BANGALORE UNIVERSITY
Syllabus, Scheme of Instruction & Examination for
B.Sc., Physics Semester Scheme (from 2014-15)

<table>
<thead>
<tr>
<th>Serial Number</th>
<th>Paper Number</th>
<th>Teaching hours per week</th>
<th>Examination duration</th>
<th>Maximum marks IA</th>
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Note-I:
- The paper number is a three digit number with ‘0’ in the middle
- The digit to the left of ‘0’ indicates the semester number
- Odd number to the right of ‘0’ indicates a theory paper
- Even number to the right of ‘0’ indicates a practical paper

Note-II:
The marks distribution for the final practical examination is as follows:
1. Writing formula, Explanation, Figure/circuit diagram 05 Marks
2. Setting up of the experiment & entering the observations in the tabular column. 20 Marks
3. Calculation / Graph, Results with units 05 Marks
4. Class Records (to be valued at the time of practical examination) 05 Marks
   Total for the practical examination – 35 marks

Note-III:
A minimum of EIGHT (8) experiments must be performed in each practical paper
Syllabus for I Sem BSc, (Physics)

PHY-101: Mechanics, Oscillations and Properties of matter

Unit -1

Motion & Friction
Newton's laws of motion with illustrations (review); Enumeration of II law - Motion in a resistive medium; Examples of drag force, concept of terminal velocity; role of static and dynamic friction; Motion along inclined plane with and without frictional force; Use of free body diagrams

Frames of reference
Inertial and Non inertial frames of reference; Galilean relativity; Postulates of special theory of relativity; Lorentz transformation equation (no derivation); mass energy equivalence; length contraction and time dilation

Unit -2

Planetary & Satellite motion
Motion along a curve - radial and transverse components of acceleration; Newton’s law of gravitation, Kepler’s laws (statements only); Escape velocity and orbital velocity; Launching of artificial Satellite; Geostationary and geosynchronous satellites

Work & Energy
Work done by a constant and variable force; Work energy theorem; Work and potential energy; examples of potential energy; Work done by gravitational force; Work done by a spring force; Conservative and non conservative force; Conservation of energy

Surface tension
Molecular interpretation of surface tension; Surface energy; Angle of contact and wetting; Pressure difference across a curved surface; Interfacial tension; Drop weight method with necessary theory; Factors affecting surface tension

Unit - 3

System of particles
Centre of mass of rigid bodies; Newton's law for a system of particles; Linear momentum for a particle and a system of particles; Conservation of linear momentum; System with varying mass; Rocket motion; Elastic and inelastic collisions (oblique)

Moment of inertia
Review of rotational motion of Rigid bodies; Kinetic energy of rotation-Moment of Inertia of a body; Theorem of Moment of Inertia-Parallel and perpendicular axes theorem with proofs (2-D case); Calculation of moment of inertia of a disk, annular ring, solid sphere and rectangular bar; Conservation of angular momentum with illustrations

Unit - 4

Oscillation
SHM; Simple and compound pendulum; damped oscillations; forced oscillations - concept of resonance; coupled oscillators

Elasticity
Review of elastic properties; Relationship between three elastic constants; Poisson’s ratio; Work done in stretching a wire; Bending of beams; Bending moment, Theory of single cantilever, Couple per unit twist, Torsional oscillations
References
1. Fundamentals of Physics- RResnik, and D Halliday, Wiley 2001
5. University Physics- FWSears, MW Zemansky & HDYoung, Narosa Publications- Delhi
7. Mechanics- Berkeley Physics Course Vol(1)- Mittal, Knight & Rudermann, TMH Delhi, 1981
10. Elements of Properties of matter - DSMathur, Shamlal Charitable Trust, Delhi, 1996

PHY-102: Practical Physics – I

List of Experiments
1. Atwood machine – with photogate
2. Torsional pendulum – to determine C and Rigidity modulus
3. Spring mass- (a) static case to determine ‘k’
   (b) dynamic case to determine ‘k’
   (c) ‘k’ as a function of L of spring
4. Bar pendulum – effective length and T
5. Rigid pendulum – T and decay of amplitude
6. Coupled oscillator – string coupled with change of tension
7. Simple pendulum - dependence of T on amplitude
8. Rolling dumb bell - on parallel inclined rails
9. Verification of parallel and perpendicular axis theorem
10. Searle’s double bar
11. Work done by variable force
12. Cantilever of negligible mass to find Young’s modulus
13. q- by Stretching
14. Fly wheel
15. Verification of principle of conservation of energy
16. Determination of coefficients of static, kinetic and rolling frictions
17. q by uniform bending
18. q by single cantilever

