Curriculum

(MBBS/BDS Entrance Examination)

Ministry of Education
Kaiser Mahal
Rationale/Background

Ministry of Education and Sports (MOES), Nepal has fully realized the problems of students who passed ISc/PCL/+2 and equivalent examination with biology seeking admission in M.B.B.S. / B.D.S. Degree.

As there was no official curriculum for MBBS/ BDS entrance exams, MOES has recently developed a curriculum in collaboration with TU, KU and HSEB by involving a number of concerned professors and subject specialists with a view to cater to the needs of the said entrance exams. In the course of developing this curriculum, MOES has made every effort to incorporate all the essential ingredients of a fully functional curriculum. It is, therefore, hoped that it will go a long way in proving to be examinee friendly as well as an effective tool to evaluate students efficiently.

Presently the students have to appear at competitive tests conducted by different universities, institutions and the MOES with slightly different principles to prove their merits. Different types of syllabi exist for the same entrance tests at different institutions and students have to focus their effort accordingly.

In order to minimize such difficulties a common principle acceptable to all concerned institutions to hold competitive examination with a common syllabus has been agreed upon under the umbrella of MOES.

The test will be conducted for 2 (two) hours on a model of Multiple Choice Question Answer (MCQA) of 100 questions carrying 1 (one) mark each per question. (Detail given in Appendix)
## Contents

<table>
<thead>
<tr>
<th>SN</th>
<th>Subject/Topics</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>PHYSICS</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Mechanics</td>
<td>1-2</td>
</tr>
<tr>
<td>2</td>
<td>Heat &amp; Thermodynamics</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Waves &amp; Optics</td>
<td>3-4</td>
</tr>
<tr>
<td>4</td>
<td>Electricity &amp; Magnetism</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Modern Physics</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td><strong>CHEMISTRY</strong></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>General &amp; Physical Chemistry</td>
<td>5-9</td>
</tr>
<tr>
<td>7</td>
<td>Inorganic Chemistry</td>
<td>9-11</td>
</tr>
<tr>
<td>8</td>
<td>Organic Chemistry</td>
<td>11-14</td>
</tr>
<tr>
<td></td>
<td><strong>BIOLOGY ( Botany and Zoology )</strong></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Structure, Reproduction and Economic Importance</td>
<td>15</td>
</tr>
<tr>
<td>10</td>
<td>Structure, Reproduction and Economic Importance</td>
<td>15</td>
</tr>
<tr>
<td>11</td>
<td>Plant Morphology</td>
<td>15</td>
</tr>
<tr>
<td>12</td>
<td>Taxonomy of Angiosperms</td>
<td>15</td>
</tr>
<tr>
<td>13</td>
<td>Plant Anatomy</td>
<td>16</td>
</tr>
<tr>
<td>14</td>
<td>Plant Physiology</td>
<td>16</td>
</tr>
<tr>
<td>15</td>
<td>Cell Biology</td>
<td>16</td>
</tr>
<tr>
<td>16</td>
<td>Genetics:</td>
<td>16</td>
</tr>
<tr>
<td>17</td>
<td>Developmental Biology</td>
<td>17</td>
</tr>
<tr>
<td>18</td>
<td>Ecology and Biodiversity Conservation</td>
<td>17</td>
</tr>
<tr>
<td>19</td>
<td>Application of Biology</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td><strong>ZOOLOGY</strong></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Introduction</td>
<td>18</td>
</tr>
<tr>
<td>21</td>
<td>Animal Diversity and Their Classification</td>
<td>18</td>
</tr>
<tr>
<td>22</td>
<td>Biology of the following</td>
<td>18</td>
</tr>
<tr>
<td>23</td>
<td>Human Diseases</td>
<td>19</td>
</tr>
<tr>
<td>24</td>
<td>Rabbit Bones</td>
<td>19</td>
</tr>
<tr>
<td>25</td>
<td>Endocrinology of Mammal</td>
<td>19</td>
</tr>
<tr>
<td>26</td>
<td>Animal Tissues</td>
<td>19</td>
</tr>
<tr>
<td>27</td>
<td>Animal Behavior</td>
<td>20</td>
</tr>
<tr>
<td>28</td>
<td>Animal Adaptation</td>
<td>20</td>
</tr>
<tr>
<td>29</td>
<td>Evolution</td>
<td>20</td>
</tr>
</tbody>
</table>
Unit XI.  Developmental Biology  

MODEL QUESTIONS

1  Physics  
2  Chemistry  
3  Biology (Botany and Zoology)

Appendix
PHYSICS

Unit I. Mechanics

1. Fundamental physical quantities, units and dimensions vectors addition and subtraction, scalar and vector products of two vectors.

2. Kinematics: velocity and speed, acceleration – velocity – time graph; equation of motion with uniform acceleration; projectile motion. Newton’s laws of motion, principle of conservation of linear momentum, work done by constant and variable force, energy and power, potential and kinetic energy, conservative and non-conservative forces, conservation of energy, renewable and non-renewable sources of energy, elastic and inelastic collision,


4. Gravitation: Newton’s laws of gravitation, variation of acceleration due to gravity, gravitational field intensity, gravitational potential, potential energy in a gravitational field, geostationary satellites, orbital velocity, parking orbits, potential and kinetic energy of satellites, escape velocity.

5. Rotational motion: Kinetic energy due to rotational motion, torque and couple, work done by a torque, moment of inertia; angular momentum and its conservation, K.E. of a rolling object.


7. Elasticity: molecular theory, stress, strain, Hook’s law, Young’s, shear and bulk modulii, energy stored in a
stretched wire, force in a bar due to contraction or expansion,

8. **Surface tension:** molecular theory of surface tension, surface energy, excess pressure inside a spherical liquid surface, angle of contact and capillary action.

