Sr. Secondary Course (Syllabus)

Physics

RATIONAL

Physical is a fundamental science because it deals with such basic feature of the world as time, space, motion matte, electricity, light and radiations. Every event that occurs in the natural world has some feature that can be viewed in these terms. Study of Physics need not necessarily be taken as means of becoming a physicist; it is a means of rationally understanding nature. Physics lies behind all technological advancement such as computer, internet, lunching of rockets and satellites, radios and TV communications, lasers, etc. It also finds applications in such simple activities of men as lifting a heavy weight or making a long jump. Physics is thus an all-pervading science and its study helps us in finding answers to questions like why and how?

In order to bring out various aspects of Physics as a fundamental science the content of the present syllabus has been so chosen as to relate with the study of natural physical phenomenon. The underlying physical laws and principles of such phenomena and their effects on daily life have been reflected in the syllabus. Themes like motion, properties of matter, energies like heat, light and electricity and electronics with would be of interest to all and specially to those who are interested in pursuing Physics as a career have been selected to from our content. The syllabus also includes such emerging areas as electronics, nuclear physics, astrophysics, medical physics and photography, which find immense applications in daily life.

Though mathematics is basic to the understanding of most of the problems of physics, in the present course stress has been given to avoid rigour or mathematics like integration and differentiation. The focus has been to teach concepts of physics rather than mathematics calculation.

This course attempts.

(i) acquire knowledge and develop understanding of concepts, fundamental laws, principles and processes in the area of physics so that relationship between cause and effects of physical phenomenon can be understood;

(ii) appreciate the contributions of physics towards improving quality of lice;

(iii) promote interest in physics and foster a spirit of enquiry; and

(iv) improve competencies of individuals in work skills required in their procession.

As a part of this process, the course also aims at developing the following abilities in the learner:

- experimental skills (like taking observations, manipulation of equipment) and communicative skills such as reporting of observations and experimental result;
- problems solving ability e.g. analyzing a situation or data, establishing relationship between cause and effects:

- scientific temper of mind by making judgment on verified facts and not opinions, by showing willingness to accept new ideas and discoveries: and
- awareness of the dangers inherent in the possible misuse of scientific knowledge.

Structure of the Syllabus

The syllabus in physics includes two parts-core modules and optional modules. The core modules comprises of the essential concepts and phenomenon of physics, which a student at this level should know. It has eight core modules, which contain predominantly the subject matter of mechanics, electricity, light and other areas of physics representing the minimum knowledge required to progress into the more advanced areas and to develop appreciation for the fact that physics plays a significant role in most situations. The optional modules are on the specific fields and have four modules one each on Astrophysics, Electronics, Photography and Audio-Videography and Medical physics. In the optional modules there is a choice to opt any one of the given four modules.

(A) CORE MODULES

Modules	**Marks**	**Min. Study Time**
1. Motion, force and Energy	14	45
2. Properties of Matter	08	25
3. Heat and Thermodynamics	06	20
4. Electricity and Magnetism	14	45
5. Oscillations and Waves	06	20
6. Optics and Optical Instruments	08	25
7. Atoms and Nuclei	07	25
8. Semiconductors and their Applications	07	20
Total	**70**	**225 hours**

(B) OPTIONAL MODULES (One Module – 10 Marks Each and 30 hrs.)

Modules	**Marks**	**Min. Study Time**
1. Astrophysics	10	30
2. Electronics	10	30
3. Photography and Audio-Videography	10	30
4. Physics in Medical Sciences	10	30

The details of Curriculum is given below:

CORE MODULES

MODULE 1: MOTION, FORCE AND ENERGY

Unit 1: Dimensional Analysis and Vectors

(i) Units

(ii) Dimensions

(iii) Dimensional formula

(iv) Application of dimensional equations

(v) Vectors and their representation (graphically)

(vi) Resolution of vectors in to rectangular components (two dimensions)

(vii) Addition and subtraction of vectors

Unit 2: Motion in a Straight Line

(i) Distance and displacement,

(ii) Speed and Velocity with special reference to average and relative velocity

(iii) Instantaneous velocity

(iv) Uniform motion with examples.

(v) Non-uniform motion (constant acceleration) with examples.

