

## ***Syllabus for Chemist-II (Archives) under Art & Culture Department, 2019***

The examination will comprise of the following papers:

(1) General English	:	100 Marks
(2) Technical Paper - I	:	150 Marks
(3) Technical Paper - II	:	150 Marks
Total	:	400 Marks

### **DETAILS OF SYLLABUS :**

#### **(1) General English Paper : 100 Marks**

- |   |   |          |
|---|---|----------|
| a) Essay Writing (Not more than 300 words)                          | : | 20 Marks |
| b) Idioms & Phrases (Objective Type/MCQ)                            | : | 16 Marks |
| c) Comprehension of given passages (Objective Type/MCQ)             | : | 12 Marks |
| d) Grammar (Objective Type/MCQ)                                     |   |          |
| Parts of Speech : Nouns, Adjective, Verb, Adverb, Preposition, etc. | : | 20 Marks |
| e) Composition (Objective Type/MCQ)                                 | : | 16 Marks |
| (i) Analysis of complex and compound sentences                      |   |          |
| (ii) Transformation of sentences                                    |   |          |
| (iii) Synthesis of sentences  |   |          |
| h) Correct usage and vocabularies (Objective Type/MCQ)              | : | 16 Marks |

**(2) TECHNICAL PAPER – I**  
**MCQ/Objective Type - 150 Marks**

**A. Care and Conservation of Books, Manuscripts and Archives Material:  
(50 Marks)**

<b>Unit I :</b>	Archives and Records management	-	10 Marks
<b>Unit II :</b>	Factors leading to the deterioration of paper	-	10 Marks
<b>Unit III :</b>	Reprography & Computerisation	-	10 Marks
<b>Unit IV :</b>	Process of restoration of document which will strengthen the document and ensure its durability	-	10 Marks
<b>Unit V :</b>	The Mizoram Public Records Act, 2011 & The Mizoram Public Records Rules, 2014	-	10 Marks

**B. Chemistry : (50 Marks)**

**Unit I : Atomic Structure**

de-Broglie's concept of dual character of matter; Heisenberg's Uncertainty Principle; Schrödinger wave equation; quantum numbers; radial and angular wave functions and probability distribution curves; atomic-orbitals; shapes of *s*, *p* and *d*-orbitals. Aufbau principle; Pauli's exclusion principle and Hund's rule of maximum multiplicity.

**Unit II : Periodic Properties and brief chemistry of s and p-block**

General features of long form of periodic table. Detailed discussions (definition, factors affecting it and periodic trends) of the following properties with reference to *s* & *p*- block: (i) Atomic and Ionic radii (ii) Ionization Energy (iii) Electron Affinity and (iv) Electronegativity. Brief explanation of Catenation and Inert pair effect, Relative stability of different oxidation states of *p*-block. Inter-halogen compounds and pseudohalogens.

**Unit III : Colloids and Surface Chemistry**

Classification of colloids, preparation of colloids- Bredig's and condensation methods, Peptization, Optical properties of colloids- Tyndall effect. Origin of charge on colloidal particles, Protective colloids, gold number. Physisorption & chemisorptions; molar enthalpy of adsorption, Langmuir and Freundlich adsorption isotherms.

**Unit IV : Dissociation Equilibria**

Dissociation equilibria of weak electrolytes, dissociation constant of weak acids ( $K_a$ ), ionic product of water ( $K_w$ ), hydrogen ion concentration and pH scale, buffer solutions and buffer activity, hydrolysis constant ( $K_h$ ), pH, buffer solutions and buffer activity & Henderson- Hasselbach equations for acidic & basic buffers.

**Unit V : Electron-displacement effects in organic molecules and the basic concept of reaction mechanism**

Role of Inductive effect, Electromeric effect, Mesomeric effect or Resonance and hyperconjugation. Types of reagents-electrophiles and nucleophiles. Energy considerations, reactive intermediates: carbocations, free-radicals, carbanions, carbenes, arynes, the stability of reaction intermediates. Hydrogen bonding and its effect on boiling point and solubility of organic molecules.

