

**ZCA 207 Statistical Mechanics**  
**Test II (make-up version)**  
Tuesday, 7 Apr 10, 2.30 pm – 3.30 pm  
Venue : --

*This test contains only ONE question. Answer all parts.*

**Name:**

**Matrix No.**

1. Consider an Einstein solid.
  - (a) What is the partition function of a single harmonic oscillator? Assume the angular frequency of the HO is  $\omega$ .
  - (b) Assume the Einstein solid is comprised of  $N$  atoms. Treating each atom as a 3-D uncoupled quantum harmonic oscillator, derive the partition function for the solid.
  - (c) Derive, from (1b), the average energy of an Einstein solid.
  - (d) What is the average energy per oscillator?
  - (e) Derive molar specific heat capacity of an Einstein solid.
  - (f) Define Einstein temperature,  $\Theta_D$ .
  - (g) For Lead,  $\Theta_D = 90$  K whereas for diamond,  $\Theta_D = 2000$  K. Will lead obey Dulong-Petit's law at room temperature? Explain.
  - (h) Will diamond obey Dulong-Petit's law at room temperature? Explain.