SYLLABUS UNDER AUTONOMY

PHYSICS

SEMESTER I **COURSE : S.PHY.1.01**

MECHANICS AND SOUND **[45 LECTURES]**

Learning Objectives :

To understand properties of matter :
(1) Dynamics of rigid bodies
(2) Motion in fluids
(3) Propagation of Sound

Unit I: [15 Lectures]

1. Newton's laws of motion, Inertial and non-inertial frames, limitations of Newtonian mechanics.
References : (1) Physics by Resnick and Halliday 1966 : 5-1to 5-6, 5-10. 6-5
(2) Concepts of Physics-I : H.C. Verma ch.5 worked examples 1-11.

2. Work done by variable force, conservative and non-conservative forces, Potential energy, work-K.E. theorem.
References : (1) Concepts of Physics-I : H.C. Verma: 8.1-8.11
(2) Physics by Resnick and Halliday 1966 : Ch. 7

3. Mechanics of single particle: falling body with air resistance, projectile with air resistance. Composition of 2 SHM's in mutually perpendicular directions.
Reference : Concepts of Physics-I : H.C. Verma 12.11

Unit II: [15 Lectures]

1. Fluid mechanics, continuity equation, Bernouilli's principle, Poiseuille's equation.
Reference : Concepts of Physics-I H. C. Verma 13.7 to 13.12

2. Elasticity, Bending moments, Cantilever, Poisson's ratio, couple per unit twist in a wire, relations connecting elastic constants.
References : Elements of properties of matter, D.S. Mathur: 8.8 to 8.18, 8.22, 8.24, 8.29, 8.30

3. Centre of mass and moment of inertia for some regular solids (wire bent into an arc, hemisphere, cone). Compound pendulum, centre of percussion, (derivation of periodic time).
Reference : Elements of properties of matter, D.S. Mathur 3.6

Unit III: [15 Lectures]

1. Wave motion in one dimension .General solution of wave equation(no derivation) , Classification of waves, Examples of one dimensional waves : Transverse wave in a string , Longitudinal waves on rod , Pressure waves in a gas (concepts only).
   Reference : Fundamentals of vibration and waves – S.P. Puri (TMH) 6.1, 6.2, 6.5, 6.5.1,6.5.2 , 6.5.3

2. Ultrasonics : Piezoelectric effect, Production of Ultrasonic waves : Piezoelectric Crystal method , Magnetostriction method . Detection , Properties and applications of Ultrasonic waves .

3. Acoustics of Buildings : Reverberation , Sabine's formula (without derivation) Absorption coefficient , Acoustics of Buildings , factors affecting Acoustics of Buildings , Sound distribution in an auditorium .

References :

Properties of matter and Acoustics – R.Murugation and K. Shivprasath ,S.Chand & Co. Ltd.

Additional References : (1) University Physics –Young and Freedman .
(2) Physics for Scientist and Engineers – R.A. Serway .
(3) Mechanics by Hans & Puri-2nd edition.

C.I.A. Problem Solving

SEMESTER I COURSE : S.PHY.1.02

ELECTRICITY AND ATOMIC PHYSICS [45 LECTURES]

Learning Objectives :

(1) To study the working of D.C. and A.C. circuits with applications
(2) To review atomic structure and atomic spectra
(3) To understand the generation of X-Rays and Scattering

Unit –I : *D.C.Circuits* [15Lectures]

1. Network Theorems : Superposition Theorem, Thevenin's Theorem, Norton's Theorem and Maximum Power Transfer Theorem(single power supply).

C.R.:7.7 TO 7.11

2. Transient Response : LR, CR and LCR circuits

C.R.: 14.1 TO 14.3

3. Electromagnetic Measuring Instruments : Moving Coil Galvanometer and Ballistic Galvanometer.

C.R.: 12.1, 12.2, 12.4, 12.5

Unit II - *A.C.Circuits* [15 Lectures]

1. Alternating Current Theory : Phasor Diagrams (j operator method) of LR, CR and LCR series and parallel circuits ,series and parallel resonance
   Application: Working of Fan & Choke.

C.R.: 15.1 TO 15.10.

2. A.C. Bridge Circuits : General A.C. Bridge Circuit, Maxwell, deSauty and Wien Bridge circuits

C.R.: 15.14

Unit- III -*Atomic Physics* [15 Lectures]

1. Bohr atom model:-Atomic structure, electron orbits, energy structure, atomic excitation , absorption and emission spectra, correspondence Principle, effect of nuclear motion.

