80,000–100,000 nm wide.

History & Development of Nanotechnology

Year	Milestone	Significance
1959	Richard Feynman's Vision - Lecture "Plenty of Room at the Bottom" 	Concept of manipulating individual atoms; laid the philosophical foundation of nanotechnology.
1974	Norio Taniguchi coins the term Nanotechnology	Defined it as precision machining at the nanometer scale.
1981	Scanning Tunnelling Microscope (STM) invented by Gerd Binnig & Heinrich Rohrer (IBM) 	Enabled imaging & manipulation of individual atoms; Nobel Prize in Physics
1985	Discovery of Fullerenes – Richard Smalley, Robert Curl, Harold Kroto 	New carbon allotrope (C_{60}); Nobel Prize in Chemistry (1996); opened path for carbon nanotubes.
1985	Discovery of Fullerenes – Richard Smalley, Robert Curl, Harold Kroto 	New carbon allotrope (C_{60}); Nobel Prize in Chemistry (1996); opened path for carbon nanotubes.
1999	First Molecular Machine 	Molecular-scale rotary motor demonstrated; proof of concept for nanomechanical devices.
2000s–Present	Expanding Applications 	- Medicine: Targeted drug delivery, diagnostics - Electronics: Carbon nanotubes, nano transistors

What is a Computer System?

A **computer system** is a programmable digital electronic device. It accepts input in the form of data, processes this data based on program instructions, and outputs information in a desired format for meaningful use.

Characteristics of Computer

1. **Speed:** Very high speed; executes millions of instructions per second.
2. **Accuracy:** Performs all tasks and calculations accurately; errors are usually human mistakes or due to computer malfunction (e.g., virus).
3. **Diligence:** Works continuously for hours without getting tired or losing concentration/speed.
4. **Power of Remembering (Memory):** Has memory to store vast amounts of data (crores of data) for later retrieval.
5. **Versatility:** Can perform many different jobs across various fields (Schools, Hospitals, Offices, Research, Entertainment, etc.).
6. **Automation:** Performs tasks automatically, saving time and money.
7. **Storage:** Vast capacity to store data (crores of files).

Computer Generation

The evolution of computer has been divided into **five generation**, As shown in table below

Emerging Technologies

Artificial Intelligence



- “The Science and Engineering of making intelligent machines, especially intelligent Computer programs is Artificial intelligence” – **John McCarthy [Father of AI]**
- **NITI Aayog** defines AI as: AI is a constellation of technologies that enable machines to act with higher levels of intelligence and emulate the human capabilities of sense, comprehend and act.
- Or simple $\Rightarrow$ **AI** refers to the ability of machines to perform cognitive tasks like thinking, perceiving, learning, problem solving and decision making.

Types of Artificial Intelligence

1. Based on Capabilities (Stages of AI)

Type	Description	Example
Narrow AI (Weak AI)	Performs a single task efficiently	Voice assistants like Siri, Alexa, Google Assistant
General AI (Strong AI)	Hypothetical future AI capable of performing any intellectual task that a human can do.	Robots capable of reasoning, problem -solving, and decision-making across multi -domain (not yet achieved)
Superintelligent AI	Surpasses human intelligence in all fields, including emotional intelligence.	Theoretical / Sci-fi (Ex Machina)



Narrow AI

Dedicated to assist with or take over specific tasks.



General AI

Takes knowledge from one domain, transfers to other domain.



Super AI

Machines that are an order of magnitude smarter than humans.

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Contribution of Indians in Science & Technology

- Ancient Indian civilization made profound and foundational contributions to the fields of mathematics and astronomy, many of which were centuries ahead of their time and significantly influenced global scientific development.

Pioneers of Science in Ancient India

Mathematics and Astronomy	Aryabhata (c. 476–550 CE)	• Wrote the Aryabhatiya. • He used 'zero' as a placeholder in calculations and precisely calculated the value of Pi as 3.1416. • He discovered that the earth rotates on its axis (causing day/night) and he provided the scientific explanation for solar and lunar eclipses.
	Varahamihira (c. 505–587 CE)	• Authored the Brihat Samhita (an encyclopedia covering architecture, astrology, and weather) and the Panchasiddhantika (summarizing five major astronomical treatises).
	Brahmagupta (c. 598 – c. 668 CE)	• Wrote the Brahmasphutasiddhanta, providing the first rules for computations involving zero (as a number) and negative numbers.
	Bhaskara II (Bhaskaracharya) (c. 1114–1185 CE)	• A 12th-century mathematician who authored the Siddhanta Shiromani (Crown of Treatises), which consists of four parts: Lilavati, Bijaganita, Grahaganita, and Goladhyaya. Faizi translated Bhaskara's Bijaganit during the Mughal period. • He is credited as a pioneer in discovering the principles of differential calculus.