

Lesson Plan

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Class and Section: M.Sc. Physics 4th Sem.

Subject: Material science

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Week	Date	Topics
1	1 st March-7 th March	Unit I:
		Dielectric function of the electron gas: Definitions of the dielectric function,
		Plasma optics
		Dispersion relation for electromagnetic waves, longitudinal plasma oscillations
		Transverse optical modes in a plasma
		Transparency of metals in the ultraviolet,
		Plasmons; Electrostatic screening Screened coulomb potential,
2	7 th March-14 th March	Pseudopotential component $U(0)$,
		Mott metal-insulator transition, Electronic interband transitions ;
		Screening and phonons in metals;
		Polaritons; Electron-electron interaction
		Electron-phonon interactio.
		Polarons; Optical reflectance:
3	15 th March-21 th March	Kramers-Kronig relations, conductivity of collisionless electron gas
		Fermi liquid, Electron-electron collisions; assignment 1
		Excitons: Frenkel excitons excitons Maxwell equations;
		Alkali halides, Molecular crystals weakly bound (Mott-Wannier)
		Exciton condensation into electron-hole drops (EHD);
		Depolarization field; Local electric field at an atom:
		Polarization; Macroscopic electric field:
		Lorentz field, Field of dipoles inside cavity

4	29 th March- 4 th April	Dielectric constant and polarizability
		Electronic polarizability,
		Classical theory, some examples, Structural phase transitions; test 1
Week	Date	Ferroelectric crystals and their classification,
5	5 th April- 11 th April	Displacive transitions
		Soft optical phonons
		Landau theory of the phase transition
		Second-order transition
6	12 th April- 18 th April	First-order transition,
		Anti-ferroelectricity,
		Ferroelectric domains
		Piezoelectricity
		Band gap, Equations of motion:
7	19 th April- 25 th April	Physical derivation of $h\mathbf{k} = \mathbf{F}$,
		Holes, Effective mass,
		Physical interpretation of the effective mass, Effective masses in semiconductors
		Intrinsic carrier concentration; law of mass action
		intrinsic mobility; Impurity conductivity
8	26 th April- 2 nd May	Donor states, Acceptor states
		Thermal ionization of donors and acceptors; Energy bands in Silicon,
		Germanium and GaAs, assignment
		Cyclotron resonance in semiconductors; Carrier lifetime and recombination
		thermoelectric effects, Semimetals Description of solubility limit
		Phases, Microstructure, Phase equilibria,
9	3 rd May-9 th May	Unitary phase diagrams Binary phase diagrams: Binary Isomorphous systems,
		Interpretation of phase diagrams, Development of microstructure in Isomorphous alloys

		Mechanical properties of Isomorphous alloys
		Binary eutectic systems, Materials of Importance-Lead-Free Solders,
		Development of microstructure in eutectic alloys
		Equilibrium diagrams having intermediate phases or compounds, Eutectoid and Peritectic
		Reactions, test 2
		Congruent phase transformations
10	10 th May - 16 th May	Ceramic and ternary phase diagrams
		The Gibbs Phase Rule
		The iron-carbon system
		revision
		test