MAGADH UNIVERSITY
BODH GAYA

SYLLABUS
OF
PRE- Ph. D. REGISTRATION
ENTRANCE TEST

PAT Physics Syllabus

2014 onwards

FACULTY OF SCIENCES

Price Rs. 100/-

PHYSICS

PAPER - I

Time - 3 Hours Full Marks-100

This paper will consist of objective type questions pertaining to the topics prescribed. There will be 50 questions each carrying 2 marks.

Statistical Mechanics and Plasma :

Saha's ionisation theory, plasma conductivity and dielectric constant, Dispersion relation in magneto plasma, Landau damping.

Ensembles-in quantum statistical mechanics, density matrix, quantum Liouville theorem. The field of sound waves, Elementary excitations in liquid He II, Statistical equilibrium of white dwarf stars, The Chandrasekhar limit.

Quantum Mechanics :

Hilbert space, Bra and ket vectors, Linear operators, Hermitian and Unitary operators, the completeness theorem, Dirac delta function.

Kinematics of quantum scattering process, Centre of mass frame and Laboratory frame, Time independent perturbation theory (non degenerate and degenerate cases), and its application to stark effect and zeeman affect. Variational method and its application to the ground states of Hydrogen and Helium atoms.

Spectroscopy :

L-S and J-J coupling, Zeeman and Paschen Ba effect, Hyperfine structure of spectral lines.

Characteristics of x-ray spectra, Regular and Irregu doublet, Rotation - Vibration spectra of diatomic molecule Electronic states and electronic bands of diatomic molecule Frank-Condon principle, spectra of hydrogen molecule.

Nuclear Physics :

Determination of nuclear masses, radii, spin an moments, Nuclear stability, mass formula, Alpha Ra spectra, Theory of alpha decay (WKB method), Geige Nuttal law, Fermi theory of Beta decay, selection rules Neutrino production and detection, Transition rules, sem conductor detector, cyclotron, Betatron, Fermi gas mode Nuclear shell model, Nuclear shell model, liquid drop mode and fission process, Nuclear forces, theory of deutero quadrupole moment and tensor forces.

Solid State Physics :

Crystal symmentry, Miller indices, Reciproca Lattice, Lau's equation, Bragg's equation, Elastic waves in one -dimensional case, Monotomic and diatomic linea lattice, vibrational modes, Richardson's equation fo thermionic emission, photoelectric effect and work function Fowler's theory, Band theory of solid by K-P model, Theor of diamagnetism and ferromagnetism, Superconductivity Phenomenological theories.

Electronics :

Bipolar Junction Transistor, Unijunction and FET, Class A, B and C power amplifiers, frequency and phase modulation methods, Blocking oscillator, Multivibrator, Klystron, Magnetron and Travelling wave tubes.

Boolean Algebra and its postulates , Demorgan's theorem, Binary systems, OR, AND and inverter logic gates, Transmitter and television receiver.

Transmission line and its equivalent circuit, characteristic impedance, propagation constant, Analysis of distortion-less line.

PAPER - II

Time - 3 Hours Full Marks-100

This paper will consist of descriptive type questions 4 question will be set from Group - A, out of which only 2 questions have to be answered Group - B will be divided into three sections. 6 questions will be set from each section of Group - B, out of which only 3 questions have to be answered from any one of the sections chosen by the examinee. Each question of both the Groups will carry 20 marks.

Group - A

Radio physics and Electronics (General)

Transmission line equation, impedance of dissipation less transmissions line, Theory of linear and loop antennas,

Radiation fields due to grounded antenna, Linear arra antenna, Broadside and end-fire array, Direction findi Mirowave antennas, Theory of Layer formation. D, E a F- layers of ionosphere, Appleton- Hartree relation Radiowave propagation Through ionosphere.

Operational amplifier and their characteristic para eters. Application of OPAMPS, Integrators, Differentiato Multivibrators.

Basic techniques and processes in ICS, monolit diodes, FET and simple circuits.

Simplification of Boolean approximations, Karna maps, Logic gates-NAND, NOR, OR getes, RTL, DTL a TTL.

Half and full adders and subtractors, Flip-Flops: R clocked J-K, Easter slave, shift registers.

Asynchronous binary counters, synchrono counters, Up and Down Counters, Multiplexer a Demultiplexer, Encoders and decoders, A / D and D converters.

ROM, PROM, EPROM and RAM memories. Instru tion set for a microprocessor, programming, storing a control unit, Micro programming of simple computer.

Group - B

Section - I : The Theory of Nuclear and Particle Physi

(Special Paper)

Relativistic quantum mechanics, K.G equation, Dirac equation and its covariance, Algebra of gama matrices and their representation, Dirac spinors, Projection operators, Derac covariants, Two component theory of neutrino.

Quantization of free scalar, Dirac and electromagnetic fields, Particle number represntation, Lippman Schwinger equation for scattering states (in and out states).

S-matrix and T-matrix, Born series for scattering Phase shift under Born and Eikonal approximation, Kramers-kroning dispersion relations, Mandelstam representation, Dispersion relation for forward potential scattering amplitude, Interaction picture, Dysons covariant perturbation theory of s-matrix, Feynman graph, Mott scattering.

Properties of free field and transition under gauge transformation, continuous displacement, rotation, reflection, parity, charge conjugation, Properties of free field and transition under gauge transformation, continuous displacement, rotation, reflection, parity, charge conjugation, time reversal, isospin, SU(2) and its application.

Section - II : Solid State Physics (Special Paper)

Lattice Waves and free electron Fermi gas :

Quantization of lattice waves, phonons, scattering of phonons, Debye-Waller factor, Band structure calculations, Fermi surface studies by cyclotron resonance and de Hass-Van Alphen effect.

Dynamics of electrons and electron-electron interac

Wannier function and equation of motion in W representation, Screening of electron by impur quantum theory of screening, the Friedal sum rules.

Transport properties optical properties :

Boltzmann equation, electrical and ther conductivities of metals, Bloch - Gruneisen law, com refractive index, Kramers-Kroning relations, Drude the Anomalous skin effect.

Energy Bands in Semiconductors and Magnetism

Carrier concentration at thermal equilibrium, mobility and Haynes-Shockley experiment, Shockley-R theory of recombination, Landau quantisation, Ther excitation of magnons, Ising model and its exact soluti

Superconductivity :

B.C.S. thory of superconductivity, superconduct ground state, cooper pairs, Josephson effect.

Section - III : Spectroscopy and Laser Applicatio

(Special Paper)

Atomic Structure :

The Schrodinger equation for two -electron ato Para and Ortho states, Spin wave functions and role of Pauli's exclusion principle, doubly excited states two-electron atoms, Auger effect (autoionisation).

The central field approximation for atom. The Hartree-Fock method and the self consistent field.

Electron - Atom Collision :

Electron scattering (general principles), Elastic scattering, Excitation of atoms to descrete levels, Ionization Resonance phenomena.

Molecular Physics :

Molecular symmetry and group theory, Matrix representation of symmetry elements of point group, Reducible and irreducible representation, Character tables specially for C_{2v} and C_{3v} point groups, Normal coordinates and normal modes, Application of group theory to molecular vibrations, Heitler-London treatment of H_2 molecule, LCAO treatment of H_2^+ and H_2 molecules, Experimental techniques of IR and microwave spectroscopy.

Laser :

Spontaneous and stimulated emission and absorption, Gaussian beam and its properties, Population inversion, Atomic gain coefficient, Threshold condition for population inversion, Two mirrors optical resonators.