(vi) Graphical representation of motion in two dimensions (including that of constant acceleration)

(vii) Equations of Motion with numerical problems.

Unit 3: Newton's Laws of Motion

(i) Concept of force and inertia

(ii) First law of motion with examples

(iii) Second law of motion with concept of momentum and force.

(iv) Third law of motion with examples.

(v) Free body diagram.

(vi) Conservation of linear momentum

(vii) Friction and lubrication

Unit 4: Motion in a Plane

(i) Projectile motion (equation, time of fight, rang, and maximum height)

(ii) Uniform circular motion (radial and tangential acceleration)

(iii) Centripetal acceleration

(iv) Application of circular motion

(v) Uniformly rotating frame of reference and non-inertial force (centrifugal force)

(vi) Relation between velocity and angular velocity

Unit 5: Gravitational motion

(i) Newton's universal law of gravitation.

(ii) Inertial mass and gravitational mass.

(iii) Acceleration due to gravity and its variation.

(iv) Kepler's laws.

(v) Motion of planets, orbital and escape velocity.

(vi) Satellites – geostationary, weightlessness.

Unit 6: Work, Energy and Power

(i) Work done by a constant force.

(ii) Work done by a carrying force (graphical method) with example of spring.

(iii) Work-energy relation

(iv) Conservative and non-conservative force.

(v) Mechanical energy (kinetic and potential) with examples.

(vi) Conservation of energy, (spring, pendulum, etc.)

(vii) Elastic and inelastic collision

(viii) Power and its units.

Unit 7: Rotational Motion

(i) Rigid body motion, center of mass, couple and Torque.

(ii) Moment of inertia, radius of gyration and its significance.

(iii) Theorems of Motion for a uniformly rotating rigid body (no derivation)

(iv) Angular momentum and its conservation with simple application.

(v) Rotational and translational motions with example (motion of ball, cylinder, flywheel on an inclined plane.

MODULE 2: MECHANICAL PROPERTIES OF MATTER

Unit 1: Properties of solids

(i) Elastic properties and hook's law.

(ii) Young's modules, Bulk modulus, modulus of rigidity and compressibility.

(iii) Applications of elasticity-cantilever, girder etc.

Unit 2: Properties of Liquids

(i) Hydrostatic pressure and buoyancy.

(ii) Pascal's law and its application

(iii) Forces of Cohesion and adhesion

(iv) Surface energy and surface Tension.

(v) Angle of contact and capillary action.

(vi) Application of surface tension, liquid drops, bubbles and detergents

(vii) Types of liquid flow-laminar and turbulent, Reynolds number,

(viii) Viscosity and Stoke's law.

(ix) Bernoulli's Theorem (no derivation) and its applications.

Unit 3: Properties of Gases

(i) Kinetic theory of gases (with derivation of ideal gas equation state)

(ii) K. E. and temperature relationship

(iii) Specific heat of gases, equilibrium of heat.

(iv) Specific heats C_p and C_v and their relationship.

MODULE 3: HEAT AND THERMODYNAMICS

Unit 1: Laws of thermodynamics

(i) Thermodynamic variables, concept of hear, and thermodynamic equilibrium.

(ii) Temperature and its measurement.

(iii) Principle of Calorimetery.

(iv) Thermodynamic processes – isothermal, adiabatic, reversible, irreversible and cyclic process

(v) First law of thermodynamics – internal energy

(vi) Second change, phase diagram, latent heat, triple point, and concept of entropy and its significance.

(vii) Carnot's Cycle and its Efficiency.

Unit 2: Transfer of Heat

Conduction of Heat

Convection of Heat

Radiation of Heat

Black Body Radiation

Wien's Law

Stefan's Law

Green House Effect

(viii) Newton's Law of Cooling.

MODULE 4: ELECTRICITY AND MAGNETISM

Unit 1: Electrostatics

(i) Properties of electric charge-quantizations & conservation.

(ii) Coulomb's law (vector form)

(iii) Electric field and field or point charge (through diagram)

(iv) Force in and charged particle in electric field.

(v) Electric field of a dipole and dipole moment

(vi) Behavior of electric dipole in uniform electric field.

(vii) Electric Potential due to appoint charge, due to a dipole and potential energy.

