(b) Provide examples of common minerals that undergo chemical weathering and describe the chemical reactions involved.

6. Discuss the classification, origin, and geochemical significance of meteorites in understanding planetary differentiation.

7. Discuss the geochemical behavior of Large Ion Lithophile Elements (LILEs) and High Field Strength Elements (HFSEs). How do their ionic properties, such as ionic radius and charge influence their partitioning during magmatic processes ? Illustrate your answer with examples from igneous petrology.

8. Answer the following
   (a) What is the difference between stable isotopes and radiogenic isotopes ?
   (b) Define isotopic fractionation and give one natural example.
   (c) Why are isotopic ratios (like $\delta^{18}O$ or $^{87}Sr/^{86}Sr$) used in geochemical studies ?
   (d) What is an isochron, and why is it useful in radiometric dating ?
   (e) Explain the significance of a closed system in isotope geochemistry.
   (f) What is the parent-daughter isotope relationship, and how is it used in age dating ?

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[This question paper contains 4 printed pages]

**Your Roll No.** : .....

**Sl. No. of Q. Paper** : **5820** **I**

Unique Paper Code : 2192011203

Name of the Paper : Elements of Geochemistry (DSCC-6)

Name of the Course : **B.Sc. (Hons) Geology (NEP)**

Semester : II

***Time : 3 Hours*** ***Maximum Marks : 90***

**Instructions for Candidates :**

(a) Write your Roll No. on the top immediately on receipt of this question paper.

(b) Attempt any **five** questions. **All** questions carry equal marks unless mentioned. Question **1** is mandatory.

1. Fill in the blanks :
   (a) Stellar nucleosynthesis produces elements heavier than helium via the ..... process.
   (b) The r-process and s-process are responsible for the formation of ..... elements.
   (c) Big Bang nucleosynthesis produced primarily hydrogen, helium, and small amounts of .....

(d) The partition coefficient (D) is defined as the ratio of an element's concentration in ..... to that in .....

(e) During partial melting, the melt is typically enriched in elements that are ..... in the solid phase.

(f) Geochemical affinity plays a key role in understanding planetary .....

(g) Meteorites are remnants of early solar system processes and are classified as chondrites and .....

(h) Calcium-aluminum-rich inclusions (CAIs) are the oldest ..... matter in the solar system.

(i) The δ notation represents deviations from a ..... standard.

(j) Compatible elements typically have D values ..... than 1.

(k) The Oddo-Harkins rule states that elements with ..... atomic numbers are more abundant.

(l) Chondrites are stony meteorites that have not undergone ..... differentiation.

(m) Partition coefficients vary significantly between mineral phases due to differences in ionic radius and .....

(n) Achondrites lack ..... and are differentiated.

(o) HREE are more compatible with garnet and thus are depleted in garnet-bearing ..... melts.





(p) Elements like U and Th are classified as lithophile due to their strong affinity for ..... phases.

(q) Isotopic fractionation occurs because lighter isotopes form bonds that are ..... to break.

(r) The slope of an isochron in isotope geochemistry corresponds to the ..... of the system.

**2.** (a) How do cosmic rays contribute to nucleosynthesis in the interstellar medium ?

(b) Explain the process of cosmic ray spallation and how it forms elements like lithium, beryllium, and boron.

**3.** (a) What are Rare Earth Elements (REEs), and why are they considered "rare" even though they are relatively abundant in the Earth's crust ?

(b) What is the lanthanide contraction, and how does it influence the geochemical behavior of the REEs?

(c) Explain how the ionic radius of REEs affects their partitioning between minerals and melts during crystallization.

**4.** What is a geochemical variation diagram, and how is it used in geochemistry to understand the evolution of magmatic systems? Explain with suitable examples.

**5.** (a) What is chemical weathering, and how does it differ from physical weathering ?