9. **Viscosity:** streamline & turbulent flows, velocity gradient, Newton's formula, coefficient of viscosity, Poiseuille’s formula, Stoke's law, methods of determination of coefficient of viscosity

**Unit II. Heat and Thermodynamics**

1. **Heat and temperature:** thermal equilibrium, heat capacity, principle of calorimetry, cooling laws, latent heat, thermal expansion of solid, liquid and gas, thermal stress, barometric correction, absolute temperature, kinetic theory of gases, ideal gas equation.

2. **Transmission of heat:** conduction, temperature gradient, conductivity, convection, radiation, black body, Wien's displacement law, Stefan's law, Kirchhoff’s law.

3. **Hygrometry:** relative and absolute humidity, phase diagram and triple point.

4. **Thermodynamics:** heat and work, internal energy, first law of thermodynamics, heat capacities of a gas, isothermal, isobaric, isochoric and adiabatic processes, second law of thermodynamics, Carnot's cycles, entropy.
Unit III. Waves and Optics

1. **Reflection at plane and curved surfaces**: refraction at plane surfaces, refractive indices, lateral shift, critical angle, total internal reflection and its applications including optical fiber, refraction through prism, converging and diverging lenses, lens maker's formula and combination of lenses, defects of vision, correcting lenses.

2. **Dispersion of light**: white light spectrum, dispersive power, chromatic aberration, achromatic combination of lenses, optical instrument: spectrometer, visual angle, angular magnification, simple and compound microscope, prism binoculars, astronomical and terrestrial telescopes.

3. **Photometry**: luminous flux, luminous intensity, illuminance, Lambert's cosine law and photometers.

4. **Wave motion**: free, damped and forced oscillation, resonance, longitudinal and transverse wave motion, Progressive wave: velocity of transverse wave in a stretched string, velocity of a longitudinal wave in a fluid, velocity of sound in air, Laplace’s correction, effect of temperature, pressure and humidity on the velocity of sound, principle of superposition; stationary waves, waves in pipes, strings and rods, intensity and intensity level, loudness, pitch and quality, noise pollution; beats, Doppler's effect. electromagnetic waves: electromagnetic spectrum, Huygen's wave theory, reflection and refraction of light wave, interference of light, coherent sources, optical path difference, phase difference, constructive and destructive interference, Young's double slits experiment; diffraction of light: Fresnel and Fraunhoffer diffraction, Single slit Fraunhoffer
diffraction, Polarization of light; Malus’ law, Brewster's law and Polaroid.

Unit IV. Electricity & Magnetism

1. Electrostatics: electrostatic field: Coulomb's law, electric field, electric flux, Gauss's theorem, potential energy, electric potential, potential gradient, action of points, Van de Graaf’s generator, capacitors, combination of capacitors, action of dielectric, relative permittivity and dielectric strength, energy of a charged capacitor, charging and discharging of capacitors

2. Electric current: metallic conduction, potential difference, Ohm's law, Ohmic and non-ohmic conductors. resistance: resistivity, combination of resistors, Kirchhoff’s laws and its application, heating effect of electric current, Joule's laws, thermoelectric effect, thermocouple, chemical effect of electric current, electrolysis, Faraday's laws

3. Magnetic field: lines of forces, magnetic field due to current, Biot Savart law, Helmholtz coils, magnetic moment of a current loop, Ampere's theorem, force on conductor: force on moving charges, Hall effect, magnetic materials, magnetization, susceptibility, permeability, domain theory, hysteresis, dia, para and ferro-magnetism.

Unit V. Modern Physics

1. **Electron:** Millikan's oil drop experiment, gaseous discharge, cathode rays; motion of electron in electric field and magnetic field, thermionic emission of electrons, specific charge of electron \((e/m)\), cathode ray oscilloscope, photons; photoelectric effect

2. **Atoms:** Bohr's theory of H-atom; energy levels; excitation and ionization energies; production of laser; its properties and uses, production of X-rays; properties and uses of X-rays; de Broglie's wave. Nucleus: atomic number; mass number and isotopes; mass energy relation; mass defect and binding energy. Radioactivity: properties of alpha, beta and gamma rays, G.M. tube; absorption of beta particles and gamma rays; laws of radioactive disintegration; half-life and mean-life; artificial disintegration; nuclear reaction; nuclear fission and fusion; radio isotopes; radiation hazards and safety measures.

3. **Electronics:** conductor, semiconductor and insulator, junction diode, rectifier, transistor, CE amplifier
CHEMISTRY

Unit I. General & Physical Chemistry

1. Language of Chemistry
   Symbols and formulae, atoms and molecules, elements and compounds.

2. States of Matter
   Molecular interpretation of three states of matter

   **Gaseous state:** Gas laws: Boyle's Law; Charles’ Law, Kelvin scale of temperature; universal gas constant; Dalton's Law of partial pressure, Graham’s law of diffusion, kinetic theory of gases (no derivation), deviation of real gas from ideal behaviour, calculations involving gas laws.

   **Liquid state:** Properties of liquids, solution, concentration of solution, concept of molarity, solubility, effect of temperature on solubility, solubility curve, viscosity and surface tension.

   **Solid state:** Properties of solids, classification of solids based on different binding forces, crystals, crystal lattice, seven types of crystal systems.

