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General Science & Ability (Part-I)

Physical Sciences

• Constituents and Structure of Universe.

1) Introduction:-

Universe is the vastest known entity includes:

- all form of matter
- Space, Time and energy
- Celestial subject (from subatomic particles to Galaxies, star, planet.)
- Estimated to be **13.8** billion years old (based on Big Bang).
- Constantly expanding - proven by **Redshift observation** (Hubble's law.).

• Big Bang Theory:

Scientific explanation of How universe began and how it has evolved over time

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Big Bang was not explosion in space but it was an expansion of space it-self.

■ Evidence of Big Bang:

- Cosmic microwave Background
- Redshift of Galaxies

■ Hubble's law:

"The Farther away a Galaxy is, the faster it appears to be moving"

2) Diagram:

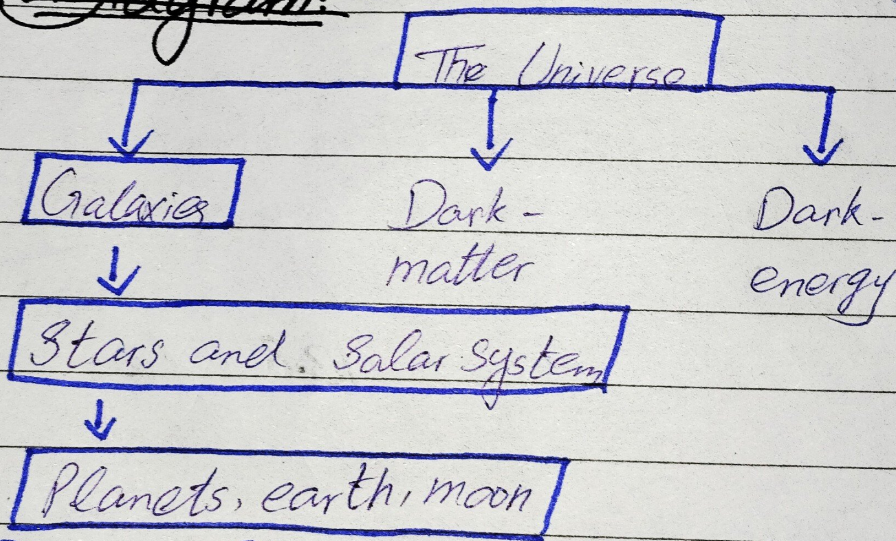


Diagram: Structure of Univers.

3) Constituents of Universe:

<u>Component</u>	<u>Description:</u>
Dark energy	Mysterious force causing accelerated expansion

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Dark matter | invisible matter effecting galaxy rotation.

Ordinary matter | Atoms forming stars, planets, humans etc.

Fact: Ordinary (visible) matter is only a tiny fraction of total universe, incredibly dense point called Singularity.

Galaxy.

1) Definition:

"A Galaxy is a huge system of stars, and celestial bodies held together by gravity and orbiting a common center."

2) Structure and Composition.

Galaxies vary in shapes, sizes, content with following features.

Star: Ranging from few millions - Trillions

Interstellar matters: Gases and dust clouds where new stars form.

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Dark matter: Inferred from gravitational effect; invisible but present.

Central Black hole: Many galaxies including ours, have a supermassive black hole at the centre.

3) Number and Scale.

Estimated galaxies in universe ~~2~~
~ 2 Trillion.

Average galaxy size

$10^5 - 10^6$ light year in dia.

Largest known galaxy

IC 1101 (dia. ~ 6 million Ly.)

4) Types of Galaxies:

4 Types of Galaxies.

Types	shape	Exm	Description
Spiral	Flat disc with arm	Milkyway, Andromeda	Central bulge with rotating arms of stars.
Elliptical	oval	M87, M49, M59	Densely packed stars, little dust/gas

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Lenticular	Both	M85, NGC 5866, NGC 4866	Intermediate form of elliptical and spiral.
Irregular	No- definite shape	Large- Magellanic clouds	Chaotic structure, often result of collision

5) Milky Way Galaxy:

Our Galaxy: a barred spiral galaxy.
Contain 100 - 400 billion stars.

Diameter $\sim 100,000$ light year.

Sun orbits the center every ~ 225 million years.

Earth is located in the Orion Arm, about
27,000 light year from center.

6) Facts and Figures:

Closest galaxy: Andromed ~ 2.5 million ly.
most distant: GN-z11 $\rightarrow \sim 13.4$ billion light years

7) Spiral Galaxy Structure Milky Way Galaxy

Spiral arm Galactic Center Spiral arm

Orion Arm Contains
Our Solar System.

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8) Conclusion

Understanding galaxies is crucial in exploring the structure, evolution and scale of cosmos.
