國立臺灣科技大學101學年度碩士班招生試題
系所組別： 材料科學與工程系碩士班丙組
科　　目： 材料導論

（總分為100分）

總分 100 分，共 8 大題。

1.

(1) Hexagonal is one of the seven crystal systems. Both Miller and Miller-Bravais coordinate systems can be used. Please label the three coordinate axes (e.g. x, y and z axes using [U V W]) and four coordinate axes (e.g. a_1, a_2, a_3 and z axes using [u v t w]) for Miller (3 points) and Miller-Bravais (4 points) systems. (Please draw two hexagonal cells to label Miller and Miller-Bravais systems separately. Hint: $u = \frac{1}{3}(2U - V)$, $v = \frac{1}{3}(2V - U)$, $t = -(u + v)$, w=W)
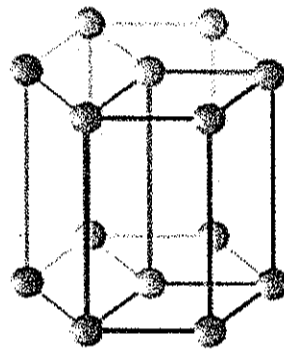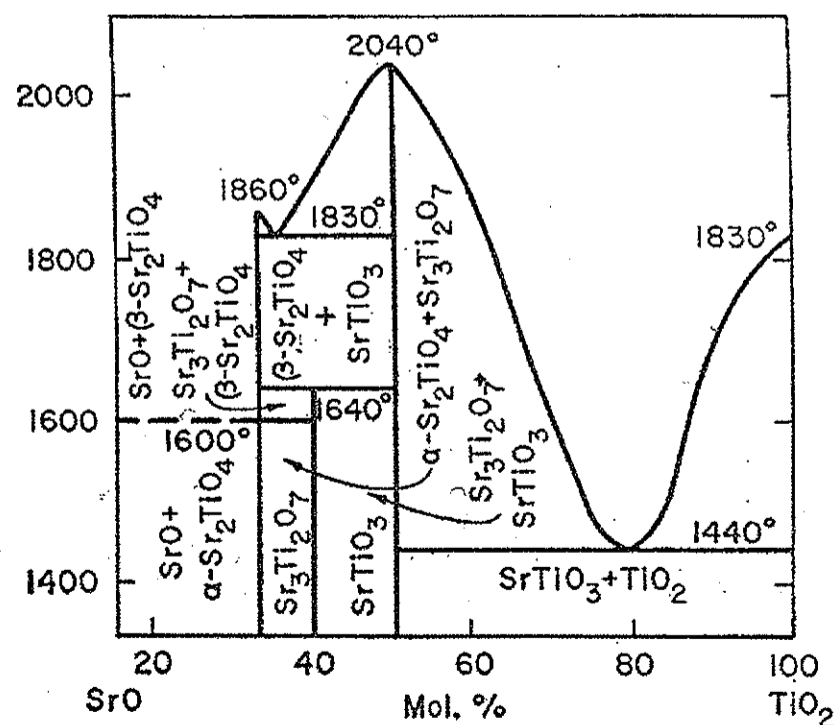

(2) Please explain why Miller-Bravais (four axes) coordinate system is rather popular than Miller (three axes) coordinate system. (8 points)

2.

(1) For the SrO-TiO_2 system (see the below figure), write all eutectic reactions with the conditions of temperatures and concentrations for cooling. (5points)
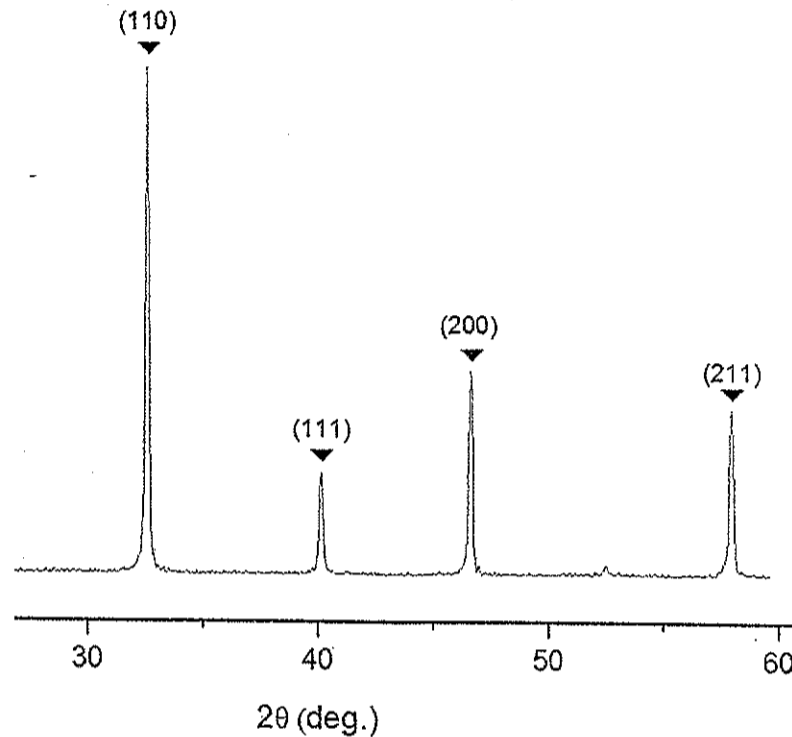
（總分為100分）

(2) The following figure shows the X-ray diffraction pattern of $SrTiO_3$ (simple cubic). Please calculate the d-spacing of each plane (8 points) and calculate the lattice parameter (a). (X-ray Source: Cu Kα=1.5406Å) (2 points)


2θ (deg.)

