BANGALORE UNIVERSITY B.Sc.(CBCS) PHYSICS

Approved Syllabus effective from Academic year 2016-17
# BANGALORE UNIVERSITY

## Scheme of Instruction & Examination for B.Sc. PHYSICS, CBCS

<table>
<thead>
<tr>
<th>Serial Number</th>
<th>Paper Number</th>
<th>Teaching hours per week</th>
<th>Examination duration</th>
<th>Maximum marks</th>
<th>Maximum total marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>PHY T101</td>
<td>4</td>
<td>3 hours</td>
<td>70</td>
<td>150</td>
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</tr>
<tr>
<td>02</td>
<td>PHY P102</td>
<td>3</td>
<td>3 hours</td>
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<td>3</td>
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**Grand total**: 1200

**Grand total (T)**: 16

**Grand total (P)**: 8

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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
- The prefix T indicates Theory paper and P indicates Practical

**Note-II:**
The marks distribution for the final practical examination is as follows:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Writing Principle / Statement / Formula with explanation of symbols and units</td>
<td>05</td>
</tr>
<tr>
<td>2</td>
<td>Diagram / Circuit Diagram / Expected Graph</td>
<td>05</td>
</tr>
<tr>
<td>3</td>
<td>Setting up of the experiment + Tabular Columns + taking readings</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>Calculations (explicitly shown) + Graph</td>
<td>07</td>
</tr>
<tr>
<td>5</td>
<td>Accuracy of results with units</td>
<td>03</td>
</tr>
<tr>
<td>6</td>
<td>Class Records (to be valued at the time of practical examination)</td>
<td>05</td>
</tr>
<tr>
<td></td>
<td><strong>Total for Practical Examination</strong></td>
<td><strong>35</strong></td>
</tr>
</tbody>
</table>

Note: Wherever explicit setting up of experiments does not exist like in the case of spectral charts or pre-acquired data is involved (astrophysics or atmospheric experiments), the marks for setting up of experiment may be provided for additional graphs and formulae.

**Note-III:**

- A minimum of **EIGHT** (8) experiments must be performed in each practical paper
- Experiments marked “Mandatory” should be performed necessarily
UNIT – I

- **MOTION**: Newton's Laws of Motion (Statement and illustration), Motion in a resistive medium; Drag force & Drag Coefficient, Drag force with \( v \) dependence (only vertical) and \( v^2 \) dependence (only vertical) – derivation for velocity and position graphs with and without resistance, concept of terminal velocity

4 hours

- **FRICTION**: Static and Dynamic Friction – Friction as a self adjusting force, Coefficient of Static and dynamic friction; Expression for acceleration of a body moving along an inclined plane with and without friction, Free Body Diagrams for the following cases (i) Two masses connected by a string hanging over a frictionless pulley (ii) Two masses in contact and masses connected by strings (horizontal only) (iii) Two masses connected by a string passing over a frictionless pulley fixed at the edge of a horizontal table.

4 hours

- **PLANETARY & SATELLITE MOTION**: Motion along a curve - radial and transverse components of acceleration (derivation); Newton's law of gravitation (vector form only), Kepler's laws (statements only); Gravitational Field and Potential – relation between them; Field and Potential due to a solid sphere (derivation); Orbital and Escape Velocity (derivation), Satellite in circular orbit and applications; Geostationary and Geosynchronous orbits.

5 hours

UNIT – II

- **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 mechanical energy

4 hours

- **SYSTEM OF PARTICLES**: Centre of mass of rigid bodies – General expression; 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; Single stage Rocket
motion – Velocity & Acceleration with and without gravity; Elastic and inelastic collisions (only 2D)

4 hours

- **BLACK BODY RADIATION**: Black body radiation and its spectral energy distribution; Kirchhoff’s law, Stefan-Boltzmann's law, Wien’s displacement law, Rayleigh-Jeans law (Statements), Derivation of Planck’s law – deduction of Wien’s Law & Rayleigh – Jeans Law, Solar constant and its determination using Angstrom’s Pyrheliometer; Estimation of the surface temperature of the sun

