



Course Outline

MATS6104

Physical Properties of Materials

Materials Science and Engineering

Science

T1, 2022

1. Staff

Position	Name	Email
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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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • The Schrödinger equation • Handling multiple electrons in a crystal • Methods of describing electron energy levels in crystals 	
3	<ul style="list-style-type: none"> • 	

	<p>resistivity/conductivity, concept of energy bands, impact of impurity and temperature on electrical conductivity of semiconductors.</p> <ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Revision of some topics covered in PART 2, and practice problems 	

2.2 Expectations of students.98 72 413.22 Ta0ix

