CURRICULUM
SCIENCE AND TECHNOLOGY

1. RATIONALE

In the present age, the laws and principles of Science and Technology find their applications almost in every walk of life. In fact, Science & Technology has become an integral part of our social life and culture. The Scientific knowledge is a powerful tool for solving our problems and for increasing national productivity. At the same time, it also carries the danger of its misuse along with indiscriminate depletion of natural resources, environmental pollution and degradation. The proper and responsible use of science and technology is an urgent need to achieve the twin goals of development and achieving the improved quality of life for society. Thus, it becomes necessary for all to be aware of the basics of Science & technology and its ever increasing applications in the interest of the human welfare. The Indian contribution in the field of science and technology has been highlighted wherever possible.

2. OBJECTIVES

The basic objectives of the course on science at the secondary stage are to:

- enable the learner to explain the science behind natural phenomena;
- familiarize the learners with various facets of science and the role it plays in human welfare;
- develop scientific attitude so that reasoning wins over blind faith and opinions;
- enable the learner to formulate simple hypotheses, verify them and apply in his/her daily life activities;
- cultivate the interest of the learners in Science & Technology and encourage them to pursue it as a career.

3. DISTRIBUTION OF MARKS

	Marks
Theme 1: Measurement	
Module-1: Measurement in Science & Technology	4
Theme 2: Matter Around Us	
Module-2: Matter - Structure and Behaviour	12
Theme 3: Energy	
Module-3: Motion and Force	5
Module-4: Energy	14
Theme 4: The Universe	
Module-5: The Universe and our Earth	6
Theme 5: Natural Resources and Our Environment	
Module-6: Our Environment and Natural Resources	8
Module-7: Man Made Resources and Environmental Problems	5
Theme 6: The Living World	
Module-8: Life Processes	17
Module-9: Health, Hygiene and Diseases	4
Module-10: Agricultural Practices	4
Theme 7: Technological Developments	
Module-11:Technology and Communication	6
Total (Theory)	**85**
Practical	**15**
Grand Total	**100**

4. COURSE DESCRIPTION

The course has been divided into various themes on which different modules have been developed. A total of 11 modules have been created, the details of which is given below. The basic approach of developing the course content given in the various modules is such that besides explaining the fundamental principles and laws of science, their application for human welfare highlighting the Indian contribution to science and technology, has been integrated in the text wherever possible.

THEME : MEASUREMENT

MODULE 1: MEASUREMENT IN SCIENCE AND TECHNOLOGY

Marks: 04 ***Suggested study time: 06hr***

Approach

As measurement is one of the important activities of day to day life, the beginning of this module aims at highlighting the methods of measuring physical quantities and the need of accurate measurement in science and technology.

1.1 Measurement in Science and Technology

Historical background of measurement; Need of accurate measurement;
Units of measurement- basic SI units, derived units, multiples and submultiples;
Measurement of Length- meter scale, least count; Measurement of area (regular and irregular plane surfaces) and volume (both regular and irregular bodies);
Measurement of Mass- physical balance;
Measurement of Time: simple pendulum as a tool of measuring time, stop watch.

THEME: MATTER AROUND US

MODULE 2: MATTER - STRUCTURE AND BEHAVIOUR

Marks : 12 ***Suggested study time: 36hr***

Approach

The module is designed to bring out the structure of matter by way of describing an atom and how atoms combine to form different substances. It also highlights that the structure of matter is responsible for its properties.

2.1 Structure and Properties of Matter

States of matter – general idea about solid, liquid and gas (structure and properties-compressibility and fluidity);
Classification of matter based on composition - elements, compounds and mixtures;
Dalton's theory of atom; Atoms and molecules – atomic mass;
Chemical formulae of simple compounds – valency and formulation;
Chemical equations – writing and their balancing;
Concept of isotopes; average mass molecular masses;
Elementary idea of mole concept – molar mass (simple calculations);
Laws of chemical combination – law of conservation of mass, law of constant proportions, law of multiple proportions and law of reciprocal proportions;
Gay Lussac's law of combining volumes, Avogadro's hypothesis (with simple problems).