Note: A minimum of EIGHT (8) experiments must be performed

References
1. BSaraf etc, - Physics through experiments, Vikas Publications
2. DPKhandelwal – A Laboratory Manual of Physics for Undergraduate Classes, Vani Publications
5. BSC, Practical Physics, CLArora, SChand & Co, New Delhi, 2007 Revised Edition
Syllabus for II Sem BSc (Physics)
PHY-201: Thermal physics and Statistical mechanics

Unit - 1

Kinetic Theory of Gases
Basic assumptions of kinetic theory; Derivation of \( pV = \frac{1}{3} m n c^2 \) - deduction of perfect gas equation; Maxwell's law of distribution of velocity \((\text{without derivation})\); Calculation of most probable velocity, mean velocity and root mean square velocity; Derivation of expression for mean free path; Degrees of freedom and principle of equipartition of energy; Derivation of \( U = \frac{3}{2} R T \), Specific heats of an ideal gas, atomicity of gases

Transport Phenomena
Viscosity and thermal conduction in gases \((\text{with derivation})\); Relation between coefficient of viscosity and coefficient of thermal conductivity of a gas

Real Gases
Derivation of van der Waal's equation of state; Andrews experiments on Carbon dioxide; Derivation of the critical constants; Comparison of van der Waal's isotherms with Andrew's isotherms

Unit – 2

Basic Concepts and the Zeroth law of thermodynamics
Macroscopic and microscopic descriptions of a system; Thermal Equilibrium - Zeroth Law of Thermodynamics; Concept of temperature; Thermodynamic equilibrium; Thermodynamic coordinates - extensive and intensive; Equations of state; Various processes - PVT indicator diagrams

First Law of Thermodynamics
The first law of Thermodynamics; Sign convention for heat and work; Work done in an isothermal process for an ideal gas; Internal energy as a state function; Application of the first law for (i) Cyclic Process (ii) Adiabatic Process (iii) Isochoric Process (iv) Isobaric Process and (v) Isothermal Process

Second Law of Thermodynamics
Reversible and irreversible processes; Carnot Cycle and its efficiency \((\text{with derivation})\); Second law of thermodynamics (Kelvin’s & Clausius’ statements and their equivalence); Carnot Engine; Practical internal combustion engines - Otto and Diesel Cycles \((\text{qualitative treatment})\); Carnot theorem; The thermodynamic temperature scale; Refrigerator- Coefficient of performance

Entropy
The concept of entropy; Entropy of an ideal gas; Entropy - reversible process, Entropy - irreversible process; Entropy and the second law; Clausius inequality; Principle of increase of entropy; Entropy change in (i) adiabatic process (ii) free expansion (iii) cyclic process (iv) isobaric process; TdS diagram of a Carnot cycle; Entropy and disorder

Unit - 3

Thermodynamic potentials
Internal Energy; Enthalpy; Helmholtz free energy; Gibbs free energy and their significance; Maxwell's thermodynamic relations and their significance; TdS relations; Energy equations and Heat Capacity equations; Third law of thermodynamics \((\text{Nernst Heat theorem})\)
Phase transitions of the first order
Melting, vaporization and sublimation; Condition of equilibrium of phases in terms of Gibbs potential; Clausius-Clapeyron equation - elevation of boiling point, depression of freezing point; Equilibrium between phases - triple point

Classical Equilibrium Statistical Mechanics
Specification of the state of the system; Phase space; Microstates and macrostates; Thermodynamic probability and its calculation; Basic postulates; Entropy and thermodynamic probability; Calculation of temperature from statistical mechanics

Unit - 4
Low Temperature Physics
Methods of producing low temperatures: (i) Joule Thomson (Joule Kelvin / Throttling / Porous plug) experiment, Joule Thomson Coefficient, inversion temperature (ii) Adiabatic demagnetization - working and theory

Liquefaction of gases
Cascade process; Regenerative cooling coupled with Joule Thomson cooling; Adiabatic expansion with Joule Thomson cooling (qualitative)