3. Laws of Stoichiometry and Avogadro's Hypothesis

   **Laws of stoichiometry:** Law of conservation of mass, law of constant proportions, law of multiple proportions, law of reciprocal proportions, Gay Lussac's law of gaseous volumes, chemical calculations based on stoichiometry. Atomic and molecular masses, empirical and molecular formulae, Avogadro's hypothesis, important deductions from Avogadro’s hypothesis, Avogadro’s number, mole concept, determination of chemical formulae from percent composition, problems based on chemical equations.
4. **Atomic Structure**

The subatomic particles, the electrons and nucleons (protons and neutrons), their masses and charges, the atomic mass unit, Dalton's atomic theory, Rutherford's experiment, Bohr's model, interpretation of hydrogen spectra on the basis of Bohr’s model, elementary idea of quantum mechanical model of atom, de Broglie relation, Heisenberg uncertainty principle, quantum numbers, atomic orbital, shapes of s and p orbitals, Pauli's exclusion principle, Hund's rule of maximum multiplicity; Aufbau principle, quantum designation of electrons, electronic configuration of atoms in the ground state up to Z = 30, Isotopes and fractional atomic weights, nuclear fission and fusion, radioactive disintegration and half life.

5. **Chemical Bonding**

Valency, octet rule, chemical bonds and Lewis structure, ionic bonds, covalent bond, electronegativity and ionic character of covalent bond, coordinate covalent bond, idea of metallic bonds, intermolecular forces, van der Waal's forces, hydrogen bonding, importance of hydrogen bonding, VSEPR theory and shapes of BeF₂, BF₃, CH₄, H₂O, NH₃, PF₅, and SF₆.

6. **Oxidation and Reduction**

Electronic concept of oxidation and reduction reactions, oxidation number, balancing redox reactions by oxidation number and ion-electron methods.

7. **Periodic Table**

Mendeleev's periodic table, modern periodic law and long form of periodic table, types of elements on the basis of periodic table, periodic trends in ionization
energy, electron affinity, atomic radii, electronegativity and valency.

8. Acids, Bases and Salts
   Classical definition, Arrhenius concept of acids, bases and salts, Bronsted-Lowry concept, Lewis concept, hydrogen ion concentration and pH, calculation of pH of strong acids, neutralization, hydrolysis of salts.

9. Volumetric Analysis
   Equivalent weight of elements and compounds (acids, bases and salts), standard solution, primary and secondary standards, different ways of expressing concentration of solution, normality equation, titration based on neutralization and redox reactions, indicator, titration curve and selection of acid base indicator, solving problems on acidimetry and alkalimetry involving normality and molarity.

10. Electrochemistry
    Electrolytic and metallic conduction, Arrhenius theory of ionization, Faraday’s laws of electrolysis, electronic interpretation of Faraday’s laws, mechanism of electrolysis and criteria of product formation electrode potential, standard electrode potential, EMF of a galvanic cell and the use of electrode potential to predict a chemical reaction, commercial batteries.

11. Chemical Kinetics
    Rate of reaction, rate law and rate constant, order and molecularity, half life period, factors affecting the rate of reaction (particle size, concentration, temperature, and catalyst, concept of activation energy, and idea of photochemical reaction.
12. Chemical Equilibrium
Equilibrium in physical processes, features of dynamic equilibrium, equilibrium constant, $K_p$ and $K_c$, relation between $K_p$ and $K_c$, LeChatelier’s principle: effect of pressure, concentration, temperature and catalyst on chemical equilibrium, equilibrium involving ions, ionization of weak electrolytes (Ostwald’s dilution law), degree of ionization and ionization constant, solubility and solubility product, common ion effect and their applications.

13. Chemical Thermodynamics
Language of thermo-chemistry, standard heats of formation and combustion, heat of neutralization, Hess’s law, energy changes in chemical reactions, spontaneous processes, second law of thermodynamics, entropy and its physical concept, entropy and criteria of spontaneity in terms of entropy change of universe, entropy change in phase transformations, Gibb's free energy and the direction of chemical change, standard free energy change and equilibrium constant, free energy and useful work.

Unit II. Inorganic Chemistry

1. Non-metals

**Hydrogen:** Unique position in periodic table, isotopes, preparation, properties and uses.

**Oxygen and ozone:** Preparation, properties and uses of oxygen, classification of oxides, preparation, properties and uses of ozone, structure of ozone, hole in the ozone layer.
Water: Structure of water, solvent properties of water, hard and soft water, detergents and water pollution, heavy water.

Carbon: Allotropes of carbon including fullerene, preparation, properties and uses of CO and CO₂, poisoning by CO.

Nitrogen: Nitrogen cycle, preparation, properties and uses of nitrogen, preparation, properties and uses of ammonia, principle of manufacture of ammonia by Haber process, structure of ammonia, principle of manufacture of nitric acid by Ostwald process, properties and structure of and uses of nitric acid, structure of oxides of nitrogen.

Sulphur: Allotropes of sulphur, preparation, properties and uses of H₂S, SO₂, principle of manufacture of sulphuric acid by contact process, properties and uses of sulphuric acid, sulphur dioxide and air pollution, acid rain.

Phosphorus: Allotropes of phosphorus, phosphine and phosphate fertilizer.

Halogen and halogen acids: Preparation, properties and uses, comparative study of HCl, HBr and HI, test of halides and tincture of iodine

Noble gases: Introduction, isolation and uses of noble gases, compounds of xenon – xenon fluorides.

2. Metals

Metals and metallurgy: Introduction, distinction between metals and non-metals, metalloid, electrochemical series and occurrence of metal, metallurgical principle and metallurgical terms.
**Alkali and alkaline earth metals:** Periodic discussion, general characteristics of alkali and alkaline earth metals, principle of extraction of sodium (Down’s process), properties and uses of sodium, principle of manufacture of sodium carbonate, sodium hydroxide, and their properties and uses, biological importance of sodium and potassium, preparation, properties and uses of quicklime, plaster of Paris and bleaching powder, chemistry of magnesium hydroxide and Epsom salt.

**Coinage metals:** Introduction, occurrence, extraction and properties of copper, chemistry of compounds of copper and silver (CuO, Cu₂O, CuSO₄·5H₂O, AgNO₃, and AgCl), purity of gold (carats and fineness).

