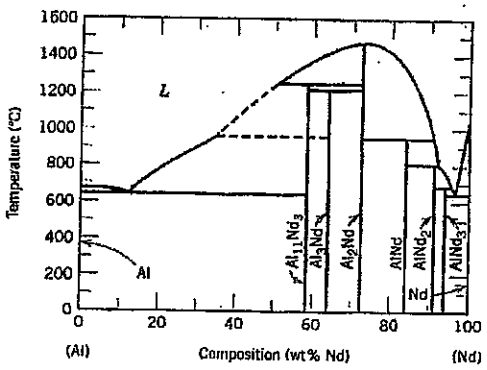
1. Describe tensile test, fracture toughness test and creep test, respectively. What data can you obtained from these tests? What is the difference(s) between tensile strength and creep strength? (10%)
2. Explain and make simple schematic diagrams of two types of dislocations. Why brittle fracture is widely observed in ceramic materials. In contrast, most metallic alloys show good plasticity. (5%)
3. Briefly explain recovery, recrystallization and grain growth of a polycrystal engineering alloy. What is the major difference between hot forging and cold forging? (10%)
4. Explain TTT and CCT diagrams, respectively. What's the major difference(s) between them? Is the CCT diagram available for aluminum alloys? Why? For a high strength low alloy steel, and, for each, the intended final microstructure: full annealing, normalizing, austempering, quench and tempering. (15%)
5. Explain diffusion mechanisms of the engineering alloys. Please write down Fick's 1st and 2nd law, and explain the difference between them. (10%)
6. For polymer materials, explain melting, glass transition and viscoelastic deformation, respectively. (10%)
7. Explain the difference between electronic conduction and ionic conduction of the materials. What is the "Hall effect"? (10%)
8. Explain "soft" and "hard" magnetic materials. Please also include at lease one example for them. (10%)
9. Please describe phase rule. The figure attached below is the Al-Nd phase diagram, for which only single phase regions are labeled. Please specify all invariant reactions in the diagram. (10%)



10. Explain Pilling-Bedworth ratio, and its relation with oxidation kinetics of metals. How polymers degrade in applications. (10%)

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