Black Body Radiation
Block body radiation and its spectral energy distribution; Kirchhoff's law, Stefan-Boltzmann's law, Wien's displacement law, Rayleigh-Jeans law, Derivation of Planck’s law, Radiation pressure (qualitative), Solar constant and its determination; Estimation of the surface temperature of the sun

References
5. Concepts of Physics Vol (1) and (2)- HC Verma, Bharathi Bhavan Publications, New Delhi, 1996
18. University Physics-Sears & MW Zemansky
19. Fundamentals of Statistical and Thermal Physics -F Reif
20. Mechanics and Thermodynamics, C Basavaraju and D Ghosh
21. Thermal Physics- C Kittel
22. Thermal Physics - Chakraborty

PHY-202: Practical Physics – II

List of Experiments
1. Specific heat by Newton’s law of cooling
2. Specific heat of water using a thermistor
3. Thermal conductivity of a bad conductor by Lee’s and Charlton’s method
4. Thermal conductivity of rubber
5. Determination of thermal conductivity of a good conductor by Angstrom method / Searle's method
6. Thermal behavior of a torch filament
7. \( \gamma \) by measuring velocity of sound- using CRO
8. Verification of Newton’s law of cooling and Stefan’s law of radiation
9. Determination of Stefan's constant by emissivity method
10. Calibration of thermocouple for Temperature measurement
11. Verification of Clausius-Clapeyron equation using pressure cooker
12. Determination of Solar constant
13. Monte Carlo experiment & error analysis
14. Verification of Maxwell’s distribution of velocity
15. Maxwellian distribution of velocities for electron using EZ81 vacuum diode
16. Dice experiment – to study statistical nature of results

Note: A minimum of EIGHT (8 ) experiments must be performed

References:
1. BSaraf etc, - Physics through experiments, Vikas Publications
2. DPKhandelwal – A Laboratory Manual of Physics for Undergraduate Classes, Vani Publications
5. BSC, Practical Physics, CLArora, SChand & Co, New Delhi, 2007 Revised Edition
Syllabus for III Sem BSc (Physics)
PHY-301: Electricity and Magnetism

Unit - 1

**Electric field and potential Review:**
Electrostatic field and intensity; Electrostatic potential; Relation between field and potential

Electric dipole, potential and intensity at any point due to a dipole

1 hour

**Network theorems**
Superposition theorem; Thevenin's theorem; Norton's theorem; Maximum power transfer theorem (for dc circuits - with problems)

2 hours

**Magnetic fields and forces**
Motion of charged particles in a magnetic field; Magnetic force on a current carrying conductor; Force and torque on a current loop, Concept of dead beat; Theory of a BG, Determination of high resistance by leakage

5 hours

Unit - 2

**Source of magnetic field**
Magnetic field due to moving charge, Biot and Savart’s law; Magnetic field due to a straight current carrying conductor; Force between parallel conductors; Definition of ampere; Magnetic field of a circular loop; Theory of HTG; Field on the axis of a solenoid, Ampere's law, Application of Ampere's law to straight wire, solenoid and toroid

10 hours

**Electromagnetic induction**
Faraday's laws; Lenz's law; Expression for induced emf; motional emf; eddy currents and applications

3 hours

Unit - 3

**Transient currents**
Self inductance; Magnetic field energy stored in an inductor; Growth and decay of current in RC, LR, LCR circuits; Damped, under-damped and over-damped conditions

5 hours

**Scalar and vector fields**
Gradient of a scalar function; Relation between field and potential; Divergence and curl product rules; Line, surface and volume integrals; Fundamental theorem of divergence and curl (statements only)

3 hours

**Electromagnetic waves**
Maxwell's equations (derivation and significance) ; Electromagnetic waves - Derivation of wave equation, Velocity of em waves, Relation between refractive index and permittivity, Plane em waves, Energy and momentum, Significance of Poynting vector

5 hours

Unit - 4

**Alternating current**
Alternating current circuits, Resistance, Reactance and Impedance; LCR series and parallel circuits (vector method), Resonance, Power in ac circuits, Representation of sinusoids by complex numbers, ac bridge - Maxwell bridge