5 hours

**UNIT – III**

- **KINETIC THEORY OF GASES**: Basic assumptions of kinetic theory; Derivation of - deduction of perfect gas equation; Maxwell’s law of distribution of velocity (*without derivation*)- deduction of most probable velocity, mean velocity and root mean square velocity; Derivation of expression for mean free path \( \lambda = \frac{3}{4\pi\sigma^2n} \); *Maxwell’s distribution law*: \( \lambda = \frac{1}{\sqrt{2\pi\sigma^2n}} \); Degrees of freedom and principle of equipartition of energy; Derivation of, Specific heats of an ideal gas, atomicity of gases

6 hours

- **TRANSPORT PHENOMENA**:
  Viscosity and thermal conduction in gases (*with derivation*); Relation between coefficient of viscosity and coefficient of thermal conductivity of a gas

2 hours

- **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

5 hours

**UNIT – IV**

- **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 - PV indicator diagrams

- **First Law of Thermodynamics**
  
  The first law of Thermodynamics; Sign convention for heat and work; Derivation of equation of state $PV^\gamma = const$; Work done in an isothermal and adiabatic 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 Engine; Carnot Cycle and its efficiency (with derivation); Second law of thermodynamics (Kelvin’s & Clausius’ statements and their equivalence); Practical internal combustion engines - Otto and Diesel Cycles (qualitative treatment); Carnot theorem (proof); 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

References:


**PHYSICS – P102, PRACTICAL PHYSICS – I**

1. Error Analysis – Data analysis techniques and graphing techniques to be learnt (*Mandatory*)
2. Atwood machine – with photogate
3. Determination of coefficients of static, kinetic and rolling frictions
4. Verification of principle of conservation of energy
5. Simple pendulum - dependence of \( T \) on amplitude
6. Determination of coefficient of viscosity by Stokes’ method
7. Determination the Acceleration due to Gravity and Velocity for a freely falling body, using Digital Timing Techniques.
8. Work done by variable force
9. Interfacial tension by drop weight method
10. Thermal behavior of a torch filament
11. Specific heat by Newton's law of cooling
12. Verification of Newton's law of cooling and Stefan's law of radiation
13. Determination of Stefan's constant by emissivity method
14. Determination of Solar constant
15. Calibration of Thermistor for Temperature measurement
16. Calibration of thermocouple for Temperature measurement

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

**References:**

1. B Saraf etc, - Physics through experiments, Vikas Publications (2013)


Syllabus for II Sem BSc (Physics) Paper II-Phy-T201:

MECHANICS – 2, HEAT AND THERMODYNAMICS – 2

UNIT – I

- **OSCILLATIONS**: SHM; Differential equation of SHM and its solutions, Kinetic and Potential energy, Simple and compound pendulum; oscillations of two masses connected by a spring; damped oscillations – over damped, under damped and undamped oscillations; forced oscillations - concept of resonance; Coupled Oscillators - in phase and out of phase oscillations - energy transfer.  
  **6 hours**

- **ELASTICITY**: Hooke’s law, Stress – Strain diagram, definitions of three elastic moduli; Relationship between three elastic constants (derivation); Poisson’s ratio; Work done in stretching a wire; Bending of beams; Bending moment, Theory of single cantilever, Couple per unit twist, Torsional oscillations.  
  **7 hours**

UNIT – II

- **Thermodynamic potentials**: Internal Energy; Enthalpy; Helmholtz free energy; Gibbs free energy and their significance; Maxwell’s thermodynamic relations (using Thermodynamic potentials) and their significance; TdS relations; Energy equations and Heat Capacity equations; Third law of thermodynamics (Nernst Heat theorem)  
  **4 hours**

- **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  
  **3 hours**

- **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  

4 hours

- **Liquefaction of gases**: Regenerative cooling coupled with Joule Thomson cooling; Adiabatic expansion with Joule Thomson cooling (qualitative)

2 hours

UNIT – III

- **FRAMES OF REFERENCE**: Inertial and Non inertial frames of reference - Importance of Inertial frame, Linearly accelerated frames, Concept of frame dependent forces; Galilean relativity - Transformation of Position, Distance/Length, Velocity (Non-relativistic velocity addition theorem), Acceleration; Principle of Invariance, Michelson – Morley Experiment, Search for ether

5 hours

- **SPECIAL THEORY OF RELATIVITY**: Postulates of the special theory of relativity; Lorentz Transformations – Length Contraction, Time Dilation – twin paradox, Velocity Addition Theorem; Variation of mass with velocity; Mass – Energy equivalence; Relativistic momentum and kinetic energy

8 hours

UNIT – IV

- **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.

