M. Sc. Applied Geology Examination, 2023

(2nd Year, 2nd Semester)

Geomaterials

Paper – DSE/TH/02B

Time : Two hours   Full Marks : 40

(Use a separate Answer script for each Part.)

Part – I (20 Marks)

Answer **Q. No. 1** and *any one* of the questions 2 and 3

1. Derive a relation between the energy of a photon and its wave number. What is Raman Shift? Why is the unit of Raman shift expressed in cm^{-1}. For exciting line with $\lambda = 5000A$, what will be the Stokes Raman wave length for natural diamond? ($1A = 10^{-8}$ cm). "The intensity of Anti stokes line of a substance can vary with temperature" accept or reject the statement with reason.   12

2. "Compressive strength is always more than the tensile strength for all kinds of materials under all physical conditions" Accept or reject the statement with reason. What is the difference between "Toughness" and "Resilience" of a material.   8

OR

3. What are the 4Cs in Gemology? "Cost of a gemstone linearly vary with its size" Accept or reject the statement with reason. "Sapphire and Rubly are chiefly composed

of Al_2O_5. But sapphire is blue but ruby is red in natural sun ligh – Why?   8

Part – II (20 Marks)

Answer *any four* questions.

1. a) State the principle of Voigt's notation in expressing stress tensor.

   b) Using this notation expand the elastic constant tensore of an orthorhombic crystal in a matrix form.

   c) Define the elastic compliance tensor of a solid.

                                          2+2+1=5

2. a) Explain the physical significance of on-diagonal elements of the elastic constant tensor for a crystal with tetragonal symmetry.

   b) Show that the internal strain energy of a solid holds a quadratic funtional relation with strain.   3+2=5

3. a) Describe the theoretical methods used to calculate the elastic constant tensor from internal strain energy.

   b) What is meant by Hill's average of bulk modulus?

   c) Explain the physical implication of Born criteria.

                                          2+1+2=5

4. a) Define the term - phonon.

   b) How does Debye temperature control the atomic scale behaviour of a crystalline solid?

   c) Show the basic theoretical steps in Einstein model used to estimate the specific heat of a crystal.

                                          1+2+2=5

5. a) With the help of an illustration explain the method of equilibrium volume calculation for a crystal under a given thermodynamic condition.

   b) Show schematically the common tangent method used to calculate the phase transition pressure of a solid phase.   2+3=5

6. a) How do Fe and Mg atoms order themselves in olivine structures?

   b) Write a short note on the effects of bivalent cation ordering on the physical properties of olivine and pyroxene.   2+3=5