Physics of Materials - Video course

COURSE OUTLINE

This course will discuss the approaches used to understand important properties of materials and the relationships between these properties. Elementary quantum mechanics, Free electron theory of metals, and quantum mechanics will be used to understand material properties.

The use of reciprocal lattice formulation will be explored. Electronic conductivity, thermal conductivity, semiconductor behavior, optoelectronic materials, and superconductivity, will be some of the phenomena examined in this course.

COURSE DETAIL

Sl. No	Topic	Hours
1.	Introduction and Approach, Properties of materials and some important relationships, Free electron theory of metals, Drude model Electronic Conductivity, Drude model Thermal Conductivity - Ratio the Wiedemann Franz Law.	10
2.	Maxwell Boltzmann Statistics, Limitations of the Drude model, Elementary quantum mechanics: History and Significant concepts, The Drude Sommerfeld model, Fermi Dirac statistics, Density of states, Fermi Energy and Fermi Surface, Improvements over Drude model, remaining limitations.	10
3.	Specific heat, phonons, Real space Vs Recirpocal space, Diffraction condition and its significance for electron energy, Wigner Seitz cells, Brillouin zones, Band Theory, Density of	10

NP-TEL

NPTEL

http://nptel.iitm.ac.in

Metallurgy and Material Science

Pre-requisites:

1. The course is aimed at Metallurgical and Materials Engineering students, typically in the second or third years of their undergraduate degree programme.However, any undergraduate engineering student can make use of this course material as long as they have completed their introductory engineering mathematics, physics, chemistry and thermodynamics courses.

Additional Reading:

1. Introduction to electronic properties of materials; David Jiles; Chapman and Hall, 1994.
2. Solid State Physics; Ashcroft and Mermin; Saunders College Publishing, 1976.
3. Materials Science and Engineering An Introduction; William D. Callister, Jr; John Wiley & Sons, Inc., 2003.
4. Introduction to Metallurgical Thermodynamics; David R. Gaskell; Hemisphere Publishing Corporation-a Taylor and Francis group, 1981.

Hyperlinks:

1. http://nobelprize.org/nobel_prizes/physics/laureates/1918/index.html
2. http://nobelprize.org/nobel_prizes/physics/laureates/2006/index.html
3. http://nobelprize.org/nobel_prizes/physics/laureates/1921/index.html
4. http://nobelprize.org/nobel_prizes/physics/laureates/1929/index.html
5. http://nobelprize.org/nobel_prizes/physics/laureates/1933/index.html
6. http://nobelprize.org/nobel_prizes/physics/laureates/1954/index.html
7. http://nobelprize.org/nobel_prizes/physics/laureates/1922/index.html
8. http://nobelprize.org/nobel_prizes/physics/laureates/1932/index.html
9. http://nobelprize.org/nobel_prizes/physics/laureates/1945/index.html
10. http://nobelprize.org/nobel_prizes/chemistry/laureates/1936/index.html
11. http://nobelprize.org/nobel_prizes/physics/laureates/1967/index.html

	occupied states, the origin of anisotropy.	
4.	Electrons and Holes, Classification of semiconductors, Direct Band gap, indirect Band gap, opto electronic materials, Magnetic properties, superconductivity, Meissner effect, Bose-Einstein Statistics, BCS theory, High temperature superconductors, physics of nano scale materials	10
	Total	40

References:

1. Introduction to electronic properties of materials by David Jiles - (Chapman and Hall, 1994)
2. Structure and Properties of Materials (Vol.iv) - Electronic Properties by John Wulf, R.M. Rose and L.A. Shepard - (Wiley Eastern, 1964)
3. Introduction to the Modern Theory of Metals by Alan Cottrell - (Ashgate Publishing Company, 1988)
4. Lectures on the Electrical Properties of Materials by Laszlo Solymar and D. Walsh - (Oxford Univ. Press, June 1988)
5. Atomic Theory for students of Metallurgy by William Hume-Rothery and B.R. Coles - (Inst. Of Materials Ashgate Publishing Company, Sept. - 1988)
6. Principles of Electrical Engineering Materials by S.O. Kasap - (McGraw - Hill, 1977
12. http://www.lrz-muenchen.de/~Sommerfeld/Bilder/as97_01.gif

Coordinators:

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