**Heavy metals: (zinc, iron, mercury and lead):** Occurrence, extraction and properties of zinc, iron and mercury, manufacture of steel, heat treatment of steel, stainless steel, rusting of iron, galvanization, chemistry of compounds of iron, zinc and mercury and lead (FeCl₃, FeCl₃·6H₂O, FeSO₄·7H₂O, ZnO, ZnSO₄·7H₂O, Hg₂Cl₂, HgCl₂·PbO, and Pb₃O₄), Mercury pollution and mercury poisoning.

**Unit III. Organic Chemistry**

1. **Organic Chemistry: some basic principles**

   **Introduction:** Definition, sources and importance of organic compounds, detection of N, S and halogens in organic compounds.

   **Bonding in organic compounds:** Tetracovalency of carbon, hybridization (sp, sp², sp³), sigma and pi-bonds.

   **Electronic displacement in covalent bond:** inductive effect, eletromeric effect, mesomeric effect and resonance.
Fission in covalent bond: Hemolytic and heterolytic fission, electrophiles and nucleophiles, carbocation and carbanions.

Formula of organic compounds: Empirical, molecular and structural, functional groups, homologous series, isomerism (structural & stereoisomerism), nomenclature of organic compounds.

2. Hydrocarbons
   Classification of hydrocarbons, sources of hydrocarbons, nomenclature.
   Alkanes: Nomenclature, preparation, properties and uses of alkanes, octane number, preparation and properties of methane.
   Alkenes: Nomenclature, preparation, properties and uses of alkenes, Markovnikov’s rule and peroxide effect, preparation, properties and uses of ethene.
   Alkynes: Preparation, properties and uses of ethyne, acidic character of ethyne.

3. Organic halogen compounds
   Alkyl halides: Nomenclature, nature of C-X bond, properties and uses of alkyl halides.
   Chloroform: Preparation, properties and uses.

4. Alcohols
   Classification, nomenclature, distinction between 1°, 2° and 3° alcohols, industrial preparation of ethanol (hydration of ethene and fermentation) properties of alcohols.
5. **Ethers**
   Nomenclature, important methods of preparation of diethyl ether, chemical and physical properties and uses of diethyl ether.

6. **Carbonyl Compounds**
   Structures and nomenclature, preparation, properties and uses of formaldehyde, acetaldehyde and acetone, aldol condensation, Cannizzaro reaction

7. **Carboxylic Acids**
   Structures and nomenclature, preparation, properties and uses of formic and acetic acid, derivatives of carboxylic acid: acid chlorides, acid anhydrides, ester and amides

8. **Amines**
   Structures, classification, nomenclature, distinction and separation of primary, secondary and tertiary amines, chemical and physical properties and uses of ethylamine.

9. **Aromatic Hydrocarbons**
   **Benzene:** Structure of benzene, nomenclature and structure of substituted benzene, properties and uses of benzene.
   **Aniline:** Preparation, properties and uses.
   **Nitrobenzene:** Preparation, properties and uses.
   **Phenol:** Preparation, properties and uses.

10. **Carbohydrates, Proteins, Nucleic Acids, and Lipids**
    **Carbohydrates:** Classification of carbohydrates, structures of glucose and fructose, functions of carbohydrates.
**Protein:** Amino acids and peptide bonds, classification of proteins, denaturation and hydrolysis of protein, functions of proteins.

**Nucleic acids:** Types and constituents of nucleic acids, functions of nucleic acids.

**Lipids:** Lipids and triglycerides, phospholipids.

11. Polymers, Pesticides, Dyes and Drugs

**Polymers:** Polymerization (addition and condensation), classification of polymers, and some important synthetic polymers (polyethylene, PVC, polystyrene, Teflon, polyester, Terylene (Dacron), nylon 66

**Pesticides:** Introduction, DDT, Malathion and pheromones

**Dyes:** Classification of dyes with examples (based on chemical constitution and mode of application)

**Drugs:** General introduction to drugs: Antiseptic, analgesic, antipyretic, antacids, and tranquilizers.
BIOLOGY
(Botany and Zoology)

BOTANY

Unit I. Structure, Reproduction and Economic Importance of
Bacteria, Virus and Lichens.

Unit II. Structure, Reproduction and Economic Importance of
1. Algae: Nostoc and Spirogyra
2. Fungi: Mucor and Agaricus
3. Bryophyta: Marchantia and Funaria
4. Pteridophyta: Fern (Pteridium)
5. Gymnosperm: Pinus and Cycas

Unit III. Plant Morphology
1. Parts of a typical flowering plant (Mustard)
2. Leaf: morphology and modification
3. Root: Regions of root, Types and Modification
4. Stem: Types and Modification
5. Flower: Parts
6. Fruits: Types
7. Seeds: Dicot, Monocot

Unit IV. Taxonomy of Angiosperms
1. Basic concept of taxonomy and binominal nomenclature
2. Characteristics and Economic importance of the following families:
   Cruciferae, Solanaceae, Gramineae and Liliaceae
Unit V. Plant Anatomy
Types of tissues, Primary internal structure of root, stem and leaf of monocot and dicot, Secondary growth of dicot stem

Unit VI. Plant Physiology
1. Water relations (diffusion, osmosis, absorption, transpiration and ascent of sap),
2. Photosynthesis
3. Respiration

Unit VII. Cell Biology
1. Cell as a unit of life, structure of prokaryotic and eukaryotic cell, cell organelles and their function.
2. Biochemically important molecules (carbohydrates, proteins, amino acids, nucleic acid and lipids)
3. Cell divisions (Mitosis, meiosis and their significance)

Unit VIII. Genetics
1. Mendelism, Mendel's Laws of Inheritance
2. Concept of incomplete dominance and co-dominance
3. Genetic materials (RNA and DNA), gene pool, crossing over, sex linked inheritance and mutation.