6 hours

**Thermoelectricity**
Seebeck effect; Thermoelectric series; Neutral temperature; Laws of thermoelectricity; Peltier effect, Demonstration of Peltier effect, Peltier coefficient; Thomson effect, Demonstration of Thomson effect, Thomson coefficient; Theory of thermoelectric circuits using thermodynamics; Thermoelectric diagrams and uses; Applications of thermoelectricity - Boy's radio micrometer, thermopile and thermoelectric pyrometer

7 hours
References
4. Electricity & Magnetism, NSKhare & SSrivastava, AtmaRam & Sons, New Delhi
9. Introduction to Electrodynamics by DJ Griffiths
10. Electromagnetism by BB Laud
11. Electrical Networks, Theraja
12. Electrical Networks, Malvino

PHY - 302: Practical Physics – III

List of Experiments
1. To find L and C by equal voltage method
2. Energy consumption in an electrical circuit - to find power factor
3. Resonance in LCR series circuit
4. Resonance in LCR parallel circuit
5. Mirror galvanometer- figure of merit
6. High resistance by leakage using BG
7. Thermoelectric circuit - find Seebeck coefficients
8. Study of thermo emf as a heat pump
10. Verification of Thevenin’s theorem
11. Verification of Superposition theorem
12. Verification of maximum power transfer theorem
13. Maxwell’s impedance bridge
14. Desauty’s bridge
15. Anderson’s bridge

Note: A minimum of EIGHT (8) experiments must be performed

References:
1. Physics through experiments, BSaraf etc, Vikas Publications
2. Advanced practical physics, Chauhan & Singh, Pragathi Publications
3. Practical Physics, DChattopadhyaya et al, Central Publications
5. Practical Physics, TCTayal
Syllabus for IV Sem BSc (physics)

PHY- 401: Physical Optics, Lasers and Fibre optics

Unit - 1

Wave Theory
Huygens’ wave theory of light; Huygens’ Principle; Construction Huygens’ wave front; Laws of reflection and refraction using spherical wave front at a plane surface

Interference – a Review:
Coherent sources and their production; Conditions for observing interference; Conditions for constructive and destructive interference

Coherent sources by wavefront division
Biprism-theory and working, experiment to determine wavelength; Effect of thin film in the path of one of the beams; Calculation of thickness of the film

Coherent sources by amplitude division:
Interference at thin films - reflected and transmitted light Colours of thin films; Theory and experiment of air wedge; Theory and experiment of Newton’s rings

Unit - 2

Diffraction - Fresnel diffraction
Division of wavefront into Fresnel’s half period zones; Theory of rectilinear propagation using these ideas; Construction and working of Zone plate; Comparison of Zone plate with lens; Theory of diffraction at a straight edge

Fraunhofer diffraction
Theory of single slit diffraction; Theory of grating - normal and oblique incidence - Experimental determination of wavelength; Discussion of Dispersive power; Resolution, Rayleigh's criterion; Expression for resolving power of grating and telescope; Comparison of prism and grating spectra

Unit - 3

Lasers
Introduction; Spontaneous and stimulated emission; Einstein's coefficients and optical amplification; Population inversion; Main components of a laser; Lasing action; Ruby Laser - construction and working - energy level diagram; He-Ne Laser - construction and working - energy level diagram; Fiber Laser - Master Oscillator power amplifier; Solid State Laser - construction and working; Applications of Lasers - Holography, bloodless surgery (principles only)

Polarization
Review of plane polarized light and method of production; Double refraction at crystals; Huygens’ explanation of double refraction; Theory of retarding plates - Quarter wave plates and Half wave plates; Production and detection of linearly, elliptically and circularly polarized light; Optical activity - Fresnel's explanation Laurent's half shade polarimeter

Unit - 4

Optical Fibres
Optical fiber-principle, description and classification; Why glass fibers? Coherent bundle; Numerical aperture of fiber; Attenuation in optical fibers - limit Multimode optical fibers; Ray dispersion in multimode step index fibers; Dispersion due to material; Dispersion and maximum bit rates; Fiber optic sensors
Modes in fibres
Introduction; Modes in fibers Symmetric step index planar waveguide TE modes; Propagation constants; Field distribution; Physical understanding of modes; TM modes of a symmetric step index planar waveguide

