Chemistry 3ZZ3
Properties of Materials

Instructor: R.S. Dumont
Office: ABB 234
Phone: x23301
Email: dumontr@mcmaster.ca
www.chemistry.mcmaster.ca/dumont

Course Description:

This is a "how and why" course. It is concerned with the underlying microscopic basis for everyday natural phenomena – such as the blue sky – and devices that make our lives easier (at least sometimes) – such as photocopiers. The common thread is material properties and an understanding of these properties through physical chemistry. The following topics are covered:

1. Optical properties
- the color wheel - subtractive & additive 3 primary color systems
- organic dyes - conjugated systems
- d-d transitions in transition metal complexes (colors in precious stones)
- crystal defects and color centers
- color in semiconductors & the band gap
- light scattering (why is the sky blue?) and refraction
- optical activity (liquid crystal displays), birefringence
- complex refractive index and absorption

2. Thermal properties
- heat capacity of diatomic gases (translational, rotational & vibrational),
- heat capacity of solids (Einstein & Debye theories) & liquids
- glass transition temperature
- differential thermal analysis and scanning calorimetry
- thermal expansivity and anharmonicity
- thermal conductivity of gases and solids (anharmonicity)
- phase equilibria – the phase rule
- ideal & non-ideal solutions – azeotropes
- binary phase equilibria – eutectics, compounds & peritectics
- ternary phase equilibria – salting out solvents
- interfacial phenomena – surface tension
- capillary rise & depression
- Langmuir-Blodgett films

3. Electromagnetic properties
- band theory of metals and semiconductors
- temperature dependence of conductivity
- doped semiconductors – p-n junctions - transistors
- dielectrics, pyroelectrics & ferroelectrics
- superconductivity
- diamagnetism, paramagnetism & ferromagnetism

Text: M.A. White, "Properties of Materials", (Oxford U. Press, Oxford U.K., 1999)

Evaluation:

Discussion Forums - WebCT	10%
Problem Sets (4)	20%
Quizzes (2)	20%
Midterm	20%
Final Exam	30%