2.2 Atomic Structure

Failure of Dalton's theory; Discovery of electron and proton;
Models of atom – Thomson, Rutherford & its failure;
Structure of atom – fundamental particles, discovery of neutron; mass number;
Bohr's atomic model; Modern picture of structure of atom : electronic configuration of first 20 elements.

2.3 Periodic Classification of Elements

Historical perspective of periodic classification (Dobereiner's triads, Newlands law of octaves, Mendeleeve's periodic table);

Modern periodic law and long form of periodic table;

Periodic properties – elementary idea of atomic radii, ionic radii, ionization energy, electron affinity, electronegativity, valency and metallic and non-metallic characteristics;

2.4 Chemical Bonding

Octet rule, types of chemical bonds;

Ionic bond- ion formation, properties of ionic compounds;

Covalent bonds- formation of covalent bonds, properties of covalent compounds, shapes of molecules (CH_4, O_2, H_2O, CO_2, N_2),

Bond parameters like covalent radii bond length, bond energy, bond polarity – examples of polar and non polar molecules;

Metallic bond (electron -sea theory) and hydrogen bonding.

2.5 Chemical Arithmetic and Reactions

Chemical reactions - types of chemical reactions (combination, decomposition, displacement, oxidation and reduction);

Nature of reaction (slow and fast, reversible and irreversible, endothermic and exothermic);

Chemical calculations and stoichiometry;

Acids, bases and salts; acid – base equilibrium in aquous system, pH scale, simple problems based on pH.

THEME: ENERGY

MODULE 3: MOTION AND FORCE

Marks : 05 ***Suggested study time: 15hr***

Approach

This module is designed with the view that since motion is all pervasive, its description and cause would help to understand different phenomenon and effects of everyday life. *The applications of the laws of motion in daily life will be highlighted with common examples*.

3.1 Motion and Its Description

The concept of motion- definition and examples; Types of motion –translatory (rectilinear, circular), rotatory and oscillatory; Uniform and non-uniform motion (one dimension only);

Distance and displacement, speed, average speed, velocity, and acceleration;

Graphical representation of motion – distance- time and speed –time graphs;

Equations of motion and their derivation by graphical method;

Uniform circular motion (qualitative idea only).

3.2 Cause of Motion -Force

Force and motion; Newton's first law of motion and inertia;

Newton's second law of motion – force and acceleration; concept of momentum;

Newton's third law of motion – action and reaction;

Friction – factors affecting friction, sliding and rolling friction, examples of advantages and disadvantages of friction, control of friction (examples of reducing and increasing);

Force of gravitation- Gravitational law; Acceleration due to gravity, mass and weight;

Motion of an object under gravity in one dimension and free fall (weightlessness);

Thrust and pressure – Archimedes principle and its applications.

MODULE 4: ENERGY AROUND US

Marks : 14 ***Suggested study time: 36hr***

Approach

The module intends to highlight the various types of energy, their sources and applications in our daily life. The means and ways of meeting the challenge of energy crisis have also been described in this module.

4.1 Work and Energy

Work done by a constant force; Relationship between work and energy, unit of energy;
Various types of energy - mechanical, thermal, light, sound, electrical, chemical and nuclear;
Mechanical energy – kinetic and potential energy; Power and its unit
Transformation and conservation of energy with examples;
Sources of energy – renewable (solar, wind, water, geothermal, tidal oceanic & biomass) and non-renewable (fossil fuels);
Energy crisis - methods and ways of saving energy;
Potential of energy resources in India and their use (an overview).

4.2 Thermal Energy

Thermal energy and temperature, Measurement of temperature: thermometer, clinical thermometer, temperature scales;
Thermal expansion of solids, liquids and gases;
Change of state and latent heat, method of mixtures for estimation of specific heat;
Effect of impurities and pressure on the melting point and boiling point of substances, working of pressure cooker.

