UKPSC Assistant Officer Exam Syllabus 2017

19. PHYSICS

I. Mathematical Methods of Physics

Vector algebra and vector calculus (Triple product), Gauss, Stokes and Green's theorem, Matrices: orthogonal, unitary and Hermitian matrices, Eigen values and eigen vectors of matrics, Matrix diagonalization, Cayley - Hamilton Theorem, Eigen value problem, Ordinary differential equations of second order, Special functions (Legendre, Bessel, Hermite and Laguerre functions), Fourier series, Fourier and Laplace transforms, Elements of complex analysis, Laurent series - poles, residues and evaluation of integrals, Tensor: covariant, contravariant and mixed tensors, Epsilon, Christoffel and Ricci tensor, Elements of computational techniques: roots of functions, interpolation, extrapolation, integration by trapezoid and Simpson rule, solution of first order differential equations using Runge – Kutta method, finite difference methods, Elementary probability theory, random variables, binomial, Poisson and normal distributions. Central limit theorem.

II. Classical Mechanics

Newton's laws, D' Alembert's principle, Central force motions, Kepler's laws and equations, Artificial Satellite, Lagrange and Possion bracket, Canonical transformations, Hamilton – Jacobi equation, Action angle variable, Lagrangian and Hamiltonian formalism and equations of motion, Two body Collisions - scattering in laboratory and Centre of mass frames, Rigid body dynamics - moment of inertia tensor, Non - inertial frames and pseudo forces, Variational principle, Generalized coordinates, Invariance and conservation laws and cyclic

coordinates, Periodic motion: small oscillations and normal modes, Special theory of relativity - Lorentz transformations, relativistic kinematics and mass–energy equivalence, Idea of four – vectors.

III. Electromagnetic Theory

Electrostatics: Gauss's law and its applications, Laplace and Poisson equations, Magnetostatics: Biot - Savart law, Ampere's theorem, Electromagnetic induction, Maxwell's equations in free space and linear isotropic media; boundary conditions on the fields at interfaces, Scalar and vector potentials, gauge invariance, Electromagnetic waves in free space. Poynting vector, Poynting theorem, energy and momentum of electromagnetic waves, four - vector potential, electromagnetic field tensor, Lorentz invariance, Lorentz force, covariant form of Maxwell's equation, Dielectrics and conductors, Reflection and refraction, polarization, Fresnel's law, interference, coherence and diffraction, Dispersion relation in plasma, Dynamics of charged particles in static and uniform electromagnetic fields, Radiation from moving charges, dipoles and retarded potentials.

IV. Quantum Mechanics

Wave - particle duality, Wave functions in coordinate and momentum representations, Commutator and Heisenberg's uncertainty principle, Dirac's notation for state vectors, Schrödinger equation (time - dependent and time - independent), Eigen value problems (particle in a box, harmonic oscillator, etc.), Tunneling through a barrier, Motion in a central potential: orbital angular momentum, angular momentum algebra, spin, addition of angular momenta;

Hydrogen atom, spin – orbit coupling, fine structure, Time - independent perturbation theory and applications, Variational method, WKB approximation, Time dependent perturbation theory and Fermi's golden rule, selection rules, Semi classical theory of radiation, Elementary theory of scattering, phase shifts, partial waves, Born approximation Identical particles, Pauli Exclusion Principle, spin -statistics connection. Relativistic quantum mechanics: Klein - Gordon and Dirac equations and their applications.

V. Thermodynamic and Statistical Physics

Laws of thermodynamics and their consequences, Thermodynamic potentials, Maxwell relations, chemical potential, phase equilibria, Phase space, micro - and macro - states. Micro - canonical, canonical and grand - canonical ensembles, partition functions, Free energy and its connection with thermodynamic quantities, phase transitions, Maxwell – Boltzmann, Bose – Einstein and Fermi – Dirac Statistics, Degeneracy in Bose and Fermi gases, Liquid – Helium and electron gas in metals, Black body radiation and Plank distribution law.

VI. Electronics

Semiconductor devices (diodes, junctions, transistors, field effect devices, homo- and hetero-junction devices), device structure, device characteristics, amplifier and oscillator circuits, frequency dependence and applications, Opto - electronic devices (solar cells, photo - detectors, LEDs). Operational amplifiers and their applications, Number system: binary, octal, hexadecimal, BCD code, Gray code, Boolean algebra, De Morgan's law, Logic circuits: OR- gate, AND- gate, NOT-gate, NAND - gate, NOR - gate and XOR - gate, Digital techniques and

applications (registers, counters, comparators and similar circuits), Flip –Flops: RS, JK, master slave JK, T – type and D – type flip – flops, Binary adders, half adders, full adders, decoders, multiplexers, encoders, digital comparator, Parity checker and generators, A/D and D/A converters, Microprocessor and microcontroller basics, Computer and communications, Need for communication networks, Internet, World Wide Web, Communication protocols, Local Area Network.

VII. **Atomic & Molecular Physics**

Quantum states of an electron in an atom. Electron spin, Hund's rule, Pauli exclusion principle, Stern - Gerlach experiment, Spectrum of hydrogen, helium and alkali atom. Electric dipole transtations and selection rules, Relativistic corrections for energy levels of hydrogen atom, hyperfine structure and isotopic shift, width of spectrum lines, LS and JJ couplings, Zeeman, Paschen - Bach and Stark effect, X- ray spectroscopy, Electron spin resonance, Nuclear magnetic resonance, chemical shift, Born - Oppenheimer approximation, Electronic, rotational, vibrational and Raman spectra of diatomic molecules, Frank – Condon principle and selection rules, Lasers: spontaneous and stimulated emission, Einstein A and B coefficients, Optical pumping, population inversion, rate equation, Modes of resonators and coherence length.

VIII. **Condensed Matter Physics**

Bravais lattices. Reciprocal lattice, Diffraction and the structure factor, Bonding of solids, Elastic properties, phonons, lattice specific heat, Free electron theory and electronic specific heat, Response and relaxation phenomena, Drude model

of electrical and thermal conductivity, Transport properties, optical, dielectric and magnetic properties of solids, Hall Effect and thermoelectric power, Dimagnetism, paramagnetism and ferromagnetism, Electron motion in a periodic potential, band theory of solids: metals, insulators and semiconductors, Superconductivity: type-I and type-II superconductor,. Josephson junction, Super fluidity, Defects and dislocations, Ordered phases of matter: translational and orientational order, kinds of liquid crystalline order, Quasi crystals.

IX. **Nuclear and Particle Physics**

Basic nuclear properties: size, shape and charge distribution, spin and parity, Binding energy, semi - empirical mass formula, liquid drop model, Nature of the nuclear force, form of nucleon - nucleon potential, charge - independence and charge - symmetry of nuclear forces, Isospin, Deuteron problem, Evidence of shell structure, single - particle shell model, its validity and limitations, Rotational spectra, Elementary ideas of alpha, beta and gamma decays and their selection rules, Fission and fusion, Nuclear reactions, reaction mechanism, compound nuclei and direct reactions, Particle accelerators and detectors: Ionization counter, Geiger Muller counter, Scintillation counter, Classification of elementary particles (quarks, baryons, mesons, leptons), Fundamental interactions, Elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness, hypercharge etc.), symmetries and conservation laws, Lepton and Baryon numbers, Gellmann - Nishijima formula, Quark model, SU(2) and SU(3) symmetries, Hadron structure in quarks, Parity, Time reversal and charge conjugation, Parity violation in weak interaction, CP - violation and CPT invariance.