1. Please explain the following terms: (24%)
(a) Liquid crystal
(b) Fermi energy
(c) Poisson's ratio
(d) Young's modulus
(e) Schottky defect
(f) Solid solution strengthening

2. Please draw the chemical structures of the following polymers: (16%)
(a) Nylon 6
(b) Poly(ethylene glycol) (PEG)
(c) Poly(ethylene terephthalate) (PET)
(d) Poly(methyl methacrylate) (PMMA)

3. Please explains the working principles of the following instruments. Also, please provides two properties of materials that can be measured by each instrument. (20%)
(a) Differential scanning calorimeter (DSC)
(b) X-ray powder diffraction (XRD)

4. Please draw a stress-strain curve to describe the difference of mechanical property for metals, ceramics and polymers. (10%)

5. Please draw a shear stress-shear rate curve to describe the rheological properties of shear thinning and shear thickening. (5%)

6. Please explain the difference between intrinsic and extrinsic semiconductors. (5%)

7. The modulus of elasticity for beryllium oxide (BeO) having 5 vol% porosity is 310 GPa.
(a) Calculate the modulus of elasticity for the nonporous material. (6%)
(b) Calculate the modulus of elasticity for 10 vol% porosity. (6%)

8. Calculate the radius of a palladium atom, given that Pd has an FCC crystal structure, a density of 12.0 g/cm^3, and an atomic weight of 106.4 g/mol. (8%)

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