4.3 Light Energy

Reflection of light, image formation by a plane and a spherical mirror, mirror formula (no derivation)
Refraction of light, formation of image by a lens (qualitative only), lens formula (no derivation);
Magnification of image and power of lens;
Dispersion of light through glass prism and spectrum of white light;
Optical instruments like simple microscope, compound microscope and astronomical telescope.

4.4 Electrical Energy

Nature of charges and force between electrical charges - Coulomb's law;
Electrostatic potential and Electric current,
Ohm's law, resistance in series and parallel;
Heating effect of electric current, dependence of heat produced on current, resistance & time;
Commercial unit of electric energy and electric power;
Quantum of electric power generation and consumption in India.

4.5 Electrical Appliances

Magnetic effect of electric current-electric motor,
Electromagnetic induction (qualitative idea only) – AC generator;
How electricity reaches our homes and villages: techniques of wiring the circuits for domestic and industrial use;
Electrical appliances like electric iron, heater, lamp, electric bell, electric kettle and their working; Hazards of electricity and safety measures.

4.6 Chemical and Nuclear Energy

General idea of chemical and nuclear energy;
Fuels – fossil fuel, coal and petroleum, biomass, calorific value, Combustion- conditions necessary for combustion, fire extinguishers (soda acid); food as fuel; voltaic and dry cells;
Radioactivity, radioisotopes, energy from atomic fission and fusion. Uses of nuclear energy;

Nuclear reactor-thermonuclear power plant;
Generation of electricity from nuclear sources in India, India as a nuclear power;
Hazards of production of nuclear energy.

THEME: THE UNIVERSE
MODULE 5: THE UNIVERSE AND OUR EARTH
Marks: 06 ***Suggested study time: 15hr***
Approach
Besides describing the constituents of the universe, the module is designed to highlight the presence of the only living planet i.e. the earth in the vast universe. It also describes the conditions that helps existence of life on earth.
5.1 The Universe and Solar System
Constituents of the Universe – galactic system, stars and constellations;
The solar system – sun, planets, satellites, their characteristics and movements;
Other heavenly bodies – asteroids, meteoroids and comets;
Formation of day & night, solar & lunar eclipses and seasons.
5.2 The Earth – A Living Planet
Special place of earth in the universe; Conditions for life on planet;
Differentiation of earth - origin and evolution of life on earth;
Life-Supporting systems (biosphere) : Lithosphere, Atmosphere, Hydrosphere;
Sun as the source of energy- circulation and utilization of this solar energy by living beings; Our duties to protect the earth.

THEME: OUR ENVIRONMENT AND RESOURCES
MODULE 6: THE ENVIRONMENT AND NATURAL RESOURCES
Marks : 08 ***Suggested study time: 24hr***
Approach
This module emphasizes the basic understanding of the environment in which living organisms survive. It also points out that the quality of human life should be improved without disturbing the natural system. This module will highlight the importance of natural resources like air, water, soil, minerals, metals, petroleum products etc. also.
6.1 Our Environment
Components of the environment: abiotic (air, water, light and soil), and biotic (micro organisms, plants, animals including human beings);
Habitat: major habitats (terrestrial, aquatic and aerial); adaptations in plants and animals to these habitats;
Causes and consequences of alteration in habitats, need of conservation of habitats;
Biosphere- the life zone, concept of ecology;
Ecosystem: its organization and functioning;
Energy flow in ecosystem : food chain and food web, trophic levels;
Balance of atmosphere; biogeochemical cycles of carbon and nitrogen.
6.2 Air and Water
Air and its composition; Importance of oxygen in daily life-respiration, photosynthesis, burning, rusting, formation of oxides;
Pressure of atmosphere and its measurement, variation of air pressure with height,
Atmosphere –evaporation, relative humidity, cloud formation, rain.
Water and its sources -an introduction; utility of water as a resource for domestic, industrial, agricultural use and energy generation;