5 hours

References
3. A K Ghatak and K Thyagarajan, Contemporary Optics, Macmillan
4. Jenkins and White, Optics, McGraw Hill
11. Optics, Klein and Furtak, Wiley Publications

PHY-402: Practical Physics – IV

List of Experiments
1. Verification of Brewster’s law
2. Refractive index of a liquid by parallax method
3. Biprism – determination of wavelength of light
4. Air wedge – determination of thickness of object
5. Newton’s rings – determination of radius of curvature of lens surface
6. Diffraction grating in minimum deviation position
7. Diffraction grating in normal incidence position
8. Resolving power of telescope
9. Diffraction at straight edge
10. Polarimeter – determination of specific rotation of a solution
11. Diffraction of LASER at a wire
12. Measurement of numerical aperture of an optical fibre
13. Fraunhofer diffraction of LASER at single slit
14. Diffraction of LASER at graduations of a metal scale

Note: A minimum of EIGHT (8) experiments must be performed

References:
2. Practical Physics, Experiments with He-Ne laser, RSSirohi
3. Advanced Practical Physics, Wirsnop & Flint
4. BSc, Practical Physics, CL Arora, SChand & Company, New Delhi, Revised Edition, 2007

General References:
5. Understanding Physics, Karen Cummings, Priscilla Laws, Edward Redish & Patrick Cooney, Wiley India, 2006 Reprint
6. College Physics, Serway
Syllabus for V Sem. B.Sc. (Physics)

PHY 501: Quantum Statistical Physics, Quantum Mechanics-I and II

Unit-1: Statistical Physics

Maxwell – Boltzmann distribution function (with derivation)  

Bose-Einstein Statistics


9 hours

Fermi – Dirac Statistics

Fermi-Dirac distribution function (with derivation), Fermi sphere and Fermi energy, Fermi gas, Electronic heat capacity in metals.

Comparison of Maxwell – Boltzmann, Bose – Einstein and Fermi – Dirac distribution functions.  

5 hours

Unit-2: Quantum Mechanics-I

Introduction to quantum mechanics: Planck’s quantum theory, failure of classical physics to explain the phenomena such as stability of atom, atomic spectra, black body radiation, photo electric effect, Compton effect and specific heat of solids. Explanation of the above effects on the basis of quantum mechanics.  

De Broglie’s hypothesis of matter waves, Thomson’s experiment, Davisson and Germer’s experiment – normal incidence method, concepts of packets for quantum particle, group velocity and phase velocity, relation between particle velocity and group velocity. Heisenberg’s uncertainty principle - different forms, Gamma ray microscope experiment, applications.  

10 hours

Unit-3: Quantum mechanics-II

The concept of wave function, physical significance of wave function. Development of time dependent and time independent Schrodinger’s wave equation. Max Born’s interpretation of the wave function. Normalization and expectation values, Quantum mechanical operators, Eigen values and Eigen functions. Applications of Schrodinger’s equation – free particle, particle in one dimensional box- derivation of Eigen values and Eigen function – extension to three dimensional box; Development of Schrodinger’s equation for One dimensional Linear harmonic oscillator, Rigid rotator, Hydrogen atom – mention of Eigen function and Eigen value for ground state.  

15 hours

References:

PHY-502: Practical Physics V (A)

1. Analysis of X-ray diffraction pattern obtained by powder method to determine properties of crystals.
2. Determination of Fermi energy of a metal.
3. Determination of thermal conductivity of a metal by Forbe’s method.
5. Characteristics of a photo cell-determination of stopping potential.
6. Determination of Planck’s constant.
7. Characteristics and spectral response (selenium photocell)
8. Hysteresis loop for iron and finding energy loss per cycle
9. Applications of CRO in the (a) study of Lissajous figures (b) calculation of rms voltage (c) calculation of frequency of AC.
10. Regulated power supply (using zener diode).
11. Determination of transistor h-parameters.
13. Transistor as a switch and active device.
14. Construction of RFO or AFO - using transistor
15.Emitter follower

Note: A minimum of EIGHT experiments must be performed.

References :
1. Worsnop and Flint, Advanced practical physics for students, Asia Pub.(1979)
5. Ramalingom & Raghuopalan : A Lab. Course in Electronics
PHY- 503: Astrophysics, Solid State Physics and Semiconductor Physics

Unit-1: Astrophysics

Parallax and distance: Helio-centric parallax, Definition of parsec (pc), Astronomical unit (AU), light year (ly) and their relations.