Unit IX. Developmental Biology
1. Reproduction and development in angiosperms
2. Vegetative propagations
3. Micro and mega-sporogenesis, micro and mega-gametogenesis
4. Pollination, fertilization and development of dicot and monocot embryo.

**Unit X. Ecology and Biodiversity Conservation**

1. Plant adaptation (hydrophytes, mesophytes and xerophytes)
2. Types of forests in Nepal
4. Abiotic and biotic factors, food chain, food web, trophic level, pond and grassland ecosystems.
5. Ecological imbalances and its consequences:
   a. Green house effect
   b. Depletion of ozone layer
   c. Acid rain
   d. Pollution: Air, water, soil, their sources of pollution, effects and control measures

**Unit XI. Application of Biology**

1. Introduction to biotechnology
2. Principles of plant and animal breeding
3. Biofertilizers
4. Antibiotics, Vaccines
5. Tissue and Organ transplantation
6. Test tube baby
7. Fermentation
8. Genetic engineering and and tissue culture
ZOOLOGY

Unit I. Introduction

1. Scope and branches of biology, its relation with other subjects
2. Life and its origin, Oparin and Halden’s theory, Miller Urey Experiments
3. Life components (Organic and inorganic)

Unit II Animal Diversity and Their Classification

General Characteristics and its classification up to class with examples of the following:

Unit III. Biology of the following

1. Plasmodium vivax: Habit and habitat, structure (Sporozoite), life-cycle and control of malaria.
2. Paramecium caudatum: Habit and habitat, structure, reproduction (Binary fission and Conjugation with its significance).
3. Pheretima posthuma: Habit and habitat, structure, digestive, nervous and reproductive system and economic importance of earthworms.
4. Rana tigrina: Habit and habitat, structure, digestive, nervous, respiratory, circulatory, excretory, and reproductive systems. Histology of the related organs.
5. Mammal (Rabbit /Man): Skin, respiratory, digestive, nervous, circulatory, excretory, and reproductive
systems. Histology of the related organs, human blood groups and sense organs (Eye and Ear).

**Unit IV. Human Diseases**

1. Socially significant: Drug abuse, Alcoholism and Smoking.
2. Communicable: Typhoid, Tuberculosis, Ascariasis, Girardiasis and AIDS.

**Unit V. Rabbit Bones**

Appendicular and Axial

**Unit VI. Endocrinology of Mammal**

Pituitary, thyroid and parathyroid, adrenal, islets of langerhans.

**Unit VII. Animal Tissues**

Epithelial, Connective, Muscular and Nervous.

**Unit VIII. Animal Behavior**

1. Reflex action
2. Taxes
3. Leadership
4. Migration of fishes and birds: Habit and habitat, structure, digestive, nervous and reproductive

**Unit IX. Animal Adaptation**

1. Aquatic.
2. Amphibians
3. Terrestrial  
4. Volant (aerial)  
5. Desert and parasitic

**Unit X. Evolution**

1. Definition, Organic evolution  
2. History, theories of organic evolution (Lamarckism, Darwinism, Neo-Darwinism)  
3. Evidences of organic evolution (morphological, embryological, anatomical, palentological, chemical and genetical)  
4. Human evolution.

**Unit XI. Developmental Biology:**

Development of frog (embryonic and post embryonic development)
PHYSICS

1. A body is projected at an angle \( \theta \) with the vertical, with kinetic energy, \( E \). The potential energy at the topmost point of the path, neglecting air resistance, is
   a) zero
   b) \( E \)
   c) \( E \cos^2 \theta \)
   d) \( E \sin^2 \theta \)

2. The power of a water pump is 3 kilowatt. The volume of water it can raise in one minute to a height of 10m, assuming \( g = 10 \text{ms}^{-2} \), is
   a) 2 m\(^3\)
   b) 2.4 m\(^3\)
   c) 4 m\(^3\)
   d) 1.8 m\(^3\)

3. A body, attached to a string, must possess a minimum velocity at the top of a vertical circle while moving round without a slack in the string. Minimum velocity will be
   a) \( g \, r \)
   b) \((g \, r)^{1/2}\)
   c) \( 4 \, g \, r \)
   d) \((4 \, g \, r)^{1/2}\)
4. If the displacement of a body in simple harmonic motion is represented by \( y = r \sin(\omega t) \), in an usual motion, its maximum acceleration will be
   a) \( r \omega \)
   b) \(- r \omega\)
   c) \(- \omega^2 r\)
   d) \(\omega^2 r\)

5. Two masses of 1 kg and 2 kg are 9 m apart and make a two body system. Their centre of mass from 1 kg mass will be at
   a) 6 m
   b) 4 m
   c) 3 m
   d) 2 m

6. Poise is an unit of viscosity. Dimension of the coefficient of viscosity is
   a) \( M^{-1} L^{-1} T\)
   b) \( M L^{-1} T\)
   c) \( M L^{-1} T^{-1}\)
   d) \( M L T^{-1}\)

7. Two bodies, one held 1m above the other directly, are released simultaneously and fall freely under gravity. After 3 second their relative separation will be
   a) 0.98 m
   b) 1 m
c) 4.9 m

d) 9.8 m

8. If an automobile moves with constant power $P$, relation between velocity and time will be
   a) $v \propto t^{1/2}$
   b) $v \propto t^{3/2}$
   c) $v \propto t^2$
   d) $v \propto t$

9. If one mole of an ideal gas at STP is heated through 1K the work done by the gas in heat unit will be
   a) 1.98 cal
   b) 8.31 cal
   c) 0.831 cal
   d) 83.1 cal