   A.B.: 4.1 to 4.8

2. X-rays: production, continuous & characteristic spectra, Diffraction, Bragg's law

   A.B. : 2.4 to 2.6

3. Compton effect , Pair production , Gravitational red shift .

   A.B.: 2.7 to 2.9

References :

(1) Electricity and Magnetism: By Chattopadhyay and Rakshit(C.R.)
(2) Waves and Oscillations by A.P. French (for AC theory)
(3) Concepts of Modern Physics –A. Beiser (6^{th} Ed) Tata McGraw Hill . (A.B.)
(4) Atomic and Nuclear Physics – Gupta and Ghosh

C.I.A. Problem Solving

SEMESTER II COURSE : S.PHY.2.01

HEAT AND OPTICS **[45 LECTURES]**

Learning Objectives :

- To study the fundamentals of Heat and Thermodynamics
- Elements of the Kinetic Theory of Gases
- Geometrical and Physical Optics

Unit I: Heat and Thermodynamics [15 lectures]

1. Reversible and irreversible processes. The notions of thermal equilibrium and variables of state. Extensive thermodynamic quantities. The microcanonical ensemble and the conservation of energy. The first law of thermodynamics. The equivalence of heat and energy (Joule's constant and units of heat and energy).

2. Why heat is not a variable of state. The notion of entropy. Entropy change in reversible and irreversible processes. The canonical ensemble. Temperature and its units (use the equivalence of heat and energy).

3. The second law of thermodynamics and Carnot's theorem and application (Refrigerator)

4. The grand canonical ensemble. Chemical potentials as thermodynamic intensive quantities in these ensembles.

5. Thermodynamic potentials: enthalpy, Helmholtz and Gibbs free energies

6. Phase changes in water: first order transitions at normal pressure. Triple points. High pressure phases of ice and new triple points.

Unit II: Kinetic theory of matter [15 lectures]

1. The properties of gases as dominated by the classical motion of molecules: basic qualitative notions of pressure and heat as arising out of the motion of molecules. Avogadro's number and the phase spaces for molecular motion: impossibility of tracking every variable. Entropy as counting of microstates, Maxwell's demon. Information and entropy
2. Ideal gases and their equation of state: internal energy, specific heats, entropy, compressibility and expansion coefficients.
3. Maxwell's distribution and its experimental verification. The notion of a mean free path. Transport: viscosity, diffusion. Brownian motion, determination of Avogadro's number. Examples of Brownian motion from different contexts.

4. Real gases and their equations of state. Free expansion and the Joule-Thompson effect. Gas-liquid phase transitions and Andrew's experiments. The law of corresponding states and critical exponents. The virial expansion. The van der Waals equation of state and its virial
coefficients.

UNIT III: Optics **[15 lectures]**

1. Geometrical optics: reflections in mirrors and refraction through lenses. Lens combinations(in contact ,out of contact.)
2. Lens aberrations. Monochromatic aberrations: spherical aberrations and distortions, comma ,astigmatism describe failure of model of parallel rays and simple shapes of surfaces (use ray tracing to discuss how geometric optics can be extended to deal with these). Chromatic aberrations show the way to new features:
3. Wavefronts (use phasors to give a definition) and the Huygens' construction: how it gives rise to geometric optics and its extension to monochromatic aberrations.
4. Exploring wave optics using the known phenomena in wave motion: interference. Exploring phenomena such as interference of light in thin films, fringes in wedge shaped films, Newton ’s rings, etc.]

References

- F. A. Jenkins and H. E. White, Fundamentals of Optics
- Brij lal , Subramanium ,Avadhanlu , Text book of Physics
- F. W. Sears and G. L. Salinger, Thermodynamics, Kinetic Theory and Statistical Thermodynamics
- F. Reif, Statistical Physics: Berkeley Physics Course, Vol. 5
- R. P. Feynman, R. B. Leighton and M. Sands, Lectures of Physics Vol 1

SEMESTER II COURSE : S.PHY.2.02

ELECTRONICS AND NUCLEAR PHYSICS **[45 LECTURES]**

Learning Objectives :

- Electrostatics and motion of charges
- Semiconductors and non-linear circuits
- Nuclear structure

Unit I: Elecrostatics and the motion of charges **[15 lectures]**

1. Charge and charge conservation. Coulomb's law, electric field. Emphasize linearity between charge and force. Charge conservation as a statement of Gauss theorem in a conservative field. Measurement of charge. Electrostatic energy
2. Steady flow of charge gives current (vector). Variation of current can give rise to magnetic field (use a demonstration to show the existence of a magnetic field when current changes).
3. Fields due to charges: dipoles, quadrupoles and their fields. Emphasize linearity and its use in superposing field amplitudes
4. Conductors and electric fields near a conductor. An isolated conductor and a capacitor. Method of images to solve problems involving charges and conducting boundaries.
5. Motion of charges in electric and magnetic fields: pure electric fields, pure magnetic fields, crossed electric and magnetic fields (use vector methods to simplify the problem). Mass spectrograph /spectrometer