Luminosity of stars: Apparent brightness, Apparent magnitude - scale of Hipparchus. Absolute magnitude - distance - modulus relationship. Distinction between visual and bolometric magnitudes, Radius of a star. 3 hours

Stellar classification: Pickering classification and Yerke’s luminosity classification. H-R diagram, Main sequence stars and their general characteristics.

Gravitational potential energy or self energy of a star based on the linear density model, Statement and explanation of Virial theorem.

Surface or effective temperature and color of a star: Wien’s displacement law. Expressions for average temperature, core temperature, hydrostatic equilibrium, core pressure of a star based on the linear density model of a star. Photon diffusion time (qualitative), Mass – Luminosity relationship and expression for lifetime of a star. 7 hours

Evolution of stars: Stages of star formation (GMC – Protostar- T-Tauri) and main sequence evolution, White dwarfs, Pulsars, Neutron stars and Black holes, Variable stars, Supernova explosion- its types, Chandrasekhar limit. Event horizon, singularity and Schwarzschild’s radius (qualitative) 5 hours

Unit-2: Solid State Physics

Crystal systems and X-rays: Crystal systems-Bravais lattice; Miller indices– Spacing between lattice planes of cubic crystals, Continuous and characteristic X-ray spectra; Moseley's law, Scattering of X-rays - Compton effect, Bragg's law. 4 hours

Free electron theory of metals: Electrical conductivity- classical theory (Drude-Lorentz model); Thermal conductivity; Wiedemann - Franz's law; Density of states for free electrons; Fermi-Dirac distribution function and Fermi energy; Expression for Fermi energy and Kinetic energy at absolute zero. Hall Effect in metals. 5 hours

Band theory of solids: Elementary ideas regarding formation of energy bands; Bloch theorem; One dimensional Kroning-Penney model; Effective mass; Energy gap. 4 hours

Superconductivity: Introduction – Experimental facts – Zero resistivity – The critical field – The critical current density – Meissner effect ,Type I and type II superconductors– BCS Theory (qualitative). 2 hours

Unit-3: Semiconductor Physics

Semiconductors: Distinction between metals, semiconductors and insulators based on band theory. Intrinsic semiconductors - concept of holes – effective mass - expression for carrier concentration and electrical conductivity – extrinsic semiconductors – impurity states in energy band diagram and the Fermi level.

Semiconductor devices: Formation of P-N junction, depletion region, Biased P-N junction, variation of width of the depletion region, drift and diffusion current –expression for diode current. 6 hours

Special Diodes: Zener diode – characteristics and its use as a voltage regulator. Photo diodes, Solar cells and LED (principle, working and applications). 4 hours

Transistors: Transistor action, Characteristics (CE mode), Biasing, Load line analysis - Transistor as an amplifier(CE mode). h-parameters 5 hours
References

1. Astronomy : Fundamentals and Frontiers – Jastrow & Thompson
2. Chandrashekhar and his limit – G. Venkataraman
3. An introduction to Astrophysics – Baidyanath Basu
5. Astrophysics. Krishnaswamy (ed)
PHY –504: Practical Physics V (B)

1. Parallax Method – Distance of objects using trigonometric parallax.
2. HR Diagram & the physical properties of stars.
3. Analysis of stellar spectra.
4. Determination of temperature of a star (artificial) using filters.
5. Analysis of sunspot photographs & solar rotation period.
8. Resistivity of a material by four probe method.
10. Temperature coefficient of resistance and energy gap of thermistor.
11. LED characteristics and spectral response.
15. Characteristics of LASER diode.

Note: A minimum of EIGHT experiments must be performed.

References :
1. IGNOU : Practical Physics Manual
2. Saraf : Experiment in Physics
3. S.P. Singh : Advanced Practical Physics
4. Melissons : Experiments in Modern Physics
6. Gupta and Kumar, Pratcical physics, Pragati prakashan, 1976
7. Ramalingom & Raghuopalan : A Lab. Course in Electronics
8. Bharagav et al : Electronics, TTI
Syllabus for VI Sem. B.Sc. (Physics)

PHY- 601: Atomic and Molecular Physics, Nuclear Physics and Material Science

Unit-1: Atomic and Molecular Physics

Vector Model of the Atom
10 hours

Molecular Physics: Pure rotational motion, Spectrum and selection rules; Vibrational motion, vibrational spectrum and selection rules; Rotation-Vibration spectrum; Scattering of light-Tyndall scattering, Rayleigh scattering and Raman scattering. Experimental study of Raman effect, Quantum theory of Raman effect - Applications. 5 hours

Unit-2: Nuclear Physics

Alpha particle scattering: Rutherford's theory of alpha scattering (assuming the path to be hyperbolic).