10. Two perfectly black bodies at Kelvin temperatures $T$ and $T'$ emit the maximum wavelengths of radiation $\lambda_m$ and $\lambda_m'$ respectively. Which of the following ratio of $\lambda_m/\lambda_m'$ is correct?
   a) $\lambda_m/\lambda_m'$ is directly proportional to $T/T'$
   b) $\lambda_m/\lambda_m'$ is inversely proportional to $T/T'$
   c) $\lambda_m/\lambda_m'$ is directly proportional to $(T/T')^4$
   d) $\lambda_m/\lambda_m'$ is inversely proportional to $(T/T')^{-1/4}$
11. When water is heated from 0 to 4°C
   a) $c_p > c_v$
   b) $c_p < c_v$
   c) $c_p - c_v = R$
   d) $c_p = c_v$

12. Resolving power of the human eye is nearly
   a) 342
   b) 1/342
   c) 3420
   d) 1/3420

13. An impure spectrum of Green, Blue, Orange and Yellow is observed on a screen when light passes through a transparent prism. The refractive index of the prism with respect to the colours will be maximum for
   a) Blue
   b) Green
   c) Orange
   d) Yellow

14. In a diffraction experiment a plane transmission grating having 5500 lines/cm is illuminated by a source of light of wavelength 6000 Angstrom. Number of maxima observed on the screen will be
   a) 2
   b) 3
c) 5
d) 6

15. Ratio of intensities of two sound waves is 4:9. If the waves are superimposed the maximum intensity produced will be
a) 4 unit
b) 16 unit
c) 25 unit
d) 81 unit

16. Velocity of sound in air at STP is 330 ms\(^{-1}\). The distance covered by sound in 2 seconds when atmospheric temperature is 30°C, will nearly be
a) 0.5 km
b) 0.7 km
c) 1 km
d) 2 km

17. If R is the radius of a resonance tube, the end correction to be applied is
a) 0.3 R
b) 0.4 R
c) 0.5 R
d) 0.6 R
18. The capacitance of a spherical conductor with radius 1 m is
   a) 1 microfarad
   b) \(9 \times 10^9\) farad
   c) \(1.1 \times 10^{-10}\) farad
   d) \(9 \times 10^{-9}\) farad

19. A dielectric has strength of \(10^6\) V m\(^{-1}\). The minimum voltage to be applied across a 1 mm thick specimen to puncture it is
   a) \(10^6\) V
   b) \(10^9\) V
   c) \(10^3\) V
   d) \(2 \times 10^6\) V

20. NC\(^{-1}\) has the same dimension as
   a) Volt meter
   b) farad meter
   c) farad/meter
   d) Volt/meter

21. The flow of \(6.25 \times 10^{12}\) electrons per second from a wire constitutes current equal to
   a) \(\mu\)A
   b) mA
   c) 1A
   d) 1nA
22. In order that Ohm's law is obeyed, which of the following is correct if \( v \) is drift velocity on electric field \( E \)?
   a) \( v \propto E^2 \)
   b) \( v \propto E^{1/2} \)
   c) \( v = \text{constant} \)
   d) \( v \propto E \)

23. Material A is used as a permanent magnet. It means
   a) A has high coercivity
   b) A has high retentivity
   c) A has low coercivity
   d) A has low retentivity

24. Two wires of the same mass and material are drawn 1mm and 2mm thick. They are connected in series and a current is sent through them. The heat produced will be in the ratio
   a) 1:16
   b) 16:1
   c) 4:1
   d) 2:1

25. The kinetic energy of a proton accelerated by 1V is
   a) \( \frac{1}{1840} \text{ eV} \)
   b) 1840 eV
   c) 1 eV
   d) \( (1840)^{1/2} \text{ eV} \)
26. The ratio of wavelength of first line of Lyman series to first line of Balmer series is
   a) 1:4
   b) 5:27
   c) 27:20
   d) 20:27

27. When an electron moves through a uniform magnetic field, its speed
   a) increases
   b) decreases
   c) remains constant
   d) depends on field

28. A radioactive material of mass 1 kg has half life of 10 days. What mass of the sample will be left after 30 days?
   a) 62.5 gm
   b) 125 gm
   c) 250 gm
   d) 500 gm

29. The radius of Al\textsuperscript{27} nucleus, in fermi, is nearly
   a) 1.5
   b) 2.5
   c) 4.5
   d) 13.5
30. The energy gap between the conduction band and the valance band of certain material is 0.7 eV. The material is
   a) an insulator
   b) a conductor
   c) semiconductor
   d) semimetal

CHEMISTRY

1. The presence of three unpaired electrons in nitrogen atom can be explained by
   a) Pauli’s exclusion principle
   b) Aufbau principle
   c) uncertainty principle
   d) Hund’s rule.

2. Two elements A and B of electronic configuration 2,8,2 and 2,8,7 react with each other to form an ionic compound of formula
   a) A₂B
   b) AB₂
   c) A₂B₃
   d) AB
3. Gas A diffuses five time faster than gas B. The ratio of the densities of gases A and B is
   a) 1/5
   b) 1/10
   c) 1/20
   d) 1/25

4. The number of coulombs of electricity required to deposit 0.3 mole of Cu^{++} is
   a) 9650
   b) 2x9650
   c) 4x9650
   d) 6x9650

5. A balance equation is in accordance with
   a) law of gaseous volume
   b) Avogadro’s law
   c) law of constant proportion
   d) law of conservation of mass

6. Oxidation is associated with
   a) change in atomic weight
   b) loss of electrons
   c) gain of electrons
   d) evolution of gas
7. The number of milli-moles of HCl required to neutralize 10 ml of 0.2 M Na₂CO₃ is 
   a) 2.0 m mole  
   b) 4.0 m mole  
   c) 0.2 m mole  
   d) 0.4 m mole 

