

(1)

Zanib Tariq
Batch → 392
National Officers Academy
Mock Test → General Science

- ①: Describe big bang theory and its significant in understanding the origin and evolution of the universe what are some of the key evidence supporting this theory?

Introduction:-

Proposed by Georges Lemaitre (1927) who called it the "primordial atom" hypothesis

The big bang theory is the prevailing cosmological model that explains how the universe began, it proposes that the universe began, it proposes that the universe started from an extremely hot, dense point roughly 13.8 billion years ago and has been expanding ever since.

Explanation OF The Big Bang Theory:-

(2)

- The universe began as a singularity a point with infinite density and temperature.
- Time, space, matter and energy originated at that moment.
- Rapid expansion (inflation) occurred in the first tiny fraction of a second.
- As the universe expanded, it cooled down allowing particles, atoms, stars, and galaxies to form.

Significance Of The Big Bang Theory:-

- Provides the most comprehensive explanation of how the universe originated and evolved.
- Lays the foundation for modern astrophysics and cosmology.
- Explains the structure and composition of the observable universe.
- Offers a scientific framework to study the formation of galaxies, stars, and elements.

(3)

"The Big Bang theory does not describe the bang itself, but rather the aftermath of a universe that is expanding and cooling"

Key Evidence Supporting the Big Bang theory:-

(A) Cosmic Microwave Background Radiation (CMB)

→ Detected by Arno Penzias and Robert Wilson in 1965

→ Faint glow left over from the early universe - strong evidence for the big bang
"The most conclusive evidence for the big bang is the cosmic microwave background radiation"
- Stephen Hawking, A Brief History of Time (1988)

(B) Hubble's Law & Redshift:

→ Galaxies are moving away from us, and their light is redshifted
→ This expansion suggests the universe was once much smaller and denser

(4)

"The universe is expanding: the redshifts of the galaxies are proportional to their distance"

Steven Weinberg The first three minutes (1977)

(c) Abundance Of light Elements:-

Predictions about the quantities of hydrogen, helium and lithium match what we observe today

(d) large-scale structure Of the universe:

The distribution of galaxies and clusters align with predictions from big bang simulations

(5)

Conclusion:-

The big bang theory is not just a theory of how the universe began, it is a powerful framework that helps scientists understand everything from the origin of time to the formation of galaxies. Supported by a wide range of empirical evidence, including CMB radiation.

Question 2:-

What is remote sensing and how it is use environment monitoring discuss the advantage and limitations of remote sensing technology in tracking change in land use vegetation and climate

Introduction:-

- originated with aerial photography in early 20th century.
- Modern remote sensing uses multispectral and hyperspectral sensors

(6)

Def → Remote Sensing is the science and technology of acquiring information about objects or areas from a distance typically using satellites or air borne sensors to detect and record reflected or emitted energy

Uses Of Remote Sensing in Environmental Monitoring:-

"Remote Sensing System collect data by detecting the energy that is reflected the Earth"

(A) Land Use & Land Cover (LULU) change Detection :-

- Mapping urban expansion deforestation and agricultural development.
- Tracking infrastructure development habitat fragmentation.

(B) Vegetation Monitoring:-

(7)

- identifying forest degradation and reforestation efforts
- Monitoring Seasonal plant growth using indices like NDVI (Normalized Difference vegetation index)

"Remote Sensing is central to modern environmental Science. It sole spans the monitoring of vegetation water and atmospheric processes"

(c) climate observation and weather forecasting:-

- Monitoring Sea surface temperature cloud patterns and precipitation
- Assessing glacial melting, drought and desertification trends
- Supporting climate modeling and global warming studies.

"Remote Sensing provides critical input for understanding the spatial and temporal dynamics of the earth's climate system"
(Campbell J.B 2011)

Advantages Of Remote Sensing technology:-

(8)

- Synoptic coverage
- Repeatability
- Access to Remote Areas
- Multispectral & Multitemporal data
- Integration with GIS

Synoptic Coverage:-

Can monitor large and global areas simultaneously

Repeatability & Consistency:

Provides consistent and repeatable data over time for trend analysis.

Access to Remote Areas:

Ideal for monitoring forests, oceans, mountains and polar regions

Multispectral data:-

Different wavelengths capture diverse features (e.g. vegetation health, moisture content)

Integration with GIS

Enables sp. integration with GIS

(9)

The value of remote sensing lies in its ability to repeatedly collect data over the same location with consistent methods and spectral resolution.

Limitations Of Remote Sensing:-

Atmospheric Interference:-

clouds can obscure optical imagery.
e.g (Sentinel-2)

Resolution Constraints:-

some feature may be too small to detect (spatial limitations).

Cost & Expertise:-

Data processing and interpretation require trained professionals

Ground Truthing:-

Necessary to validate results: remote sensing alone may not be reliable

"Remote sensing must be complemented by field data to ensure the accuracy and applicability of interpreted results"

(10)

Case studies:-

- Amazon Rainforest:-
Landsat imagery reveals alarming rates of deforestation since the 1980s.
- Africa's Sahel Region:-
NDVI used to monitor greening and desertification trends
- Polar Ice sheets:-
MODIS and Cryosat track melting patterns and seasonal extent

Conclusion:-

Remote sensing is indispensable for modern environmental monitoring. Its ability to deliver high-resolution, repeatable and extensive data makes it ideal for tracking changes in land use, vegetation and climate.

However, its best use comes when combined with ground data and integrated tools like GIS