Alpha decay: Gamow's theory of alpha decay, Q-value of alpha decay, Exact energy of alpha particle emitted, characteristics of alpha spectrum. Geiger-Nuttal law.

Beta decay: Types of beta decay (electron, positron decay and electron capture). Characteristics of beta spectrum and Pauli's neutrino hypothesis.

Detectors: Variation of ionization current with applied voltage in a gas counter, GM Counter.

Particle accelerators: Cyclotron, Electron Synchrotron.


Unit-3: Material Science


Dielectrics: Static dielectric constant, polarizability (electronic, ionic and orientation), calculation of Lorentz field (derivation), Clausius-Mosotti equation (derivation), dielectric breakdown, electrostriction (qualitative), electrets. Piezo electric effect, cause, examples and applications.

Liquid Crystals: Classification-Thermotropic and lyotropic. Properties - anisotropy in dielectric constant, electrical conductivity, magnetic susceptibility, refractive index and elasticity. Applications: construction and operation of twisted nematic display and thermography.

5 hours
References
2. Introduction to Atomic Physics – H.E. White
9. N. Rudraiah (Ed) : Modelling of Nano and smart materials
13. Modern physics, Murugeshan et al.
PHY- 602: Practical Physics VI (A)

1. Study of hydrogen spectrum.
2. Sommerfeld’s fine structure constant determination.
3. Determination of e/m by Thomson’s method.
5. Verification of inverse square law using GM counter (with a radioactive source).
6. Determination of mass absorption coefficient of gamma rays.
7. Determination of half-life of $^{40}$K.
8. Millikan’s Oil drop experiment
10. Analysis of band spectrum of PN molecule.
11. Analysis of rotational spectrum of nitrogen.
12. Analysis of rotational vibrational spectrum of a diatomic molecule (HBr).
15. Determination of dipole moment of organic liquid

Note: A minimum of EIGHT (8) experiments must be performed.

References:
1. IGNOU : Practical Physics Manual
2. Saraf : Experiment in Physics
3. S.P. Singh : Advanced Practical Physics
4. Melissons : Experiments in Modern Physics
6. Gupta and Kumar, Practcal physics, Pragati prakashan, 1976
PHY-603: Atmospheric Physics, Electronics and Computational Physics

Unit-1: Atmospheric Physics and Earth’s Atmosphere

Origin and composition of atmosphere:
Fixed and variable gases, Mechanism of production and destruction of atmospheric constituents, Different layers of atmosphere. 2 hours

Temperature structure of the atmosphere:
Vertical profile and horizontal distribution, Pressure (over land and ocean), Variation of pressure with altitude, hydrostatic equation, Relative and Absolute humidity, Density (over land and ocean), wind (speed and direction). 3 hours

Sun’s Radiation
Spectrum of radiation (EM spectrum, Visible range, diffuse radiation), Black body radiation (Planck’s law, emission curves from Sun and Earth atmosphere), Absorption of solar radiation by earth’s atmosphere (absorption and emission of radiation by molecules, absorptivity, emissivity, Kirchoff’s law, reflectivity and transmittivity), Beer’s law (derivation), Global energy balance for earth – atmosphere system, Green house effect. 4 hours

Atmospheric motions
Atmosphere dynamics – Eulerian and Lagrangian approaches; Accelerated rotational frames of reference – Centripetal and Coriolis force, Gravity and pressure gradient forces (with derivation); Applications of Coriolis force – Formation of trade winds, cyclones, erosion of river banks. 6 hours

Unit–2: Electronics

Integrated circuits
Monolithic IC - description of discrete IC - Techniques of manufacturing thin film and thick film IC. 2 hours

Operational amplifiers
Ideal OP amplifier characteristics. The basic op-amp circuits, Inverting amplifier, Non-inverting amplifier; Applications of op-amp – summer, integrator, differentiator. 3 hours