8. A chemical reaction will be spontaneous if 
   a) activation energy for the reaction is low  
   b) entropy decreases during a reaction  
   c) free energy decreases  
   d) free energy increases 

9. A catalyst increases the rate of a chemical reaction by 
   a) decreasing the free energy  
   b) decreasing the heat of reaction  
   c) decreasing the activation energy  
   d) increasing the average speed of the reacting molecules 

10. The number of grams of oxygen required for complete combustion of one mole of butane gas is 
    a) 416 gm  
    b) 208 gm  
    c) 13 gm  
    d) 6.5 gm
11. The degree of dissociation of an electrolyte
   a) decreases with dilution
   b) increases with dilution
   c) may increase or decrease with dilution
   d) is not affected by dilution

12. For the reaction \( \text{N}_2 + \text{O}_2 \rightleftharpoons 2 \text{NO} \), the equilibrium constant \( K_p \) changes with the change in
   a) total pressure
   b) amount of NO
   c) amount of \( \text{N}_2 \) and \( \text{O}_2 \)
   d) temperature

13. In the reaction \( \text{NH}_3 + \text{H}_2\text{O} \rightleftharpoons \text{NH}_4^+ + \text{OH}^- \), which of the following constitutes conjugate acid base pair
   a) \( \text{NH}_3 \) and \( \text{H}_2\text{O} \)
   b) \( \text{NH}_4^+ \) and \( \text{OH}^- \)
   c) \( \text{H}_2\text{O} \) and \( \text{OH}^- \)
   d) \( \text{NH}_3 \) and \( \text{OH}^- \)

14. 100 ml of 0.5 M H\textsubscript{2}SO\textsubscript{4} solution and 0.1 litre of 1 M HCl were mixed. The normality of the resulting solution will be
   a) 1.5 N
   b) 0.75 N
   c) 2.0 N
   d) 1 N
15. The pH of $10^{-12}$ M HCl is
   a) 12.0
   b) 2.0
   c) 7.0
   d) -12

16. Which of the following oxide is neutral
   a) CO
   b) SnO₂
   c) ZnO
   d) SiO₂

17. Aqua regia is a mixture of
   a) HNO₃ and HCl
   b) H₂SO₄ and HCl
   c) HNO₃ and HCl
   d) HNO₃, HCl and H₂SO₄

18. When ammonia gas is passed over heated CuO, ammonia is oxidized to
   a) NO₂
   b) N₂O
   c) HNO₂
   d) N₂
19. Alkaline earth metals are
   a) Na and K
   b) Mg and Ca
   c) Cu and Ag
   d) Al and Fe

20. The function of lime stone in the extraction of iron in blast furnace is to act as
   a) an oxidizing agent
   b) a reducing agent
   c) flux
   d) slag

21. The fineness of gold in 18 carats gold is
   a) 18
   b) 750
   c) 888
   d) 999

22. When nitrobenzene is treated with zinc dust and ammonium chloride, we get
   a) aniline
   b) phenyl hydroxylamine
   c) azoxybenzene
   d) hydrazobenzene
23. Which of the following is the strongest acid?
   a) FCH₂COOH  
   b) ClCH₂COOH  
   c) BrCH₂COOH  
   d) ICH₂COOH 

24. Which statement explains why the element carbon forms many compounds?
   a) carbon combines readily with oxygen
   b) carbon have high electronegativity
   c) carbon readily forms ionic bond
   d) carbon readily forms covalent bonds with other carbon atoms

25. The number of dichlorinated isomers that can be formed by the halogenations of CH₃CH₂CH₂CH₃ is
   a) 2
   b) 3
   c) 5
   d) 6

26. The compound that undergoes Cannizzaro reaction is
   a) CH₃COOH
   b) C₂H₅CHO
   c) HCHO
   d) CH₃OCH₃
27. The compound that gives positive carbylamine reaction is
   a) (CH₃)₂NH
   b) (CH₃)₃N
   c) (CH₃)₄N⁺
   d) CH₃NH₂

28. PVC is a
   a) condensation polymer
   b) addition polymer
   c) copolymer
   d) thermosetting polymer

29. Hydrolysis of table sugar produces
   a) two molecules of glucose
   b) glucose and fructose
   c) glucose and galactose
   d) glucose and lactose

30. The gas obtained by adding water on aluminum carbide is
   a) ethyne
   b) ethane
   c) methane
   d) ethane
BIOLOGY
(Botany and Zoology)

BOTANY

1. Founder of binomial nomenclature was:
   a) Carolus Linnaeus
   b) Engler
   c) Darwin
   d) Bentham

2. Lichens are ecologically important because they:
   a) are associated with mycorrhizal roots
   b) are associated with Algae and Fungi
   c) are earliest settlers of barren rocks
   d) can grow in polluted areas

3. On germination each Zygospore of Spirogyra gives rise to
   a) Four plants
   b) Three plants
   c) Two plants
   d) One plant

4. Which one is an edible fungus?
   a) *Penicillium*
b) *Rhizopus*

c) *Mucor*

d) *Agaricus*

5. Which one of the following plants are amphibians?
a) Algae
b) Bryophytes
c) Ferns
d) Gymnosperms

6. The protonema of the moss is:
a) Haploid
b) Diploid
c) Sporophyte
d) Sporophyll

7. Pollination in *Cycas* is carried out by:
a) wind
b) water
c) insect
d) man

8. Fruit is developed from
a) Stigma
b) Ovary
c) Anther
d) Calyx

9. Climbing roots are found in
   a) *Asparagus*
   b) Betel
   c) *Brassica*
   d) Orchids

10. The family cruciferae is represented by the floral formula
    a) P 3 + 3, G 3
    b) K 2+2, C4, A 2+4, G (2)
    c) K 4-5, C 4-5, A 10, G 1
    d) K (5), C (5), A 5, G (2)