Simple methods for making water potable, conservation of water: judicious use, rain water harvesting;
Properties of water-polar nature, universal solvent and lather formation (hard and soft water);
Density of water and specific gravity;

6.3 Mineral Resources -Metals and Non-metals

Minerals and ores, metals and non-metals (in general); Mineral resources in India;
Extraction, purification and properties of metals – iron, aluminium and copper; corrosion of metals;
Alloys of iron, aluminum and copper and their uses in daily life;
Non metals- importance and general properties;
Preparation, properties and uses of hydrogen, silicon and phosphorus;
Sulphur - occurrence, properties, its common compounds, allotropes of P and S, use of sulphuric acid.

6.4 Carbon and its Compounds

Carbon - its properties (catenation and tetra valency);
Allotropes and their properties- diamond, graphite, fullerene (elementary idea only);
Hydrocarbons and their classification; homologous series;
Functional groups (elementary idea), nomenclature;
Compounds of common use like acetic acid, formalin, alcohol and acetone;

MODULE 7: MAN MADE RESOURCES AND ENVIRONMENTAL PROBLEMS

Marks : 05 ***Suggested study time: 15hr***

Approach

The module points out that the use of different types of human made material in our daily life is based on the structure and property of the material. This knowledge is the basis to show the application of different materials as human made resources. The harmful effects of their over exploitation and the need for their protection & conservation has also been emphasized in the module.

7.1 Materials in Our Daily Use

Distinction between natural and synthetic (man-made) materials;
Principle of preparation/manufacture (outline only), properties and uses of – washing soda, baking soda, bleaching powder and plaster of paris;
Manufacture and properties of materials like polymers, fibres – natural and synthetic, nylon, rubber, plastics;
Manufacture and properties of materials for housing like cement, glass;
Materials for household items like candles, inks; and soap and detergents; match boxes;
Materials used in medicine like anesthetics, antibiotics, analgesics and Antacids;
Harmful effects of man-made materials.

7.2 Environmental Problems

Environmental problems (both natural and human made) – their causes, global as well as local;
Natural hazards (particularly in Indian context): types of natural hazards like flood, cyclone-causes and consequences;
Earthquakes: causes and effects, measurement of intensity and coping with earthquake; Volcanoes : effects. Forest fire- its cause and effect;
Impact of human population on environment, forests and wild life;
Pollution and its types; sources, consequences; biomagnification;
Biodegradable and non-biodegradable materials;
Prevention and control of air, water, soil and noise pollution; ozone layer depletion;
Ecological balance.

THEME: LIVING WORLD

MODULE 8: LIFE PROCESSES

Marks : 17 ***Suggested study time: 60hr***

Approach

The module is designed to highlight the unity and the diversity in the living world. It also endeavors to acquaint the learner with various life processes occurring in plants and animals.

8.1 Diversity in the Living World

Concept of diversity; need for classification of living beings;
Binomial nomenclature – a general idea; five kingdom classification;
Classification of plants up to divisions, animalia up to phyla with vertebrates up to class (not more than five distinguishable basic characters and common familiar examples).

8.2 Building Blocks of Life - Cells, Tissues and Organs

Cell- the basic unit of structure and function of life;
Cell structure and functions; differences between animal and plant cells;
Cell division : mitosis (all the phases and significance), and meiosis(only significance with reference to sexual reproduction);
Different levels of organisation;
Tissues –different types in plants (protective and conducting) and animals (epithelial, connective, muscular and nervous);

8.3 Food and Nutrition

Modes of nutrition – autotrophic, heterotrophic, saprotrophic , and parasitic;
Nutrition in plants: photosynthesis, raw materials, simple description of the process (mention light and dark reactions without chemical details); factors affecting photosynthesis;
Materials synthesized by plants to be used as food;
Nutrition in animals: Human alimentary canal and associated glands, salivary, liver and pancreas: process of digestion- concept of enzymes, digestive process in mouth, stomach and small intestine;
Absorption and assimilation of digested food;
Concept of balanced diet; types of nutrients, their sources and functions in the body (Indian health situations); food adulteration and food adulterants;
Nutritional disorders (like marasmus, kwashiorkor, scurvy, rickets, beriberi, pellagra, xerophthalmia, anemia and goiter).