## C. Physics : (50 Marks)

### Unit I : Mechanics

Dimensional analysis. Newton's laws of motion and applications. Rotating frames of reference, Coriolis force, Rotational dynamics-kinetic energy, angular momentum, theorems of moment of inertia and calculations in simple cases. Conservative forces, fictitious force. Gravitational potential and intensity due to spherical objects. Motion under inverse square law. Central forces, Kepler's problem, escape velocity and artificial satellites (including GPS). Streamline motion, viscosity, Poiseuille's equation. Applications of Bernoulli's equation and Stokes' law, Special relativity and Lorentz transformation-length contraction, time dilation, mass-energy relation.

### Unit II : Thermal physics

Thermal equilibrium and temperature. The zeroth law of thermodynamics. The first law of thermodynamics. Isothermal and Adiabatic changes, Efficiency of Carnot's engine. Entropy and the second law of thermodynamics. Kinetic theory and the equation of state of an ideal gas. Mean free path, distribution of molecular speeds and energies. van der Waals equation and applications. Transport phenomena. Brownian motion. Thermodynamic potentials-Maxwell relations. Phase transitions. Black-body radiation, Stefan-Boltzmann law, Wien displacement law, Planck radiation law.

### Unit III : Waves, Oscillations and Optics

Simple harmonic motion, spring-mass system and LC circuits. Stationary and progressive waves, Damped harmonic motion, forced oscillation and Resonance, Sharpness of resonance, Plane and Spherical waves, Superposition of waves. Lissajous figures, Phase and Group velocities. Laws of reflection and refraction. Thin lens formula, nodal planes, system of two thin lenses. Chromatic and spherical aberrations. Simple optical instruments-magnifier, eyepieces, telescopes and microscopes. Huygens' principle-reflection and refraction of waves. Interference of light-Young's experiment, Newton's rings, Michelson interferometer. Fraunhofer and Fresnel diffraction, diffraction grating, resolving power.

## (2) TECHNICAL PAPER - II MCQ/Objective Type - 150 Marks

### A. Care and Conservation of Books, Manuscripts and Archives Material: (50 Marks)

<b>Unit I :</b>	Preservation of records	-	10 Marks
<b>Unit II :</b>	Dealing with born digital archives	-	10 Marks
<b>Unit III :</b>	Binding materials	-	10 Marks
<b>Unit IV :</b>	Planning and designing of archival building	-	10 Marks
<b>Unit V :</b>	Private Archives	-	5 Marks
<b>Unit VI :</b>	Records Retention Schedule	-	5 Marks

## **B. Chemistry : (40 Marks)**

### **Unit I : Chemical bonding**

Basic concept of ionic bond, covalent bond and coordinate bond. Polarities of bonds in covalent molecules and their dipole moments. Concept of hybridization, types, orientation of hybrid orbitals. Valence shell electron pair repulsion (VSEPR) theory and shapes of simple molecules and ions containing lone pairs and bond pairs of electrons. Molecular orbital theory (LCAO method) and bonding in homonuclear and heteronuclear diatomic molecules and their ions.

### **Unit I : Chemistry of d-block elements**

General group trends with special reference to electronic configuration, colour, oxidation states, reducing properties and magnetic properties, ability to form complexes. Differences between the first, second and third transition series.

### **UNIT-III : Concept of Organic Synthesis and Name Reactions**

Formation of carbon-carbon bond, electrophilic and nucleophilic carbon species, acid-assisted reaction (Friedel Crafts alkylation and acylation), base-assisted condensations (Knoevenagel, Michael, Wittig reaction, Reformatsky reaction, Claisen-Schmidt reaction, Mannich reaction); Formation and acid-assisted cleavage of acetals and ketals; formation and hydrolysis of esters and amides (acyclic and cyclic).