(viii) Relation between electric field and potential

(ix) Statement and use of Gauss theorem Determining electric field of a point charge, ling wire, plane sheet, solid sphere, spherical shell.

(x) Conductors, and field inside conductor, electrostatic shielding.

(xi) Capacitors and their combinations

(xii) Dielectric and their polarization

(xiii) Electric field in dielectric, capacitor with dielectric.

Unit 2: Electric Current

(i) Electric current in a conductor

(ii) Ohm's law, Resistivity of material and Colour coding of resistors.

(iii) Combination of resistances (series and parallel)

(iv) Kirchoff's laws and their application to electrical circuits

(v) Wheatstone bridge principle

(vi) Potentiometer and its application

Unit 3: Chemical and Thermal Effects of Electric Current

(i) Heating effect of electric current, joules law of heating

(ii) Electrolysis – Faraday's laws of electrolysis and their application

(iii) Thermoelectricity (Seabeck, peltier and Thomson effect (only qualitative)

Unit 4: Magnetic Effect of Electric Current

(i) Magnetic effect of electric current

(ii) Bio-Savart law – Magnetic field at the center of a coil carrying current (qualitative treatment)

(iii) Amprere's circuital law and its application in finding magnetic field of a wire loop (at a center), toroid and solenoid.

(iv) Force on a current carrying wire in a uniform magnetic field and definition of ampere.

(v) Force on a charged particle in a magnetic field and Lorentz force.

(vi) Magnetic dipole moment of a current loop

(vii) Torque on a current loop in magnetic field.

(viii) Moving coil Galvanometer and its conversion into ammeter and voltmeter.

Unit 5: Magnetism

(i) Magnet and magnetic field

(ii) Components of Earth's magnetic field

(iii) Molecular theory of magnetism (qualitatively)

(iv) Dia, para and Ferro magnetic materials

Unit 6: Electromagnetic Induction and Alternating Current

(i) Faraday's law of electro-magnetic induction

(ii) Lenz's law

(iii) Self and mutual induction

(iv) Growth and decay of current in L. R and CR circuits (qualitative)

(v) Alternating current and voltage, illustrating with phase diagram – Peak and RMS values.

(vi) Circuits containing only R. L or C separately, their phase relationship between I &V

(vii) Power in AC circuit – Power factor and watts current (pure inductor and Pure capacitor)

(viii) LCR series combination (using phaser diagram only) and resonance

Unit 7: Electric Power Generation and its Transmission

(i) Generators – AC and DC

(ii) Transformers

(iii) Transmission of power (domestic and industrial distribution)

(iv) Various energy sources, electrical power generation – hydro-electricity, chemical energy, molecular energy, wind energy and solar energy.

(v) Status of Electric power in India.

(vi) Problem of low voltage and load shedding.

MODULE 5: OSCILLATIONS AND WAVES

Unit 1: Simple Harmonic Motion

(i) Periodic motion – amplitude, period frequency and phase

(ii) Simple Harmonic Motion as a projection of uniform circular motion with examples of spring and simple pendulum.

(iii) Forced oscillations – resonance with examples.

(iv) Damped oscillations with example (without mathematics)

Unit 2: Elastic Waves

(i) Moving pulse, harmonic waves, wavelength, frequency, speed and their relationship, amplitude of wave

(ii) Wave motion in taut string, formula for its speed.

(iii) Wave motion in gaseous medium and formula for its speed.

(iv) Phase difference between two harmonic waves.

(v) Superposition of waves – interference of waves, reflection of waves from rigid boundary, standing waves and beast (only qualitative treatment, with equation)

(vi) Characteristics of sound waves.

(vii) Threshold of hearing, intensity of sound and its unit.

(viii) Shock waves, noise pollution.

(ix) Resonance column (overtones and harmonics) only through diagram

(x) Doppler's effect and its application.

MODULE 6: OPTICS AND OPTICAL INSTRUMENTS

Unit 1: Reflection and Refraction of Light

(i) Reflection of light from spherical mirrors, sign convention.

(ii) Mirror formulae and problems based on it

(iii) Reflection of light, Snell's law of refraction

(iv) Total Internal Reflection and its application.

(v) Refraction through single curved surface and lenses.

(vi) Lens maker's formula and magnification

(vii) Power of lens.