8.4 Transport of Materials in Plants and Animals

Transport in plants- diffusion, osmosis and active transport; xylem, phloem, ascent of sap and translocation of food;
Transport in animals- composition of blood, functions of blood;
Heart and it's working; blood vessels – arteries, veins, capillaries;
Blood groups (ABO and Rh) and transfusion;
Disorders of circulatory system –Leukaemia, haemophilia, hypertension, heart attack.

8.5 Respiratory Gaseous Exchange and Elimination of Body Wastes

Respiration in plants;
Respiration in human beings - organs involved in breathing;
Ventilation of lungs - inhaling, exhaling, breathing rate;
Gaseous exchange and cellular respiration;
Diseases of respiratory system –bronchitis and pneumonia;
A brief idea of excretion in plants;
Excretory organ – kidneys, its functions;
Osmoregulation and homeostasis;
Kidney failure, dialysis and kidney transplant (very elementary idea).

8.6 Control and Coordination- Nervous and Hormonal Systems

Nervous system –nerve cell, synapse, reflexes;
Structure and function of the brain and spinal cord;
Sense organs- skin, tongue, nose, eye and ear (their importance and function);
Eye- structure and working, vision, accommodation, defects of vision (Myopia, hypermetropia and astigmatism) and care of eye;
Hormone (endocrine) system – pituitary, thyroid and pancreas.

8.7 Reproduction and Population Control

Types of reproduction – asexual and sexual; Reproduction in plants-vegetative and sexual;
Human reproductive system – male and female; Production of gametes, ovulation. fertilization;
Puberty, menstrual cycle and pregnancy;
Growth of population and consequences of rapid increase of population (Indian context); Birth control and its need;
Reproductive health and sexually transmitted diseases - syphilis, gonorrhoea, AIDS.

8.8 From Parents to Children – Elements of Genetics

Chromosomes and genes, determination of sex; inheritance of blood groups (ABO, Rh), colour blindness, haemophilia and thalessaemia.

MODULE 9: HEALTH, HYGIENE AND DISEASES

Marks : 04 ***Suggested study time: 09hr***

Approach

The module is aimed to impart knowledge regarding health, hygiene and disease and to create consciousness towards proper nutrition and health care of an individual and the community.

9.1 Health, Hygiene and Diseases

Concept of a healthy body; personal and community health;
Factors affecting health: proper nutrition, healthy habits and physical exercise etc;
Concept of hygiene; hygienic environment – a social responsibility;
Environmental sanitation and cleanliness; first aid;
Disease and types of diseases : communicable and non-communicable;
Classification of various kinds of communicable diseases- viral, bacterial, fungal, protozoan, helminthic; Causes, modes of transmission, symptoms and preventive measures of some common diseases like influenza, jaundice, tuberculosis, cholera, amoebic dysentery, malaria, hepatitis B; control of epidemics.

MODULE 10 : ARGRICULTURAL PRACTICES AND ANIMAL HUSBANDRY

Marks : 04 ***Suggested study time: 09hr***

Approach

The module is designed to impart knowledge about various agricultural practices undertaken for improvement of crop production. It also brings out the need and importance of proper practice of storage and preservation of food grains .

10.1 Agricultural Practices and Animal Husbandry

Human dependence on plants and animals for food;
Preparing seed bed; sowing, care of seedling; transplanting;
Use of manures and fertilizers; use of plant growth regulators; irrigation;
Different agricultural practices: crop rotation, multiple cropping, harvesting;
Important varieties of fruits (mango) and seeds;
Protection of crops in fields and in storage;

Different methods of preservation of agricultural produce.
Elements of animal husbandry – domesticated animals;
Improved breeds - cattle and live stock (poultry and fish);
Management of livestock – breeding, feeding, shelter and care of animals,
Major diseases of domestic animals and their prevention (cattle and poultry).

