This question paper contains **3** printed pages]

Roll No. ☐☐☐☐☐☐☐☐☐☐☐

S. No. of Question Paper : **6162**

Unique Paper Code : **219102**   **D**

Name of the Paper : **Mineralogy and Crystallography**

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

Semester .: **I**

Duration : **3 Hours**   Maximum Marks : **75**

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

Question No. **1** is compulsory. Attempt any *four*

more questions from the remaining.

1.   Give answers to the following questions :   (2+2+6+3+2)

   (*a*)   What are the polyhedral shapes of anions surrounding cations with the following coordination numbers :

   (*i*)   CN = 3

   (*ii*)   CN = 8

   (*b*)   How many Bravais lattices are there ?

   (*c*)   Define the following terms and provide sketches where appropriate :

   (*i*)   melatope

   (*ii*)   uniaxial indicatrix

   (*iii*) length-fast and length-slow

   (*d*)   What types of bonds are most likely between these elements or molecules ?

   (*i*)   Fe-O

   (*ii*)   Al-Al

   (*iii*) Na-OH

(*e*) What is Bragg's law for X-ray diffraction ?

(*f*) Give optical properties (pleochroism, interference colour, isotropism/anisotropism) of the following minerals :

   (*i*) Biotite

   (*ii*) Olivine

   (*iii*) Microcline

2. Define the following : $3 \times 5 = 15$

  (*a*) Space group

  (*b*) Miller indices

  (*c*) X-ray diffraction

  (*d*) Polymorph

  (*e*) Hermann-Mauguin symbols.

3. How are the following mineral physical properties controlled by crystal structure and/or chemical composition ? Give specific mineral examples for each : $5 \times 3 = 15$

  (*a*) hardness

  (*b*) cleavage

  (*c*) melting point.

4. Discuss the structural classification system for silicate minerals (based on combinations of $[SiO_4]$ tetrahedral). List the subgroups and give at least one mineral example (with chemical formula) for each.   15

5. Compare and contrast isotropic and anisotropic minerals. Give at least 3 examples of minerals with each property.   15

6. Discuss compositional variations (e.g. between end members) and describe substitutions of the major cations in any *two* of the following mineral groups : 7.5×2=15

 (*a*) Feldspars

 (*b*) Pyroxenes

 (*c*) Garnets.

7. Give reasons for the following : 5×3=15

 (*a*) Mg and Fe exhibit good solid solution, whereas K and Na exhibit only limited solid solution

 (*b*) Plagioclase series is continuous at all T

 (*c*) We find diamonds at the Earth's surface.

8. Sketch and label the following biaxial interference figures : BXO, BXA, OA, ON (flash). Show vibration directions in each, along with positions of optic directions, optic axes, isogyres, isochromes, etc. where appropriate. 15