9 hours

- **WAVES**: Wave Equation, Speed of transverse waves on a uniform string; Speed of longitudinal waves in a fluid; Group velocity and Phase velocity – relation between
them; 4 hours

References:

1. References:


24. Physics of Waves, University Leadership Project, Prasaranga, Bangalore University
25. Perspectives of Modern Physics, Arthur Beiser, Mc- Graw Hill;
27. Special Relativity, A P French, MIT, w.w.Nortan and CompanyFirst Ed (1968)
1. Torsional pendulum – to determine C and Rigidity modulus
2. Bar pendulum – determination of g
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. Rigid pendulum – T and decay of amplitude
5. Coupled oscillator – string coupled with change of tension
6. Rolling dumb bell - on parallel inclined rails
7. Verification of parallel and perpendicular axis theorem
8. Searle’s double bar
9. Cantilever of negligible mass to find Young's modulus
10. q- by Stretching
11. q by uniform bending
12. q by single cantilever
13. q by Koenig's method
14. n by dynamic method
15. Fly wheel
16. Verification of Clausius-Clapeyron equation using pressure cooker

17. Thermal conductivity of a bad conductor by Lee’s and Charlton’s method
18. Thermal conductivity of rubber

19. Determination of thermal conductivity of a good conductor by Angstrom method / Searle's method

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

References:
1. B Saraf etc, - Physics through experiments, Vikas Publications
2. D P Khandelwal – A Laboratory Manual of Physics for Undergraduate Classes, Vani Publications
5. BSC, Practical Physics, C L Arora, S Chand & Co, New Delhi, 2007 Revised Edition

Syllabus for III Sem BSc (Physics) Paper III-Phy-T301:

ELECTRICITY and MAGNETISM

UNIT – I


8 hours

Transient currents : Self inductance – definition, explanation, expression $L = \frac{\mu N^2 A}{l}$, Magnetic field energy stored in an inductor; Growth and decay of charge in series RC circuit, Growth and decay of current in series LR circuit, Decay of charge in series LCR circuit - Damped, under-damped and over-damped conditions

5 hours

UNIT – II

Magnetic Field and Forces : Force on a moving charge in a magnetic field, Lorentz force and definition of $B$, force on a current carrying conductor in uniform magnetic field, Force between parallel conductors; Definition of ampere;

Biot – Savart’s law, Magnetic field due to a straight current carrying conductor (Derivation for Finite/Infinite Length, Amperes swimming rule, Right hand palm rule), Magnetic field of a circular loop; Force and torque on a circular current loop in a magnetic field, magnetic dipole moment, Field on the axis of a solenoid (derivation and explanation), Principle and theory of a moving coil BG, Concept of dead beat galvanometer, determination of high resistance by leakage, theory of HTG, Ampere’s Circuital law (statement), Application of Ampere’s law to straight wire, solenoid and toroid

13 hours

UNIT III

Scalar and vector fields : Gradient of a scalar function (use of del operator), Divergence and Curl product rules (explanation with geometrical representation), Line, surface and volume integrals
(explanation with examples), Fundamental theorem for divergence and curl (statements only).