(viii) Combination of lenses.

Unit 2: Dispersion and Scattering of Light

(i) Dispersion of light through prism

(ii) Spectrometer and its uses

(iii) Spherical and chromatic aberration.

(iv) Scattering of light in atmosphere

(v) Rainbow

Unit 3: Electromagnetic waves

(i) Maxwell's theory of em-waves.

(ii) Properties of em-waves

(iii) Em-waves spectra

(iv) Em-waves propagation and their application

Unit 4: Wave Properties of Light

(i) Nature of light

(ii) Light as wave

(iii) Huygen's wave theory and wave propagation – reflection and refraction

(iv) Interference – Young's double slit experiment

(v) Diffraction of light (qualitative)

(vi) Polarization, polarization by reflection and its application in daily life

Unit 5: Optical instruments

(i) Compound microscope and its magnifying power

(ii) Telescope – astronomical (Newton's reflector) and terrestrial

(iii) Resolving power in terms of Rayleigh's criteria

(iv) Resolving power of eye, telescope and microscope

MODULE 7: ATOMS AN NUCLEI

Unit 1: Structure of Atom

(i) Alpha –particle scattering and Rutherford's atomic model

(ii) Bohr's atomic model, energy levels in electron volts

(iii) Hydrogen Spectrum

Unit 2: Photoelectric Effect and Mater Waves

(i) Emission of electrons

(ii) Photoelectric effect and its explanation

(iii) Photocell and its applications

(iv) Wave nature of matter, de-Broglie Waves – Davission and Germer Experiment

Unit 3: Nuclei and Radio - Activities

(i) Atomic mass unit, mass number, size of nucleus

(ii) Isotopes and neutrons

(iii) Mass-energy equivalence (MeV)

(iv) Mass defect and binding – energy curve

(v) Radio activity - á, â decay and ã emission

(vi) Half life and decay constant of nuclei

(vii) Application of radioactivity in carbon dating, medical and agriculture.

Unit 4: Nuclear Fission and Fusion

(i) Fission reaction
(ii) Fusion reaction
(iii) Energy in stars
(iv) Nuclear reactor
(v) Peaceful and destructive application of Nuclear Energy.
(i) Nuclear Pollution

MODULE 8: SEMICONDUCTORS AND THEIR APPLICATIONS

Unit 1: Basics of Semiconductors

(i) Energy bands in solids
(ii) Conductors, insulators, and semiconductors (on the basis of electrical conductivity)
(iii) Charge carries in semiconductors-Holes and electrons
(iv) Electrical conductivity of semiconductors
(v) Intrinsic and extrinsic semiconductors
(vi) P-type and n-type semiconductors.

Unit 2: Semiconductor Devices

(i) Pn – junction diode
(ii) Characteristic of pn-j unction diode
(iii) Types of diode
(iv) Transistor – *pup* and *npn*
(v) Characteristic curves of transistor

Unit 3: Applications of semiconductor Device

(i) Pn-j unction diode as a rectifier
(ii) Transistor as an amplifier (common emitter)
(iii) Transistor as a switching device
(iv) Logic gates and their realization (OR, AND, NOT, NAND, NOR)

OPTIONAL MODULE 1: ASTRO PHYSICS.

Unit 1: The Sun and the Solar Family

(i) The Sun – introduction

(ii) Interesting phenomenon on solar atmosphere – corona.

(iii) Magnetic field in the solar system

(iv) Sunspot cycle, granulation on solar surface, solar flares, prominence

(v) Planets and their characteristics.

(vi) Comets, meteors, meteoroids and asteroids

(vii) Evaluation of solar system

Unit 2: Astronomical Telescopes

(i) Windows in electro – magnetic spectrum

(ii) Principle and use of refraction and reflecting telescope

(iii) Newtonian and Cassegrainian telescopes- their principles and uses

(iv) X-ray telescope and radio – telescope

(v) Spherical aberration

(vi) Rayleigh's criterion

Unit 3: Stars

(i) Measuring distances and masses of stars

(ii) Brightness of stars

(iii) Surface temperature of Stars

(iv) Stellar spectra, stellar classification

(v) H. R. diagram

(vi) Evaluation of stars – different theories

Unit 4: Universe

(i) Our galaxy

(ii) Interstellar gas clouds

(iii) Structure of the galaxy, central bulge, disc of the galaxy

(iv) Halo and corona

(v) External galaxies

(vi) The expanding universe

(vii) Origin of the universe, evolving universe, steady state universe, cosmic back – ground radiation, open or closed universe

MODULES 2: ELECTRONICS IN DAILY

LIFE Unit 1: Measuring Instruments in

Electronics

Unit 2: Power Supply and Signal Generating Systems

(i) Multimeter principle and its uses.