Unit II: Semiconductors, analog and digital electronics **[15 lectures]**

1. Differences between conduction in metal wires and semiconductors. Thermal characteristics. The importance of doping: p and n type semiconductors. Hall effect.
2. Introduction to non-linear circuit elements. The importance of I-V characteristics in defining the action of a device (non-Ohmic behaviour). A diode and its I-V characteristics. Half wave, full wave and bridge rectifier: efficiencies, ripple factor, load regulation.
3. . Filters: capacitor filter, inductor filter (choke), π filter. Voltage stabilization:-Zener diode as a voltage stabilizer, Regulated power supply.
4. Transistors: Definition of α and β (Both ac and dc), input impedance, output impedance. CE,CB,CC Mode and their comparison. The transistor as an amplifier. The transistor as a switch.
5. Boolean algebra and the basic operations: unary operation of NOT, binary operations of AND, OR and XOR. Combination into NAND, NOR and XNOR. Can you build all operators out of a smaller number of them? Building operators using transistors. The mathematical foundations of digital electronics. Number systems: decimal, binary, octal and hexadecimal systems. Conversions between them. Arithmetic in different number systems. Binary arithmetic can be implemented through switches.
6. Setting up an equivalence between arithmetic in the binary number system and Boolean algebra

Unit III: Nuclear physics **[15 lectures]**

1. Discovery of the nucleus, nuclear transmutations. Radioactivity. Discovery of the proton and the neutron and the basic structure of nuclei. Nuclear stability and instability. Half-life, decay constants, radioactive series. Radiometric dating .]

2. Binding energy of nuclei and Wigner's semi-empirical mass formula. Transuranics and islands of stability.
3. Electron scattering from nuclei and the measurement of nuclear sizes. Definition of a cross section. Mathematical treatment, use of uncertainty relations. Nuclear energy levels, and the analogy with atomic energy levels.

4. Thermo-nuclear reactions in stars: hydrogen burning and helium burning. The nuclear route to a supernova. Neutron stars.

References

- D. J. Griffiths, Introduction to Electrodynamics
- E. M. Purcell, Electricity and Magnetism: Berkeley Physics Course Vol 2
- R. P. Feynman, R. B. Leighton and M. Sands, Lectures of Physics Vol 2
- M. A. Preston and R. K. Bhaduri, Structure of the Nucleus
- A.P. Malvino, Electronic Principles
- R.P. Jain , Modern Digital Electronics

C.I.A. Problem Solving

PRACTICALS

Regular Experiments

SEMESTER I COURSE : S.PHY.PR.1

PRACTICAL 1
Mechanics , Sound , Heat, Light

1. Flywheel
2. Torsional Oscillations
3. Bifilar Pendulum
4. Viscosity by Poiselle's method
5. Bar Pendulum
6. Y by Vibration

PRACTICAL 2
Electricity , Atomic Physics, Electronics, Nuclear Physics

1. Thevenin's theorem
2. Maximum Power transfer theorem
3. Superposition theorem
4. LR circuit
5. CR circuit
6. LCR series resonance
7. Frequency of AC mains

SEMESTER II COURSE : S.PHY.PR.2

PRACTICAL 1
Mechanics ,Sound ,Heat, Light

1. Spectrometer (determination of angle of prism)
2. Spectrometer (determination of refractive index of material of prism)
3. Combination of lenses
4. Newtons rings
5. Wedge Shaped Film
6. Viscosity by Stokes method

PRACTICAL 2
Electricity , Atomic Physics,Electronics,Nuclear Physics

1. LDR Characteristics
2. Bridge Rectifier (to study load regulation)
3. Zener as a regulator

4. Transistor (CE) Characteristics
5. Verification of NAND , NOR , EXOR gates and DeMorgans theorem

DEMONSTRATION EXPERIMENTS

COURSE : S.PHY.PR.1

PRACTICAL 1 AND 2. SEMESTER –I

1. Angular momentum conservation (Rotating platform)
2. Charging and discharging of a capacitor
3. Use of PC for graphs, demonstration experiments

COURSE : S.PHY.PR.2

PRACTICAL 1. AND 2. SEMESTER II

1. Single slit Fraunhoffer diffraction
2. Brewsters law
3. Laser beam divergence, intensity
4. Use of Oscilloscope

SKILL EXPERIMENTS

COURSE : S.PHY.PR.1
PRACTICAL 1. AND 2. SEMESTER-I

1. Use of Vernier Callipers , Micrometer Screw Gauge and Travelling Microscope
2. Graph plotting
   (Exponential , Straight line with intercept , Resonance curve etc.)

COURSE : S.PHY.PR.2
PRACTICAL 1. AND 2. SEMESTER II

1. Spectrometer : Schuster's Method
2. Use of DMM

REFERENCES:

1. Advanced Practical Physics – Worsnop & Flint
2. Advanced course in Practical Physics D. Chattopadhya , P.C. Rakshit & B. Saha
3. B. Sc. Practical Physics –C. L. Arora

--------X--------

Note: Minimum eight experiments from each paper, four demos and all the skills have to be performed and written in the journal to appear for the practical examination