THEME: TECHNOLOGICAL DEVELOPMENT
MODULE 11: TECHNOLOGY AND COMMUNICATION

Marks : 06 ***Suggested study time: 15hr***

Approach

Though, technological developments are taking place in every walk of our life, the space technology and communication technology have brought revolution in the field of space and communication respectively. The module points out the need for communication and how methods and media have developed for the purpose.

11.1 Space Exploration

Space Launching Vehicles – Elementary ideas;
Different types of artificial satellites and their applications in the field of communication, remote sensing and weather forecast etc;
Indian achievement in the field of space science.

11.2 Communication Technology

Communication - its need and importance; Process of communication;
Historical developments in the field of communication (in brief);
Nature and characteristics of waves,
Use of different types of waves for communication like sound waves and electromagnetic waves; Different types of communication systems - wireless system including radio and TV, Telecommunication, computer in communication and use of satellite in communication.

List of Experiments

Perform any fifteen experiments in all, out of which at least three experiments should be from each section.

(Section A)

1. To determine the area of a surface using a graph paper.
2. To measure potential difference across the terminals of two or more cells when they are connected in (i) series (ii) parallel.
3. To study the change in the size, nature and position of image with the change in the position of an object (candle placed) in front of a convex lens.
4. To determine the density of the material of a given solid using a spring balance and a measuring cylinder.
5. To find the average speed of an individual, as one walks or runs, to and fro between two points.
6. To measure temperature of hot water as it cools and to plot time temperature graph for it.
7. To study the change in current flowing through a resistance with potential difference across it.
8. To study the laws of reflection of light using a plane mirror strip.
9. To trace the path of a ray 8 light through a rectangular glass slab and find how does the angel of refraction.
10. To trace the path of ray of light through a glass prism and to measure the angle of deviation.

SECTION - B

11. Cutting and bending a glass tube and boring a cork.
12. To prepare an aqueous solution of common salt of a given composition.
13. Separation of mixtures:
    a) Separation common salt from water – by evaporation
    b) Separation of copper sulphate/solution – by crystallization
    c) Separation of mixture of Naphthalene and sand – by sublimation
14. To differentiate between a chemical and physical change in an on going process.
15. To test the presence of water vapours in air.
16. To test the presence of carbon dioxide (CO_2) in air.
17. To find out the approximate percentage of oxygen in air.
18. To test the acidic/basic nature of a solution with the help of pH paper.
19. To find the pH of fruit/vegetables juices with the help of pH paper.
20. To identify washing soda and baking soda out of the two given samples.

SECTION -C

21. To study the process of osmosis through a semi-permeable membrane.
22. To study that oxygen is liberated during the process of photosynthesis using an aquatic plant.
23. To study the role of plant tissues in conduction of water.
24. To test that green leaves produce starch when exposed to sunlight.
25. To observe organisms from given pictures or specimens or in the surroundings (eg. Crop field, a garden or a nearby pond), classify them as producers and consumers, consumers, construct their food chains and indicate their trophic levels.
26. To study the water holding capacity of different types of soil.
27. To test the presence of carbohydrates (starch and sugar) and fat in certain food samples.
28. To test the presence of adulterants in food items.
29. To compare the level of pollution in terms of particulate matter by comparing leaf samples collected from different areas.
30. To study the external structural adaptations in any two organisms cockroach, fish, frog, lizard and pigean.

Distribution of marks for Practical Examination

Time : 2Hrs. 30 Min.		**Max. Marks : 15**
1.	Two experiments (2×4=8) (Both the experiments should not be form same section)	8
2.	Record book	3
3.	Viva-voce	4
Total		**15**