**3 hours**

**ELECTROMAGNETIC WAVES**: Equation of Continuity, Displacement Current, Maxwell’s equations in differential form (Derivation and physical significance), Derivation of wave equation (for one dimension), Velocity of em waves in free space and isotropic dielectric medium (derivation), Relation between refractive index and permittivity (qualitatively), Transverse nature of Plane em waves, Poynting Vector, Energy density in electromagnetic field, Momentum and Pressure of em waves (derivation), Electromagnetic waves in a conducting medium – skin effect and skin depth

**10 hours**

**UNIT IV**

**ALTERNATING CURRENT**: rms and average value of ac – definition and expressions, Representation of sinusoids by complex numbers (brief explanation), response of LR, CR and LCR series circuit to sinusoidal voltage – j operator method, series and parallel resonant (LR parallel C) circuits (mention condition for resonance with expressions for impedance and current), expression for Q factor, band width, AC bridge - Maxwell bridge (derivation of condition for balance, determination of self-inductance of a coil).

**6 hours**

**THERMOELECTRICITY**: Seebeck effect (brief explanation, experiment and temperature dependence), Thermoelectric series, Neutral temperature, Laws of thermoelectricity (qualitative), Peltier effect, Peltier coefficient (qualitative analysis), Thomson effect, Thomson coefficient (qualitative analysis), Theory of thermoelectric circuits using thermodynamics (Application of thermodynamics to a thermocouple and connected relations with derivation), Thermoelectric diagrams and uses (in finding the Seebeck Coefficients, Peltier coefficient, Thomson coefficient, total emf of a thermocouple, neutral temperature) Applications of thermoelectricity - Boys’ Radiomicrometer, thermopile and thermoelectric pyrometer (brief explanation with experimental setup).

**7 hours**

**References:**


4. Electricity & Magnetism, NSKhare & SSSrivastava, AtmaRam & Sons, New Delhi


10. Electromagnetism by BB Laud 2ed

11. Electrical Networks, Theraja 3rd revised edition

**PHYSICS – P302, PRACTICAL PHYSICS – III**

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. Verification of Law of intermediate metals

9. Study of thermo emf as a heat pump

10. Load regulation of constant current source
11. Black box - identify & measure R, L and C

12. Verification of Thevenin's theorem

13. Verification of Superposition theorem

14. Verification of maximum power transfer theorem

15. Maxwell’s impedance bridge

16. Desauty's bridge

17. Anderson’s bridge

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

References:

1. Physics through experiments, BSaraf etc, Vikas Publications 1987

2. Advanced practical physics, Chauhan & Singh, Pragathi Publications 1ed

3. Practical Physics, DChattopadhyaya et al, Central Publications


5. Practical Physics, D C Tayal 2002

Syllabus for IV Sem BSc (Physics) Paper IV - PhyT401:

OPTICS and FOURIER SERIES

UNIT I

WAVE OPTICS: Huygen's wave theory of light; Huygen's principle, construction Huygen's wave front, Laws of reflection and refraction using spherical wave for at a plane surface (derivation of image distance = object distance using Huygen's construction, derivation of Snells law).

3 hours

INTERFERENCE:
Coherent sources and their production; Conditions for observing interference (mention); Conditions for
constructive and destructive interference (mention)

Coherent sources by division of wave front
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

Coherent sources by division of amplitude:
Interference at thin films - reflected and transmitted light, Colours of thin films; Theory of air wedge; Theory of Newton's rings (Only reflected System). Determination of Refractive index of a liquid

Unit - II
Diffraction - Fresnel diffraction
Concept of Fresnel's half period zones; Theory of rectilinear propagation; Fresnel diffraction, Construction and working of Zone plate; Comparison of Zone plate with lens; Cylindrical Wavefront (Half period strips – qualitative), Theory of diffraction at a straightedge

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

UNIT III
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; Theory of superposition of two plane polarized waves with perpendicular vibrations, Production and detection of linearly, elliptically and circularly polarized light; Optical activity - Fresnel's explanation, Laurent's half shade polarimeter.
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; Spatial Coherence and directionality, estimates of beam intensity, temporal coherence and spectral energy density

UNIT IV


(i) \( f(x) = e^{x}i \) if \(-\pi < x < \pi\)
(ii) \( f(x) = \begin{cases} -1 & -\pi \leq x \leq 0 \\ 10 & 0 \leq x \leq \pi \end{cases} \)
(iii) \( f(x) = x^{2} \in \text{ interval } [-1, +1] \)

Expansion of functions with arbitrary period.