Oscillators
Feedback concepts - oscillator circuits - Feedback amplifier - oscillator operation – Barkhausens Criterion - phase and frequency considerations- phase shift oscillator and Wien bridge oscillator (using op amp). 3 hours

Digital Electronics
Logic states; Voltage range of high and low logic states; Number codes; Hexadecimal representation; BCD; signed numbers; Arithmetic 1’s and 2's complement; Gray code. Logic gates and truth tables; OR gate, AND gate; Inverter (the NOT function); NAND and NOR; exclusive OR; exclusive NOR. 5 hours

Combination logic: Adders (full and half adder) & Subtractors (full and half). 2 hours

Unit–3: Computational Methods in Physics (using C-program)

Basics of C Language:
Program structure in C, Constants and Variables, Input and output statements, Arithmetic and conditional operations, conditional structure, Looping structures, one dimensional Arrays, programs to solve linear and quadratic equations. 3 hours

Algorithms: modeling and simulation in physics: Errors in numerical calculations. 1 hours
Roots of an equation: Newton-Raphson method and Bisection method. Application using Bisection method for LCR transient circuit (to determine R for given values of L and C for a pre-specified rate of dissipation of energy), program in C.  

3 hours

Numerical Integration: Simpson’s 1/3 rule, Simpson’s 3/8 rule, Applications - calculation of time period of a simple pendulum, rms current of ac, work done by variable force.  

2 hours

Numerical Differentiation: Newton – Forward and Backward formulae. Application: Problem on heat current: \( H = -\kappa A \frac{dT}{dx} \)  

2 hours

Ordinary Differential equation: Euler’s method, Runge – Kutta II and IV order methods. Applications: Freely falling body in a resistive medium with resistance proportional to velocity, Projectile motion, LCR transient circuit, solution to Schrödinger wave equation for Harmonic potential (plotting wave function only).  

4 hours

References

2. Weather, climate and atmosphere by Siddartha.
4. Introduction to Atmospheric Science by Turberick and Lutzens, Elsevier Publications
5. Computational Physics, An Introduction by R C Verma, Ahluwalia, Sharma
6. A first Course in Computational Physics by Paul L. DeVries, Javier E. Hasbun
7. Numerical Methods for Engineers by Steven C. Chapra, Raymond P Canale
PHY-604: Practical Physics VI (B)

1. Low pass filter using Op-amp
2. High pass filter using Op-amp
3. Band pass filter using Op-amp
5. Op-amp-summer, integrator, differentiator.
6. Phase shift oscillator using op – amp
7. Wien-bridge Oscillator using op – amp
9. Temperature of atmospheric air - by using Thermograph (Bimetallic type)- Plotting the graph of temperature Vs time.
10. Relative humidity using hair hygrometer
11. Estimation of relative humidity using wet and dry bulb thermometer
12. Wind speed and direction by Hand held anemometer and wind wane
13. Estimation of height from the given pressure data

Execution of computer programs using C for the following problems.

14. (a) Determination of R in LCR transient circuit using Bisection method
    (b) Freely falling body in a resistive medium using Euler method / Runge – Kutta method
15. (a) Cooling of a body due to radiation – Stefan – Boltzmann Law using Euler method
    (b) rms current of ac using Simpson’s rule
16. (a) Problem on heat flow using Newton Forward formula
    (b) Projectile motion with resistance using Euler method/Runge – Kutta method
17. (a) Work done by a variable force using Simpson’s rule
    (b) LCR transient circuit – analysis – using Euler method
18. Schrödinger wave equation – Harmonic potential – Wave function plot only

Note: A Minimum of EIGHT experiments must be performed

References

1. IGNOU : Practical Physics Manual
2. Saraf : Experiment in Physics
3. S.P. Singh : Advanced Practical Physics
4. Melissons : Experiments in Modern Physics
6. Gupta and Kumar, Practical physics, Pragati prakashan, 1976
7. Ramalingom & Raghupalan : A Lab. Course in Electronics
8. Bharagav et al : Electronics, TTI
10. A first Course in Computational Physics by Paul L. DeVries, Javier E. Hasbun
11. Numerical Methods for Engineers by Steven C. Chapra, Raymond P Canale