3. (a) Compare the focal distances of yellow, red, and blue lights after they pass through a convex lens.　(b) How and why does focal distance change with the dielectric constant of a convex lens?　　[10 points, 5 points for each item]

4. (a) Describe the temperature dependence of electrical conductivity (σ vs T) for intrinsic semiconductors.　(b) How to obtain the band gap energy of an intrinsic semiconductor from σ-T relation?　(c) Draw current vs voltage (I-V) curves for a solar cell in the light and the dark.　[15 points, 5 points for each item]

5. (a) Compare thermal conductivity of a dielectric material in crystalline state and in amorphous state.　(b) What kind of field would induce polarization in a dielectric material? [10 points, 5 points for each item]

6. With respect to the phase diagram of the Fe-Fe_3C alloy system, please write down the reactions of peritectic, eutectic and eutectoid transformations.　　　　　　(9%)

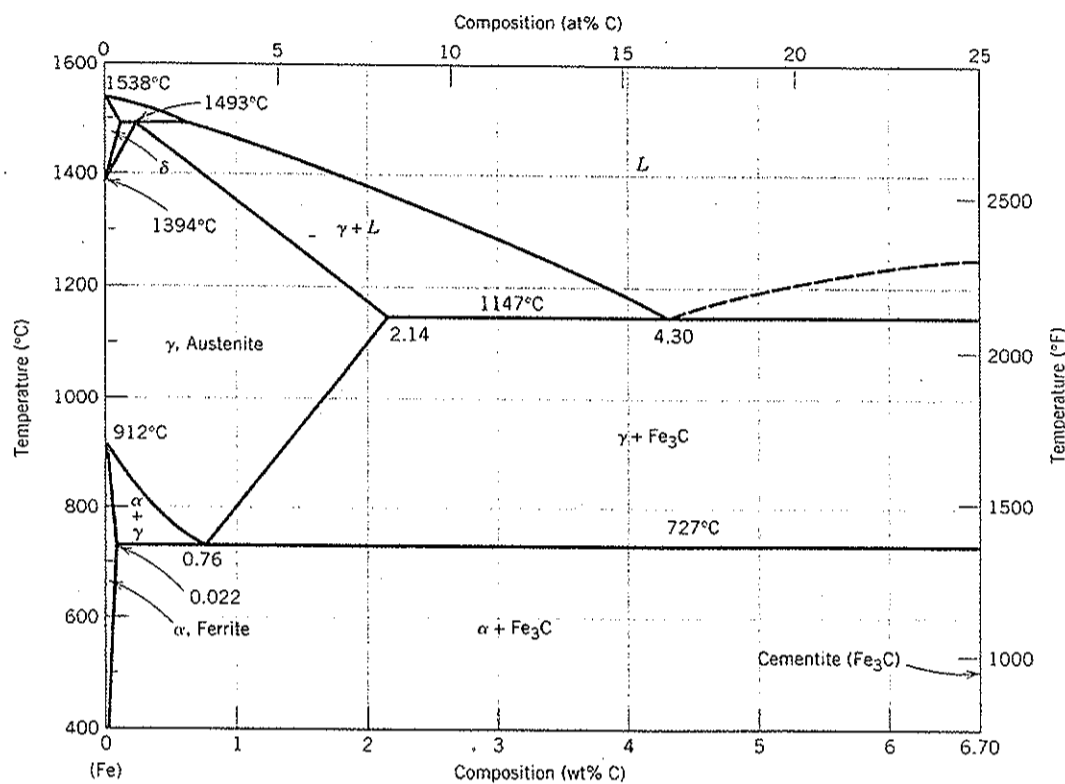7. Write down and discuss the Hume-Rothery rules.　　　　　　　　(12%)
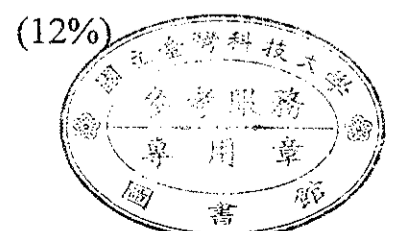
8. Consider 1.0 kg of austenite containing 0.60 wt% C, cooled to below 727°C (1000 K).

(a) How many kilograms each of total ferrite and cementite form? (5%)

(b) How many kilograms each of pearlite and the proeutectoid phase form? (5%)

(c) According to **1.1**, how many kilograms of the eutectoid phase form? (4%)