(Concept of change of scale; Fourier Series for Periodic Rectangular Wave; Half - Wave rectifier; Trapezoidal wave:

\[
 f(x) = \begin{cases} 
 x, & 0 \leq x \leq 1 \\
 1, & 1 \leq x \leq 2 \\
 3-x, & 2 \leq x \leq 3 
\end{cases}
\]

)Application to Square wave, triangular Wave and Saw Tooth Wave (superposition of first three components to be shown graphically).

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 multi-mode step index fibers.

References:


5. Jenkins and White, Optics, McGraw Hill Education India Pvt Ltd 4\textsuperscript{th} ed (2011)


13. Physics of Waves, University Leadership Project, Prasaranga, Bangalore University (1ed 1981)


15. Mathematical Physics, B D Gupta, Vikas Publishing House, 4\textsuperscript{th} ed (2016)
1. Verification of Brewster’s law

2. Refractive index of a liquid by parallax method

3. Focal length of combination of lenses separated by a distance

4. Biprism – determination of wavelength of light

5. Air wedge – determination of thickness of object

6. Newton’s rings – determination of radius of curvature of lens surface


8. Diffraction grating in minimum deviation position

9. Diffraction grating in normal incidence position

10. Resolving power of telescope

11. Resolving power of a grating

12. Diffraction at straight edge

13. Polarimeter – determination of specific rotation of a solution

14. Diffraction of LASER at a wire

15. Measurement of numerical aperture of an optical fibre.

16. Fraunhoffer diffraction of LASER at single slit

17. 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, R S Sirohi 2nd ed

3. Advanced Practical Physics, Worsnop & Flint Asia Pub. (1979)

4. BSc, Practical Physics, C L Arora, S Chand & Company, New Delhi, Revised Edition, 2007
UNIT I : STATISTICAL PHYSICS  (15 HOURS)

Specification of state of the system, Macro state, Micro State, Phase Space, Stirling’s Approximation, Thermodynamic Probability and its calculation (Description of each with an example); Entropy and Thermodynamic probability \( S = k \ln \Omega \). Basic postulates of Statistical Physics ; Ensemble (Micro – canonical, canonical and grand canonical ensembles)

Maxwell – Boltzmann Statistics : Maxwell – Boltzmann Distribution function (Derivation of \( n_i = \frac{g_i}{e^{\alpha + \beta E_i}} \) Energy distribution function \( f(E_i) = \frac{n_i}{g_i} \); Maxwell – Boltzmann law of velocity distribution (mention- most probable velocity, average velocity, rms velocity) Limitations of M – B statistics

3 hours

Bose – Einstein Statistics : B-E distribution function (Derivation of \( n_i = \frac{g_i}{e^{\alpha + \beta E_i} - 1} \) Bose-Einstein condensation properties of liquid He (qualitative) [Mention of expression of Bose Temperature \( T_B \)- Concept BE Condensation –variation of \( N_0 \) (number of particles in Zero energy state) and \( N_e \) (number of particles in non-Zero energy state) with temperature- BE condensation properties of Liquid He\(^4\) (Qualitative description) ]

Radiation as photon gas, Bose’s derivation of Planck’s law, Rayleigh-Jeans law, Wein’s law ; Specific Heat capacity of metals [Einstein’s theory of specific heat capacity of solids – [Derivation of the equation where \( \theta = h\nu/k \)]

5 hours

Fermi – Dirac Statistics :

Fermi-Dirac distribution function; Fermi sphere and Fermi energy, Fermi gas; Electronic Specific heat Capacity in metals (Mention of the contribution to specific heat capacity from free electrons)

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

5 hours

UNIT II : QUANTUM MECHANICS – I
Failure of Classical Physics to explain the phenomena such as stability of atom, atomic spectra, black body radiation, photoelectric effect, Compton effect and specific heat of solids, Planck’s quantum theory, Explanation of the above effects on the basis of quantum mechanics

[Experimental observation, failure of classical theory, quantum mechanical explanation, Photoelectric effect - Einstein’s explanation, Compton Effect – mention of expression for wavelength shift (no derivation), Specific heat of solids - Einstein’s and Debye’s explanation of specific heat (qualitative). Stability of atom and atomic spectra, Black body radiation [Mention of Planck’s equation, arrive at Wien’s and Rayleigh-Jean’s equation for energy distribution from Planck’s equation].

