



DRAVIDIAN UNIVERSITY
Centre for Off-Campus Education & Research
Syllabus for M.Phil/Ph.D Physics
Paper - II :: Broad Field

UNIT – I:

Atomic Spectra: Introduction – The hydrogen atom (one electron atom) and the three quantum numbers – Spectra of hydrogen atom – Spectra of alkali elements – Elements with more than one valence electron – Forbidden transitions and selection rules – Space quantization – The Stern – Gerlach experiment – SS, LS and JJ coupling schemes – Spectroscopic terms – Equivalent and non-equivalent electronic systems.

Zeeman and Stark Effects: Introduction – Normal and anomalous Zeeman effect – The magnetic moment of the atom and ‘g’ – factor – Emitted frequencies in anomalous Zeeman transitions – The Lande g-formula – The Paschen Back effect – Normal Stark effect – Width of spectral lines.

Raman Spectra: Classical and quantum theories of light scattering, experimental techniques of Raman Spectra, Vibrational Raman Spectra. Pure rotational Raman spectra, vibrational rotational Raman spectra – stimulated Raman effect – application of Raman spectroscopy structure determination.

UNIT –II:

Crystallography: Periodic arrays of atoms: Lattice translation vectors and Lattice symmetry Operation – Point groups and space groups. The basis and the crystal structure, primitive lattice cell. Fundamental types of lattices: Two-dimensional lattice types, three dimensional lattice types, Crystal planes – indexing. Simple crystal structures: sodium chloride, Calcium chloride, Hexagonal closed packing diamond cubic zinc, sulfide and Hexagonal zinc sulfide structures, ploytypism, glasses.

(a) Semiconductor Junctions and Devices: Formation of p-n junction, theory of equilibrium p-n junction – Depletion layer internal contact potential, junction capacitance, its variation with junction voltage – varicaps – current flow in p-n junctions, physical mechanism of breakdown in p-n junctions, junction devices, laser diode, solar cell.LED.

(b) Superconductivity: Introduction, Concept of zero resistance – Magnetic behavior of perfect conductor and a super conductor – Messiner effect, Isotope affect, specific heat behavior. The two fluid model Thermodynamics of the super conducting transition, London’s equations, BCS theory (Qualitative aspects only). Applications of super conductors. High Tc superconductors – Y – Ba – Cu-O compound preparation and properties

UNIT – III:

(a) Analogue Electronics: The transistor – PNP and NPN – Configurations – CE characteristics – Current and Voltage amplification – CE amplifier – UJT characteristics, FET, JFET, MOSFET, POWER FET – Characteristics and operations – SCR – characteristics and operations.

(b) Digital Electronics: The transistor as a switch, OR, AND and NOT gates – NOR and NAND gates – Boolean algebra – Demorgan's theorems – Exclusive OR gate, Decoder / Demultiplexer – Data selections / Multiplexer – Encoder.

Flip – Flops – The RS Flip Flop – JK master Slave Flip – Flops – T Flip – Flop, D Flip – Flop – Shift Registers – Synchronous and asynchronous counters – cascade counters.

Radiowave propagation: Propagation of waves – propagation of waves in free space ground (surface) waves – sky wave (ionospheric) propagation – virtual – height – Critical frequency MUF, skip distance – space waves – radio horizon and microwave wave propagation.

Modulation & Demodulation: Amplitude modulation – Generation of AM wave – Demodulation of AM waves DSBSC modulation – Generation of DSBSC waves – Coherent detection, DSBSC waves – SSB modulation – Generation and detection of SSB waves – Vestigial sideband modulation – Frequency Division multiplexing (FDM). Frequency modulation – Phase modulation – Basic definitions, single tone. Narrow band and Wide-band frequency modulation – generation of FM waves.

UNIT – IV:

a) Diffraction methods for structure analysis: Crystal projections and their uses in crystallography – Reciprocal Lattice: Geometrical construction, relation between direct – reciprocal Lattice, Bragg's law in reciprocal space – X-ray diffraction, Bragg's Law, Laue transmission and back reflection methods – Powder Methods. Principle of Powder diffraction, interpretation of powder photographs analytical indexing and Ito's method – Electron and Neutron diffraction: Basic principles and application of neutron and electron diffraction, electron microscope, correlation between X-ray, electron and neutron diffraction studies.

(b) ESR, Mossbauer Spectroscopy: Electron Spin Resonance Spectroscopy: Magnetic moment of an electron, two states of an electron in a magnetic field, ESR spectra theory-hyperfine interaction-g factor, linewidths and intensities, relaxation effects, ESR measurement methods and ESR applications.

Mossbauer Spectra : Introduction, Mossbauer effect, recoilless emission and absorption, Mossbauer spectra, Lamb Moss factor, Mossbauer nuclides, standard reference absorber, experimental methods and applications.

Introduction to NMR, nuclear spin and magnetic moment, quantum description of
(a) NMR and NQR Techniques: NMR, theory of NMR chemical shift, spin lattice (T₁),

spin spin (T₂) couplings, the Bloch equations, the theory of relaxations, relaxation mechanisms for spin ½ nuclei, proton NMR and NMR applications.

Basic concepts of NQR spectra, half integrals, integral spins, instrumentation, pulse RF detection and NQR applications.

(b) Advanced spectroscopic and Microscopic techniques

X-ray Fluorescence Spectroscopy, Photoelectron Spectroscopy, Photo Acoustic Spectroscopy – Surface Topographic techniques scanning electron microscopy Transmission Electron Microscopy.

UNIT – V:

Microwave and Satellite Communication: Microwave Communication Systems: Propagation modes, Microwave communication systems. Analog Microwave Communication. Digital Microwave Communication : Digital Microwave systems. Bandwidth efficiency, Digital Radio systems.

Satellite Communications: Orbital Satellites, Geostationary Satellites, Orbital patterns, Look angles, orbital classifications, Spacing and frequency allocation, Radiation patterns, foot prints, satellite system link models, Satellite system parameters, Satellite system link equations, Link budget. Non-ideal system parameters. Multiple Accessing Frequency Hopping, Channel capacity.