(ii) C R O and its uses for measurement of voltage, frequency and wave form.

(iii) Transducers and their application

(iv) Display Device –L E D, L E D and their uses

(i) Solar cells and their uses

(ii) Frequency generator, power supply inverters, emergency light

(iii) Zener diode as a voltage regulator

Unit 3: Microprocessor and its Applications

(i) Microprocessor – architecture and functional blocks

(ii) Instructions – data transfer, control and branch, and input – output

(iii) Uses of microprocessor in household devices

Unit 4: Circuit Breaker, Timer and Power Control

(i) Electronic circuit breaker

(ii) Timers, M C B power control.

(iii) Calculator and Electronic watches –principle and operations

OPTIONAL MODULES 3: PHOTOGRAPHY AND VIDEO –AUDIOGRAPHY

Unit 1: PHOTOGRAPHY – CAMERA

(i) Camera – an introduction, part of a camera, camera eye (lens), shutters, special lens

(ii) Types of camera – their basic principle, constructions and working

(iii) Principle of video camera

(iv) Choosing a camera, picture size.

(v) Choice of lens – angle of view and resolving power, aperture and focusing.

Unit 2: Film Exposing and Processing

(i) Films (storture), types of films

(ii) Film exposure, aperture and speed relationship, use of exposure meter

(iii) Developing the exposed film, developers, ingredients and their functions, preparation of developers, types of developers B & W whored.

Preservation of developers, methods, field of developments, tray method tank method, precautions during film development

(v) Film fixing, fixing, washing and drying of film.

Unit 3: Audio – Video Recording

(i) Basic principle of recording (Inter-conversion)

(ii) Methods of conversion of video signal into electrical signals.

(iii) Methods of conversion of audio signal into electrical signals

(iv) Storage of audio – video signals on tapes

(v) Quality of recording, sound recording on cine films

Unit 2: Power Supply and Signal Generating Systems

(vi) Tape characteristics, structure and composition, tape format, tape speeds, important tape parameters

(vii) Preservation of tapes, storage techniques, precaution

(viii) Over recording, need for over recording various methods of over – recording, protection of over–recording.

Unit 4: Compact Disc For Audio – Video Recording

(i) Compact disc – limitation of traditional audio recording system, lamination video recording system.

(ii) Need for compact disc, advantages of compact disc.

(iii) C D for audio recording.

(iv) Basic principle of audio recording.

(v) Construction of CD for audio.

(vi) Methods of CD – audio –recording.

(vii) Care and cautions.

(viii) CD for video –recording, construction of CD for video.

(ix) Basic principle for video recording.

(x) Methods of CD – video recording.

(xi) General operating and installation precautions.

(xii) CD – players, operating principle.

(xiii) Quality of reproduction.

PHYSICS CURRICULUM FOR PRACTICAL WORK

The knowledge of physical concepts and generalization that is gained mainly through theory gets crystallized with the help of practical work undertaken by a learner. It leads to better understanding through first hand experience and reinforcement. The practical work acts as an aid to instruction. It science and facilitate the development of the physco-motor skills.

The skills which this course on practicals aims to develop are:

(i) Observing skills, which include, proper use of measuring instruments and apparatus.

(ii) Manipulative skills, which include selection of appropriate equipment, setting it up, performing experiments with reasonable speed, accuracy and neatness.

(iii) Reporting skills which include presenting the observations sin an appropriate manner / sequence, calculating the result accurately and interpreting data and drawing conclusion.