5 hours
d de Broglie’s hypothesis of matter waves (λ in terms of momentum, energy, temperature for monoatomic gas molecules); Thomson’s experiment; Davisson and Germer’s experiment – normal incidence method; Concept of wave packet, Group velocity and particle velocity (relation between group velocity and particle velocity) Heisenberg’s uncertainty principle - different forms; Gamma ray microscope experiment; Application to Non – existence of electron in nucleus

10 hours

UNIT III : ATMOSPHERIC PHYSICS

Fixed gases and variable gases; Temperature structure of the atmosphere; Hydrostatic balance, Variation of pressure with altitude, scale height; Relative and Absolute humidity

4 hours

Beer’s law (derivation); Global energy balance for earth – atmosphere system, Greenhouse effect; Atmosphere dynamics – Accelerated rotational frames of reference – Centripetal and Coriolis force (derivation), Gravity and pressure gradient forces (with derivation), Applications of Coriolis force – Formation of trade winds, cyclones, erosion of river banks

6 hours

NANOMATERIALS

Nanomaterials – Introduction, classification – (0D, 1D, 2D). Quantum dots, nanowires and nanofilms, Multilayered materials- Fullerene, Carbon Nano Tube (CNT), Graphene (Mention of structures and properties); Synthesis techniques (Top down- Explanation of Milling & bottom up - Sol gel process). Characterisation techniques- (brief description of SEM, TEM, AFM).

Electron confinement (0D, 1D, 2D- energy levels as a particle in a box); Size effect-Surface to volume ratio; distinction between nanomaterials and bulk materials in terms of energy band. Distinct properties of nano materials (Mention- optical, electrical, mechanical and magnetic properties);
Mention of applications: (Fuel cells, catalysis, phosphors for HD TV, next generation computer chips, elimination of pollutants, sensors)  

5 hours

References:

9. Basic of Atmospheric Physics, A Chandrasekar, PHI Learning Private Limited (EEE)
10. Weather, climate and atmosphere by Siddartha.
12. Introduction to Atmospheric Science by Turberick &Lutzens,Elsevier Publications

PHYSICS – P502, PRACTICAL PHYSICS – V(A)

1. Applications of CRO in the (a) study of Lissajous figures (b) calculation of rms voltage (c) calculation of frequency of AC. (Mandatory)
2. Monte Carlo experiment & error analysis
3. Verification of Maxwell’s distribution of velocity
4. Maxwellian distribution of velocities for electron using EZ81 vacuum diode
5. Dice experiment – to study statistical nature of results
6. Study of statistical distribution on nuclear disintegration data (using GM counter as a black box)
7. Characteristics of a photo cell-determination of stopping potential.
8. Determination of Planck's constant.
9. Characteristics and spectral response (selenium photocell)
11. Temperature of atmospheric air - by using Thermograph (Bimetallic type) - Plotting the graph of temperature Vs time.
12. Relative humidity using hair hygrometer
13. Estimation of relative humidity using wet and dry bulb thermometer
14. Wind speed and direction by Hand held anemometer and wind wane
15. Estimation of height from the given pressure data
16. Regulated power supply (using zener diode).
17. Determination of transistor h-parameters.
19. Transistor as a switch and active device.
20. Construction of RFO or AFO - using transistor
21. 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
UNIT-I : ASTROPHYSICS (15 hours)

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


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,Schwarzchildradius(qualitative)

5 Hours

Unit-2: Solid State Physics (15 hours)

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

6 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); Applications - SQUIDs.

3 hours

Unit-3: Semiconductor Physics

Distinction between metals, semiconductors and insulators based on band theory. Intrinsic semiconductors - concept of holes – effective mass - expression for carrier concentration(derivation for both holes and electrons) and electrical conductivity – extrinsic semiconductors – mention of expressions for carrier concentrations and conductivity – impurity states in energy band diagram and the Fermi level.

