

**B. SC. GEOLOGICAL SCIENCE EXAMINATION, 2022**

( 2nd Year, 1st Semester )

**IGNEOUS PETROLOGY****PAPER – CORE/TH/06**

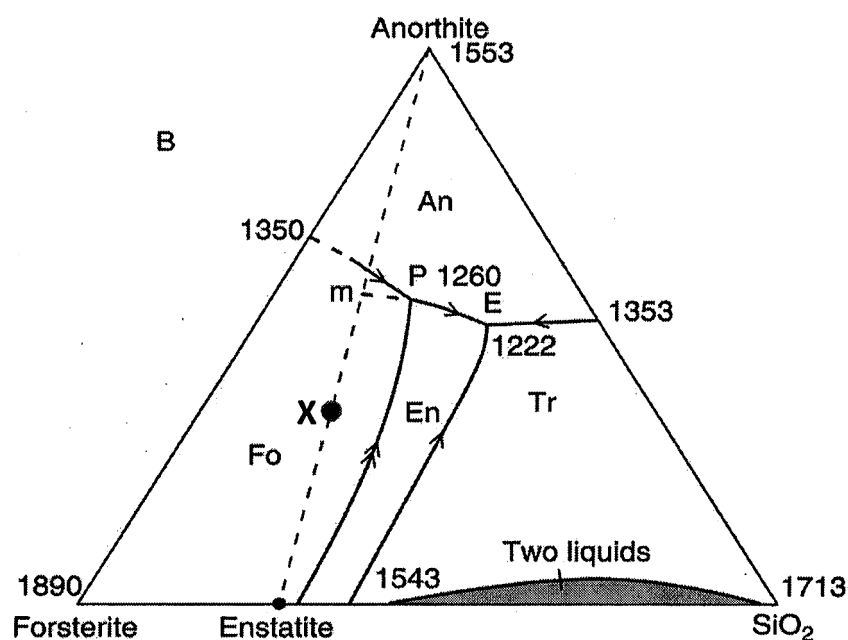
Time : Two hours

Full Marks : 40

(Use a separate Answer script for each Part)

**PART – I (20 Marks)**

1. Forsterite – Anorthite – SiO<sub>2</sub> ternary phase diagram constructed at 1 atmosphere is shown below. Consider a magma composition (X) that is plotted in the diagram. Study the phase diagram and answer the questions below.



- (a) How many cotectic lines are present in the diagram? What is the difference between double-arrow cotectic line and the single-arrow cotectic lines? Explain with examples.
- (b) Describe the equilibrium crystallization history of a melt with composition X. Calculate the degree of freedom (variance) at each step during the whole solidification process. When and at what temperature will the crystallization history end? State the mineral assemblage and their tentative modal proportion in the final rock. Give a suitable rock name. Justify your answers.
- (c) Describe the fractional crystallization history of the same melt X, considering fractionation of early formed crystals from the melt at each step when the remaining melt reaches the reaction line, cotectic line and the final invariant point. How many rocks would this process form? Name the rocks and their mineral assemblages. Justify your answers.

[2 + 4 + 4 = 10]

[ Turn over

2. Answer any four questions from the following:

[2 ½ × 4 = 10]

(a) What are the differences between a peritectic point and a eutectic point? Explain with suitable examples.

(b) "Minute differences in the melt composition may produce contrasting rocks with quartz-present and quartz-absent mineral assemblages". Justify the validity of the statement with reason.

(c) What is reverse zoning? How does it develop in plagioclase in natural system? Explain with necessary figure.

(d) What is the mechanism of magma formation in the Mid Oceanic Ridge system? Clarify it with the suitable sketches.

(e) What is Bowen's Reaction Series? Can a basaltic magma produce a granitic melt? Elucidate the conditions of its formation with reference to Bowen's Reaction Series.

(f) How a subsolvus granite may be distinguished from a hypersolvus granite? Use suitable figures to explain it.

**PART II ( 20 Marks)**

Answer any 4 (*four*) questions

- 1 How do you explain two chemically identical rocks from the upper mantle to have different mineralogy? What is geothermal gradient? Why are the geothermal gradients for the oceanic plate and the continental shield different?
- 2 How can chemistry be used to distinguish families of magma types? What is a basalt tetrahedron? Why are calc-alkaline magmas mostly restricted in the convergent setting? 2+2+1= 5
- 3 Plate tectonics plays a major role in the generation of several magma types” – Explain. What is ‘Steinman Trinity’? 3+2 = 5
- 4 What is decompression melting? Do you expect decompression melting in a convergent tectonic setting? Give rason. 3+2 = 5
- 5 Write a short note on the effects of volatiles on mantle melting. Why does granodiorite show greater melting point depression than basalt in an experiment under H<sub>2</sub>O saturated condition? 3+2 = 5