The syllabus in practical physics has been developed in consonance with the theory part of the physics syllabus so that the learner can understand better the knowledge gained in

theory. In order to expose the learner to different areas of physics, the practicals are grouped into three sections A, B and C. A learner is required to perform 18 experiments in all, selecting six from each section given below:

LIST OF PRACTICALS

Group A – Perform Any Six

1. Determine the internal diameter and depth of a cylindrical container (like tin can, calorimeter) using a vernier calipers and find its capacity. Verify the result using a graduated cylinder.

2. Determine the diameter of a given wire using a screw gauge and its length with the help of meter scale. Determine mass of the wire using a physical balance and calculate the density of the material of the wire in kg. /$m^{3.}$

3. Determine the radius of curvature of a concave mirror using a spherometer. Verify the result by parallax method using one needle.

4. Find the time period of a simple pendulum for small amplitudes and draw the graph of length of the pendulum against square of the time period. Use the graph to find the length of the second's pendulum.

OR

Find the time period of a simple pendulum of different amplitudes up to about 60_o) and draw a graph between the time period and amplitude of the simple pendulum for a given length.

5. Find the weight of a given body using law of parallelogram of vectors and verify by spring balance.

6. Study the Newton's law of cooling by plotting a graph between cooling time and temperature different between calorimeter and surroundings.

7. Determine the specific heat of a solid using the methods of mixtures.

OR

Determine the specific heat of a solid using the method of mixture.

8. Find the spring constant of a helical spring by measuring its extension by a known load. Then to find acceleration due to gravity by measuring time period of vertical oscillations of a known loan.

9. Find the required to empty a burette, filled with water, to ½ of its volume, to ¼ of its volume, to 1/8 of its volume a so on. Plot a graph between volume of water in the burette and time and thus study at each stage, that the fractional rate of flow is the same (analogy to radio – active decay)

10. Determine the radius of gyration about the center of gravity of a meter scale used as bar pendulum by studying its oscillations about axes close to its C. G.

Group B: Perform Any Six

1. Determine – (i) in an air column the wavelength of sound produced, (ii) the velocity of sound in air at room temperature using a resonance column and tuning fork.
2. Compare the frequencies of two tuning forks by finding first and second resonance positions in a resonance tube.
3. Establish graphically the relation between the tension and length of a string of sonometer vibrating in its fundamental mode resonating with a given tuning fork. Use the graph to determine the mass per unit length of the string.
4. Find the volume of v for different volume of u in case of a concave mirror and find its focal length (f) by plotting graph between $(1/u)$ and $(1/v)$.
5. Find the focal length (f) of convex lens by plotting graph between $1/u$ and $1/v$.
6. Find the focal length of a convex mirror using a convex lens.
7. Determine the focal length of concave lens by combining it with a suitable convex lens.
8. Draw a graph between the angle of incidence (i) angle of deviation (D) for a glass prism. Determine the refractive index of the glass of the prism using this graph.
9. Compare the refractive indices of two transparent liquids using a concave mirror and a single pin.
10. Set up an astronomical telescope and find its magnifying power.

Group C – Perform Any Six

1. Verify law of combination (series and parallel) of resistances using ammeter – voltmeter method and coils of known resistances.
2. Compare the e. m. f's of two given primary cells using a potentiometer.
3. Determine the specific resistance of two material of the given wire using a meter bridge.
4. Determine the internal resistance of a cell using a potentiometer
5. Determine the inductance and resistance of a given coil using suitable series resistance and A. C. voltmeter.
6. Study decay of current in R. C. circuit using a galvanometer and find the time constant of the circuits.
7. Draw the characteristic curve in forward biased $p\,n$ junction diode and to determine the static and dynamic resistance of the given diode.
8. Study the characteristic of a, an $n\,p\,n$ transistor in common emitter mode and to find out the values of current and voltage gains.
9. Draw lines of force due to a bar magnet keeping

(i) North pole pointing north

(ii) North pole pointing south

Locate the neutral point.

10. Determine the internal resistance of a moving coil galvanometer by half deflection method. Convert the galvanometer into a voltmeter of suitable range and verify it.

SCHEME OF PRACTICAL EXAMINATION

Duration: 3 hours

There will be a practical examination of 20 marks apart from the theory examination.

The distribution of 20 marks is as follows:

Viva : 3 Marks

Record Book : 3 Marks

Two Experiments : 14 Marks (7 Marks each)

(Theory should not be from the same group)