

Ex/SC/GEOL/PG/CORE/TH/05/2022

M. Sc. (APPLIED GEOLOGY) EXAMINATION, 2022

(1st Year, 2nd Semester)

TECTONICS AND SOLID EARTH GEOPHYSICS

PAPER – CORE/TH/05

Time : Two hours

Full Marks : 40

(Use a separate Answer script for each Part)

PART – I

Answer *any four* questions.

4×5=20

1. Derive the equation of motion in elastic media and determine the speed of compressional waves. 5
2. a) Prove that the pressure field in incompressible fluids must satisfy Laplace equation.
b) In an oceanic region crustal heat flows occur in the vertical direction by conduction under a steady state condition. Assuming no heat source in the crust, evaluate how the temperature can vary in the vertical direction. 3+2=5
3. a) Show that the geothermal gradient in Earth's mantle depends principally on the coefficient of thermal expansion and specific heat.
b) A fluid with a specific heat C and density ρ is flowing through a small volume at a velocity v_i . The thermal gradient in this volume is $\frac{\delta T}{\delta x_i}$. Calculate the amount

[Turn over

[2]

of heat accumulated in the volume per unit time by advection. The index i denotes x and y in a 2D Cartesian space. $3+2=5$

4. a) How would you choose the initial flow and thermal perturbations to develop the theory of convection instability. Explain the mathematical considerations.
b) Find the most dominant wavelength of convection instability initiation in a fluid layer of thickness b . $3+2=5$
5. a) Derive the expression of Atwood number and explain its physical implications in gravitational instabilities.
b) Show that gravitational instabilities initiate at the interface of two semi-infinite fluid layers with a specific wavelength if the two fluids have an interfacial tension σ .
6. a) Explain how a subducting slab can develop pressures in the regions above and below it in the subduction zone.
b) What is the critical dynamic condition required for the slab to attain a stable dip? Support the answer with an appropriate theoretical explanation. $3+2=5$

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PART – II

Answer **any five** questions.

$5 \times 4 = 20$

1. a) Explain the origin of Earth's magnetic field with the help of "Self-exciting magneto-hydrodynamo" model. 4
b) How will you identify paramagnetic and ferromagnetic minerals on the basis of hysteresis loop? Identify the magnetite and haematite with the help of IRM study. $2+2=4$
c) Explain the nature of different types of seismic waves. 4
d) Describe the nature of curie curves for the formation of Fe-Ti-oxides due to pre- and post heating reactions. What is a blocking temperature? $2\frac{1}{2}+1\frac{1}{2}=4$
e) How will you identify different magnetic vectors present in the natural rocks from Zijdervelt plots? What is PCA? $3+1=4$
f) Discuss the characters of Convergent Plate Boundaries. 4
g) How does the grain-size vary in different magnetic minerals with respect to structure of magnetic domains? What is ChRM? $2\frac{1}{2}+1\frac{1}{2}=4$
h) Write Short Notes (**any two**): $2 \times 2 = 4$
 - i) Triple Junction
 - ii) Euler Pole,
 - iii) Ferromagnetism, and
 - iv) Transform Fault.