

EX/SC/GEOL/PG/CORE/TH/04/2025

M. Sc. APPLIED GEOLOGY EXAMINATION, 2025

(1st Year, 1st Semester)

PAPER : CORE/TH/04

(Metamorphic Petrology)

Time : 2 Hours

Full Marks : 40

PART—I (20 Marks)

Answer **Question No.1** and *any one* from
Question No.2 and **Question No.3**

- 1.** Accept or reject the following statements with reason.

3×4=12

- (a) “A magma with 1100 °C can never induce ultra high temperature metamorphism of its contact rock with 700 °C.” **[CO1]**
- (b) “Vapor present reactions can be used as a good geothermobarometer.” **[CO2]**
- (c) “Brine is a better dessicator than a CO₂ rich fluid during high grade metamorphism.” **[CO3]**
- (d) “Melting curve of the asthenospheric mantle is always negative.” **[CO3]**

GEOL-1425

[Turn Over]

(2)

2. (a) Derive Clausius-Clapeyron slope from the laws of thermodynamics. 5 [CO3]
(b) What should be the slope of a good geobarometer? Justify 3 [CO2]
3. (a) Define the threshold values of the UHT and UHP metamorphisms. 2 [CO2]
(b) A four-component system has 8 phases at constant load pressure. Calculate the maximum number of invariant points and the number of univariant reactions associated with each of the invariant point. What happens if the system fails to achieve equilibrium? 6 [CO3]

PART—II (20 Marks)

Answer any **four** questions. 5×4=20

1. “High-grade mineral paragenesis would not be observed if vapour phase is present in excess”. Justify the validity of the statement with reasons. Discuss the principal theories of migmatite formation. [CO1]
2. What is ultra-high temperature (UHT) metamorphism? Why is sapphirine + quartz association considered a typical indicator of UHT metamorphism? Which mineral associations may be stabilized in extreme temperature conditions in the KFMAS system? [CO3]
3. What is the significance of P_{max} and T_{max} in clockwise and counterclockwise P-T evolution of metamorphic rock? Justify your answer with reasons. [CO2]

(3)

4. “The peak metamorphic mineral assemblage in a rock is represented by garnet, quartz, sillimanite, alkali feldspar, plagioclase and rutile. Locally coarse garnet, sillimanite and quartz are mutually separated by a corona of cordierite. In few domains garnet and quartz are separated by symplectitic cordierite and orthopyroxene.”
(i) Deduce the mineral reactions from the above observations with justifications.
(ii) Evaluate the probable P-T path with reasons. Give a suitable name to the rock. [CO2]
5. What are the physical conditions of ultra-high pressure (UHP) metamorphism? What are the mineralogical signatures in UHP metamorphic rocks? Discuss the favourable tectonic set-up where UHP metamorphism may take place. [CO3]
6. What is the criterion for choosing a metamorphic mineral equilibrium as a good geothermometer? How can chemically zoned coexisting minerals be used for the estimation of the P-T path? [CO2]

★ ★ ★