DEPARTMENT OF PHYSICS
COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY
KOCHI – 22.

SYLLABUS FOR Ph.D./M.Phil. - ENTRANCE TEST-2015

I. Classical Mechanics

Mechanics of a particle, Mechanics of a system of particles, Conservation laws of energy, momentum and angular momentum. Constraints – D' Alembert's principle and Lagrange's equations. Simple applications of Lagrange's equations. Variational principle – Langrange's equation from Hamilton's principle.

Hamilton's equations of motion – canonical transformations – Poisson – brackets. Hamilton – Jacobi equation – applications – Action – angle variables.

II. Quantum Mechanics

Matter waves – de Broglie's hypothesis – Schrodinger wave equation. Conservation of probability – expectation values – postulates of quantum mechanics – operators – eigen values and eigen functions – commutation relations – uncertainty principle – Dirac delta function – Harmonic oscillator.

Dirac notation – matrix representation of state vectors and operators – change of basis – unitary transformations – Angular momentum – eigen value spectrum – matrix representation of angular momentum operators – Spin angular momentum.

III. Statistical Physics

M.B. statistics – B.E. statistics – F.D. statistics. Concept of ensembles – canonical and grand canonical ensembles. Thermodynamic relations in canonical and grand canonical ensembles.

Partition function – Applications – ideal gas, paramagnetism, oscillators, atoms and molecules. B.E. statistics and black – body radiation. Specific heat of solids.

IV. Modern optics and electromagnetic theory

Principle of superposition – theory of partial coherence – visibility of fringes – interference with multiple beams – resolving power. Fresnel and Fraunhofer diffractions – Diffraction produced by single slit, circular aperture – Grating – dispersive power.

Maxwell equations – Vector and Scalar potentials gauge transformations – Poynting's theorem – plane e.m. wave in a non-conducting medium – reflection and refraction at a dielectric interface.

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V. Spectroscopy

Vector atom model and space quantisation – quantum states of one electron atom – atomic orbitals – hydrogen spectra – spectra of alkali elements. Spin – orbit effects. LS and j-j coupling.

Pure rotational, vibration and electronic spectra of molecules. Raman and IR spectroscopy. Elements of NMR and ESR spectroscopy.

VI. Nuclear physics

Charge – radius – mass and binding energy of nuclei spin – parity – nuclear moments. Nuclear decays. Elementary particles.

General characteristics of nuclear forces – deuteron – n-p and p-p scattering – liquid drop model and nuclear fission – stability of nuclei.

VII. Solid State Physics

Crystal symmetry – unit cell – Miller indices – simple crystal structure, NaCl, CsCl and zinc blende structures. X-ray diffraction – Bragg's law – Types of binding in crystals.

Lattice vibration – monoatomic and diatomic lattices, normal modes and phonons. Free electron theory. Fermi energy – magnetic properties of substances.

VIII. Electronics

PN junctions – rectifying circuits – Half wave – Full wave rectifiers – Zener diode – BJT – Current gain, voltage-ampere relations – FET and MOSFET – Amplifiers (CE, CB and CC)

Principle of feed back amplifiers – operational amplifiers – Integrated and differential amplifiers. Digital circuits – logic gates – Resistance-Transistor logic gates, Transistor-Transistor logic – NAND and NOR circuits with COMOS switches, AND, NOT, OR, XOR gates. RS, D, JK flip flops.

IX. Mathematical Physics

Matrices – eigen values and eigen vectors, Gamma and beta functions, Bessel functions, Legendre and Hermite polynomials.

Complex variables – Cauchy – Reimann conditions, Cauchy's integral theorem and integral formula, Laurent and Taylor expansion, Cauchy's residue theorem - Jordan's lemma and its applications.