# Compulsory Concepts (Second Year of Cycle Two)

## The Living World

### Ecology
- Study of populations (density, biological cycles)
- Dynamics of communities
  - Biodiversity
  - Disturbances
- Dynamics of ecosystems
  - Trophic relationships
  - Primary productivity
  - Material and energy flow
  - Chemical recycling
- Ecological footprint
- Ecotoxicology
  - Contaminants
  - Bioconcentration
  - Bioaccumulation
  - Toxicity level
- Genetics
  - Heredity
  - Gene
  - Allele
  - Character trait
  - Genotype
  - Phenotype
  - Homozygote
  - Heterozygote
  - Dominance
  - Recessivity
  - Protein synthesis
  - Cross-breeding

## The Material World

### Physical properties of solutions
- Concentration (ppm, mole/L)
- Electrolytes
- Strength of electrolytes
- pH scale
- Electrolytic dissociation
- Ions
- Electrical conductivity

### Chemical changes
- Combustion
- Oxidation
- Photosynthesis and respiration
- Acid-base neutralization reaction
- Salts
- Balancing chemical equations
- Law of conservation of mass
- Stoichiometry
- Types of bonds: Covalent and ionic
- Endothermic and exothermic reactions

### Organization of matter
- Rutherford-Bohr atomic model
- Lewis notation
- Simplified atomic model
- Neutron
- Nomenclature
- Polyatomic ions
- Concept of mole
- Avogadro's number

### Periodic Table
- Families and periods
- Relative atomic mass
- Atomic number
- Periodicity of properties
- Isotopes

### Nuclear Transformations
- Nuclear stability
- Radioactivity
- Fission and fusion

### Electricity and electromagnetism
***Electricity***
- Electrical charge
- Static electricity
- Ohm's law
- Electrical circuits
- Kirchoff's laws
- Relationship between power and electrical energy
- Electrical field
- Coulomb's law

***Electromagnetism***
- Forces of attraction and repulsion
- Magnetic field of a live wire
- Magnetic field of a solenoid

### Transformation of energy
- Law of conservation of energy
- Energy efficiency
- Distinction between heat and temperature
- Relationship between work, force and travel
- Relationship between mass and weight
- Effective force
- Relationship between potential energy, mass, acceleration, and travel
- Relationship between kinetic energy, mass and velocity
- Relationship between heat energy, specific heat capacity, mass, and temperature variations

## The Earth And Space

### Biogeochemical cycles
- Carbon cycle
- Nitrogen cycle
- Phosphorus cycle

### Climate zones
- Factors that influence the distribution of biomes
- Marine biomes
- Terrestrial biomes

### Lithosphere
- Minerals
- Permafrost
- Energy resources
- Soil profile (horizons)
- Soil depletion
- Buffering capacity of soil
- Contamination

### Hydrosphere
- Catchment area
- Oceanic circulation
- Glacier and ice floe
- Salinity
- Energy resources
- Contamination
- Eutrophication

### Atmosphere
- Green house effect
- Atmospheric circulation
  - Prevailing winds
- Air mass
- Cyclone and anticyclone
- Energy resources
- Contamination

### Space
- Solar energy flow
- Earth-Moon system (gravitational effect)

## The Technological World

### Graphical Language
- Axonometric projection: exploded view (reading)
- Multiview orthogonal projection (assembly drawing)
- Dimensional tolerances

### Mechanical engineering
- Characteristics of linking mechanical parts
- Adhesion and friction between parts
- Degrees of freedom of a part
- Guiding controls
- Construction and characteristics of motion transmission systems (friction gears, pulleys and belt, gear assembly, sprocket wheels and chain, wheel and worm gear)
- Speed changes
- Construction and characteristics of motion transformation systems (screw gear system, cams, eccentrics, connecting rods, cranks, slides, rotating slider crank mechanisms, rack-and-pinion drive)

### Electrical engineering
- Power supply
- Conduction, insulation, and protection (resistance and coding, printed circuit)
- Typical command functions (lever, pushbutton, toggle, unipolar, bipolar, unidirectional, bidirectional)
- Transformation of energy (electricity and light, heat, vibration, magnetism)
- Other functions (condenser, diode)

### Materials
- Constraints (deflection, shearing)
- Characteristics of mechanical properties
- Heat treatments
- Types and properties
  - Plastics (thermoplastics, thermosetting plastics)
  - Ceramics
  - Composites
- Modification of properties (degradation, protection)

### Manufacturing
- Shaping
  - Machines and tools
- Manufacturing
  - Characteristics of laying out, drilling, tapping and threading
- Measurement
  - Direct measurements (vernier calipers)

### Biotechnology
- Cloning
- Wastewater treatment
- Biodegradation of pollutants

**The shaded content is specific to the EST programme.