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), DC Biasing , Load line analysis (Operating Point, Fixed Bias – Forward bias of Base – Emitter, collector – emitter loop, transistor saturation, Load line analysis ; Voltage divider bias – Transistor saturation, Load line analysis)

Transistor as an amplifier(CE mode); . H-parameters

5 hours
References:


PHYSICS – 504, PRACTICAL PHYSICS – V(B)

1. Parallax Method – Distance of objects using trigonometric parallax.
4. Ramalingom & Raghupalan : A Lab. Course in Electronics
6. Analysis of stellar spectra.
7. Determination of temperature of a star (artificial) using filters.
8. Analysis of sunspot photographs & solar rotation period.
11. Resistivity of a material by four probe method.
12. Determination of Lorentz Number
13. Semiconductor temperature sensor.
14. Temperature coefficient of resistance and energy gap of thermistor.
15. LED characteristics and spectral response.
21. Analysis of X-ray diffraction pattern obtained by powder method to determine properties of crystals.
22. Determination of Fermi energy of a metal.
23. Determination of thermal conductivity of a metal by Forbe’s method.

Note: A minimum of EIGHT experiments must be performed.

References:

1. IGNOU : Practical Physics Manual IGNOU publications
2. Saraf : Experiment in Physics Vikas publicatios
3. S.P. Singh : Advanced Practical Physics
7. Ramalingom & Raghuopalan : A Lab. Course in Electronics
Syllabus for VI Sem. B.Sc. (Physics) Paper VII – Phy T601:

ATOMIC, MOLECULAR AND NUCLEAR PHYSICS

UNIT I: ATOMIC AND MOLECULAR PHYSICS (15 HOURS)

Vector Model of the Atom

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 II: RADIOACTIVE DECAY, DETECTORS AND ACCELERATORS (15 HOURS)

Alpha particle scattering: Rutherford’s theory of alpha scattering (assuming the path to be hyperbolic) 2 hours

Radioactive Decay: Laws of radioactive decay, half – life, mean life, decay constant; theory of successive disintegration (expression for number of atoms of nth element in the chain – Bateman equations); radioactive equilibrium (secular and transient - cases of long lived parent, short lived parent, daughter and parent of nearly equal half – life). 3 hours

Alpha decay: Range and energy, Geiger- Nuttal law, Characteristics of alpha spectrum, Gamow’s theory of alpha decay [Barrier height, tunneling effect, λ= Pf f is the frequency of collision of nucleon with the potential barrier; P is the probability of transmission through the barrier]; Barrier
penetrability factor \( p(e^{-\sqrt{\frac{2\mu}{\hbar^2}}\int_0^r r'(\sqrt{V'(r)-E})dr} \) (no derivation)]

Derivation of Q-value-of alpha decay; Exact energy of alpha particle emitted

3 hours

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

2 hours

**Detectors**: Variation of ionization current with applied voltage in a gas counter, Proportional counter, GM Counter (Construction, working, characteristics, efficiency and quenching)

3 hours

**Particle accelerators**: Linear accelerator, Cyclotron, Betatron

2 hours

UNIT III: NUCLEAR REACTIONS AND PARTICLE PHYSICS

**NUCLEAR REACTIONS**: Types of reactions, Conservation laws in nuclear reactions with examples, derivation of Q – value for reactions using the energy – momentum conservation, exoergic and endoergic reactions, threshold energy, reaction rate, reaction cross – section, concept of direct and compound reactions, resonance reaction; Power reactors

8 hours

**ELEMENTARY PARTICLES**: Classification of elementary particles, Fundamental interactions (Gravitational, Electromagnetic, Weak, strong – range, relative strength, particle interactions for each);

Symmetries and Conservation Laws (momentum, energy, charge, parity, lepton number, baryon number, isospin, strangeness and charm); Concept of Quark Model, Color quantum number and gluons;

7 hours

**Reference Books**:
2. Introduction to Atomic Physics – H.E. White
15. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOP-