11. Annual rings in stems determine:
    a) Number of branches
    b) Height of a plant
    c) Thickness of the trunk
    d) Age of a plant

12. An organelle in which respiration occurs is:
    a) Golgi bodies
    b) Ribosomes
    c) Mitochondria
    d) Chloroplast
13. Which one of the following is not a dividing stage?
   a) Prophase
   b) Interphase
   c) Metaphase
   d) Telophase

14. Watson and Krick are known for their contributions in discovering:
   a) One-gene one-enzyme hypothesis
   b) Double helix structure of DNA
   c) Ascent of sap
   d) C₃ and C₄ plants

15. Which one of the following is not found in DNA?
   a) Cytocine
   b) Guanine
   c) Adenine
   d) Uracil

16. Mendelian recombination is due to
   a) Independent assortment of genes
   b) Linkage of genes
   c) Mutation
   d) Dominance
17. Which one of the following is not listed as an endangered animal in Nepal?
   a) Tiger
   b) Elephant
   c) Crocodile
   d) Yak

18. Endosperm in angiosperm is
   a) Haploid
   b) Diploid
   c) Triploid
   d) Tetraploid

19. The concept of the ecosystem was first given by
   a) E. P. Odum
   b) Carl Linnaeus
   c) Charles Darwin
   d) A. G. Tansley

20. Ability of a plant or animal cell to repeatedly divide and differentiate into a complete organism is
   a) Cloning
   b) Breeding
   c) Cellular totipotency
   d) Mitosis


ZOONOLOGY

1. For origin of life most important condition is the presence of
   a) Water
   b) Carbon
   c) Oxygen
   d) Nitrogen

2. Classification of Porifera is based on
   a) Branching
   b) Spicules
   c) Reproduction
   d) Symmetry

3. The common feature of *Plasmodium* and *Paramecium* is the
   a) Mode of nutrition
   b) Locomotary organ
   c) Reproduction by fission
   d) Habit

4. In *Pheretima posthuma* the setae are absent in
   a) 14 to 16th
   b) 10th to 14th
   c) 2nd to 5th
d) 10\textsuperscript{th} to 14\textsuperscript{th}

5. Innominate vein in frog collects the blood from
   a) Fore limbs
   b) Jaws and tongue
   c) Brain and eye
   d) Muscles of the trunk

6. Condyle process of the mammalian lower jaw is articulated with the
   a) Glenoid fossa of squamosal
   b) Zygomatic process of upper jaw
   c) Zygomatic process of the upper jaw
   d) Basioccipital region of skull

7. Mammalian pictorial girdle has reduced
   a) Clavicle
   b) Scapula
   c) Glenoid cavity
   d) Coracoid

8. Which one is the dividing layer of the mammalian skin?
   a) Stratum corneum
   b) Stratum spongiosum
   c) Stratum malpighii
   d) Stratum lucidum
9. Breaking of mammalian RBC is due to
   a) Lacking of nucleus
   b) Lacking of mitochondria and endoplasm reticulum
   c) Presence of haemoglobin
   d) Presence of Na + in it.

10. Science related to mental disorder is
    a) Psychology
    b) Neurology
    c) Psychiatry
    d) Physiotherapy

11. Anti-blood clotting protein in the blood is the
    a) Histamine
    b) Heparin
    c) Colagen
    d) Elastin

12. Thermoregulatory centre lie in
    a) Optic lobe
    b) Cerebellum
    c) Cerebrum
    d) Diencephalon

13. Hormone responsible for milk secretion in mammals is
    a) Vasopressin
b) Thyroxine  
c) Adrenalin  
d) Luteotropic  

14. Histological structure of mammalian and amphibian kidneys differ in the  
a) Distribution of blood vessels  
b) Distribution of Malphigian Body (MB)  
c) Structure of the MB  
d) Structure of the potential cover  

15. Bruner’s gland in the mammalian gut are present in the submucosa of  
a) Stomach wall  
b) Ileum  
c) Duodenal wall  
d) Oesophagus wall  

16. Bohr’s effect is the  
a) Mass movement of \( Na^+ \) ions from the axoplasm to the surrounding interstitial fluid  
b) Dissociation of oxy-haemoglobin in the blood capillaries due to the effect of \( CO_2 \) concentration in the body cells  
c) Exchanging between \( HCO_3^- \) of the RBC and \( Cl^- \) of the blood plasma  
d) Effect of Neurohumors on pace-maker for heart beating.
17. Progesterone hormone in Graffian follicle of mammals is produced by the
   a) Discus proligens
   b) Membrana
   c) Zona pellucida
   d) Zona radiate

18. Which of the following organs do not indicate the common ancestry?
   a) Homologous organs
   b) Analogous organs
   c) Vestigial organs
   d) Atavistic organs

19. Pneumatic bones are the characteristics of
   a) Amphibians
   b) Aquatic forms
   c) Volants
   d) Arboreal forms

20. Archenteron in frog gastrula is formed by the process called
   a) Epiboly
   b) Emboly
   c) Migration of central micromeres
   d) Formation of yolk plug
## Appendix

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<thead>
<tr>
<th>SN</th>
<th>Subject / Topics</th>
<th>Marks</th>
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<tbody>
<tr>
<td></td>
<td><strong>PHYSICS</strong></td>
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<tr>
<td></td>
<td>Unit I. Mechanics</td>
<td>8</td>
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<tr>
<td></td>
<td>Unit II. Heat &amp; Thermodynamics</td>
<td>3</td>
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<td>6</td>
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<td>Unit V. Modern Physics</td>
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<td><strong>CHEMISTRY</strong></td>
<td>30</td>
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<td></td>
<td>Unit I. General &amp; Physical Chemistry</td>
<td>15</td>
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<td>Unit IV. Taxonomy of Angiosperms</td>
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