Course Outline

MATS6104

Physical Properties of Materials

Materials Science and Engineering

Science

T1, 2022

1. Staff

Position	Name	Email

2.1 Course

	of the material rather than memorizing equations with relevant background equations provided.		
Assignment 3	A short written question-and-answer type assignment covering relevant course materials covered in the PART 2.	10%	Week 8
Final Exam	This exam is devoted to content covered in the PART 2 of course consisting of lectures, nominated reading material and assignments and will include, where appropriate, relevant equations. It will consist of a combination of essay-style answers, multiple-choice questions, and calculations. (2hrs)	40%	Exam Week

2.3 Course schedule and structure

Week	Topics	Activity
1-2	**PART I- Fundamentals of electron theory**	
1	• Introduction to the course • Shortcomings of classical physics • Particle and wave nature of matter • Introduction to the Schrödinger equation • The Schrödinger equation- model of the hydrogen atom • Quantum description of the atom	
2	• The Schrödinger equation • Handling multiple electrons in a crystal • Methods of describing electron energy levels in crystals	
3	•	

	resistivity/conductivity, concept of energy bands, impact of impurity and temperature on electrical conductivity of semiconductors. • Defects chemistry and transport phenomena – defects, point defects, ionic solids, Frenkel and Schottky defects, Defect representation, Kröger-Vink notation, electronic and ionic compensation, defect reactions, constructing defect diagrams, and applications.	
8	• Thermal properties of materials – heat capacity, specific and molar heat capacity, classical and quantum theory of heat capacity, Debye model, thermal conductivity, thermal conduction - classical and quantum consideration, thermal resistance and stresses, Seebeck effect, Peltier effect and applications, Thomson effect, thermoelectric materials, and figure of merit.	Assignment 3
9	• Dielectric, capacitance, and ferroelectric materials – capacitors, Gauss's law, capacitance calculation for simple geometries, capacitors in electrical circuits, dielectrics, electrical dipole moment, polarization, ferroelectricity, response of ferroelectrics in external fields, and applications of the ferroelectric materials. • Magnetic phenomena – permanent magnets, circular current carrying wire, magnetic dipole, magnetic dipole moment, magnetisation, magnetic force on moving charges, Lorentz force equation, Biot-Savart's Law, magnetic field determination, paramagnetic, ferromagnetic, antiferromagnetic and ferrimagnetic materials, applications of magnetism, and magnetic materials.	
10	• Revision of some topics covered in PART 2, and practice problems	

2.2 Expectations of students.98 72 413.22 Ta0ix