PHYSICS – 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. Determination of half-life of K40.
6. Millikan’s Oil drop experiment
7. Analysis of band spectrum of PN molecule.
8. Analysis of rotational spectrum of nitrogen.
9. Analysis of rotational vibrational spectrum of a diatomic molecule (HBr).
10. Absorption spectrum of KMnO4.
11. B – H Curve using Oscilloscope
12. Verification of Curie – Weiss Law
13. To verify and design AND, OR, NOT and XOR gates using NAND gates
14. To convert a Boolean Expression into Logic Gate Circuit and assemble it using logic gate ICs.
15. Digital Half-adder & Full-adder circuits using logic gate ICs.
16. Half Subtractor & Full Subtractor, using logic gate ICs

Note: A minimum of EIGHT experiments must be performed.

References:
1. IGNOU: Practical Physics Manual
2. Saraf: Experiment in Physics Vikas Publications
3. S.P. Singh: Advanced Practical Physics
4. Melissons: Experiments in Modern Physics
6. Gupta and Kumar, Practical physics, Pragati prakashan, 1976

Syllabus for VI Sem. B.Sc. (Physics) Paper VIII – Phy T603:

ELECTRONICS, MAGNETIC MATERIALS, DIELECTRICS AND QUANTUM MECHANICS – II

UNIT I: OPAMPS

Operational amplifiers

Block Diagram of an OPAMP, Characteristics of an Ideal and Practical Operational Amplifier (IC 741),
Open loop configuration - Limitations, Gain Bandwidth Product, Frequency Response, CMRR, Slew Rate and concept of Virtual Ground

Feedback concepts, Advantages of feedback, types of feedback, Expression for Gain; OPAMP as a feedback amplifier – Non – Inverting and Inverting amplifier, Modification of input and output impedances with feedback; Voltage follower; Differential amplifier with feedback;

2 hours

Linear Applications - frequency response of Low pass, high pass and band pass filters (first order),

inverting summing amplifier, ideal Differentiator, Integrator;

2 hours
OPAMP Oscillators

Positive Feedback concept - oscillator operation – Barkhausen Criterion; Types of oscillator circuits (Qualitative); Phase shift oscillator and Wien bridge oscillator (using op amp).

DIGITAL ELECTRONICS

Number Systems: binary, octal, hexadecimal (interconversions); Number codes: BCD, Gray Code (conversions to other systems); Signed Numbers; Arithmetic using Radix and Radix -1 complement.

Logic gates and truth tables: OR gate, AND gate; Inverter (the NOT function); NAND and NOR; exclusive OR; exclusive NOR.

Boolean laws and theorems – simplification of SOP equations; Realization of AND, OR, NOT using universal gates NAND and NOR;

Combination logic: Adders (full and half adder) and Subtractors (half)

UNIT II – Magnetic Properties of Matter and Dielectrics

Magnetic Properties of Matter

Review of basic formulae: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility, magnetization (M), Classification of Dia –, Para –, and ferro – magnetic materials;


2 hours

2 hours

2 hours

1 hour

2 hours

2 hours

3 hours

5 hours
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.

7 hours

UNIT-III : 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

5. Introduction to solid State Physics, **Charles Kittel**, VII edition, (1996.)


1. Low pass filter using Op-amp
2. High pass filter using Op-amp
3. Band pass filter using Op-amp
4. Op-amp inverting and non-inverting amplifier – ac or dc
5. OPamp as a differential amplifier – COMMON MODE AND DIFFERENTIAL MODE
6. Op-amp-summing amplifier – ac and dc,
7. OPamp as integrator and differentiator.
8. Phase shift oscillator using op-amp
9. Wien-bridge Oscillator using op-amp
10. To design an Astable Multivibrator of given specifications using 555 Timer
11. Determination of dielectric constant.
12. Determination of dipole moment of organic liquid
13. Verification of inverse square law using GM counter (with a radioactive source).
14. Determination of mass absorption coefficient of gamma rays.

Note: A minimum of EIGHT experiments must be performed.

References:
1. IGNOU : Practical Physics Manual
2. Saraf : Experiment in Physics, Vikas Publications
3. S.P. Singh : Advanced Practical Physics
4. Melissons : Experiments in Modern Physics