### **UNIT IV : Chemical Kinetics & Catalysis**

Concepts of Rate, Order and Molecularity of reaction, Effect of Temperature on Reaction Rate; Temp Coefficient of a reaction, Arrhenius Equation; Concept of Activation energy, Collision Theory & Absolute Reaction Rate Theory. Types and characteristics of Catalysis. Enzyme catalysis, Michaelis–Menten equation.

### **UNIT V : Thermodynamics**

Limitations of the First Law and need of the second law, Statements of the second law; Carnot's cycle; Efficiency of Carnot's engine; Concept of Entropy; Entropy change for an Ideal gas with (i) T & V (ii) T & P & (iii) Entropy change for Reversible and Irreversible processes. Third Law Statement; Nernst Heat Theorem, Concept of Residual Entropy.

## **C. Physics : (40 Marks)**

### **Unit I : Electricity and Magnetism**

Coulomb's Law, Electric Field, Gauss's Law and applications, Electric Potential, Poisson and Laplace equations for homogeneous dielectric, uncharged conducting sphere in a uniform field, point charge and infinite conducting plane. Bio-Savart law and applications. Ampere's circuital law and its applications, Magnetic induction and field strength, Magnetic field on the axis of circular coil, Electromagnetic induction, Faraday's and Lenz's law, self and mutual inductances. Kirchoff's laws and its applications; Wheatstone bridge, Carey foster's bridge Alternating currents L.C.R. Circuits, series and parallel resonance circuits, quality factor. Maxwell's equations and electromagnetic waves. Magnetic fields in Matter. Dia, para, Ferro, Antiferro and Ferrimagnetism (Qualitative approach only). Hysteresis.

### **Unit II : Modern Physics**

Photoelectric effect, Einstein's photon theory. Bohr's theory of hydrogen atom. Stern-Gerlach experiment, quantisation of angular momentum, electron spin. Pauli exclusion principle and applications. Zeeman effect. X-ray spectrum and Bragg's law, Compton effect, Compton wavelength. Wave nature of matter, de Broglie wavelength, wave-particle

duality. Heisenberg's uncertainty relationships. Schroedinger's equation-eigenvalues and eigenfunctions of (i) particle in a box, (ii) simple harmonic oscillator. Potential step and barrier penetration. Natural and artificial radioactivity. Binding energy of nuclei, nuclear fission and fusion.

### **Unit III : Electronics**

Classification of solids into conductors, insulators and semiconductors on the basis of energy bands. Intrinsic and extrinsic semiconductors, P.N. junction, Reverse and forward based P.N. junction, Avalanche and Zener breakdown, Photodiode, LED, Zener diode, solar cell. Use of diodes and transistors for rectification, amplification, oscillation, modulation and detection of r.f. waves. Transistor receiver. Boolean Algebra, Logic Gates and their truth table, Sum of Product rule, some applications, Adder and Subtractor.

## **D. Aptitude Test : (20 Marks)**

### **(a) Numerical And Figurework Tests: (4 Marks)**

These tests are reflections of fluency with numbers and calculations. It shows how easily a person can think with numbers. The subject will be given a series of numbers. His/Her task is to see how the numbers go together to form a relationship with each other. He/She has to choose a number which would go next in the series.

### **(b) Verbal Analysis And Vocabulary Tests: (6 Marks)**

These tests measure the degree of comfort and fluency with the English language. These tests will measure how a person will reason with words. The subject will be given questions with alternative answers, that will reflect his/her command of the rule and use of English language.

### **(c) Visual And Spatial/3-D Ability Tests: (4 Marks)**

These tests are used to measure perceptual speed and acuity. The subject will be shown pictures where he/she is asked to identify the odd one out; or which comes next in the sequence or explores how easily he/she can see and turn around objects in space.

### **(d) Abstract Reasoning Tests: (6 Marks)**

This test measures the ability to analyse information and solve problems on a complex, thought based level. It measures a person's ability to quickly identify patterns, logical rules and trends in new data, integrate this information, and apply it to solve problems.

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