

**SYLLABUS FOR COMPETITIVE EXAMINATION FOR THE  
POST OF JUNIOR SCIENTIFIC OFFICER (CHEMISTRY)  
UNDER HOME (FORENSIC) DEPARTMENT,  
GOVT. OF MIZORAM, 2016**

**SYLLABUS FOR COMPETITIVE EXAMINATION FOR THE POST  
OF JUNIOR SCIENTIFIC OFFICER (CHEMISTRY)  
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**SUBJECTS**

- (a) General English (Conventional / Objective Type) ..... 100 Marks  
(b) Technical Paper - I (MCQ/Objective Type)..... 150 Marks  
(c) Technical Paper - II (MCQ/Objective Type)..... 150 Marks

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**GENERAL ENGLISH**

**(Full Marks : 100)**

- (a) Essay Writing (Conventional)..... 20 Marks  
(b) Idioms & Phrases (Objective Type)..... 16 Marks  
(c) Comprehension of given passages (Objective Type)..... 16 Marks  
(d) Grammar (Objective Type) ..... 16 Marks  
Parts of Speech : Nouns, Adjective, Verb, Adverb, Preposition, etc.  
(e) Composition (Objective Type)..... 16 Marks  
    i) Analysis of complex and compound sentences  
    ii) Transformation of sentences  
    iii) Synthesis of sentences  
(f) Correct usage and vocabularies (Objective Type) ..... 16 Marks

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**SYLLABUS FOR JUNIOR SCIENTIFIC OFFICER (CHEMISTRY)  
UNDER HOME (FORENSIC) DEPARTMENT, 2016**

**TECHNICAL PAPER – I (MCQ/Objective Type) (150 MARKS)**

<b>Unit – I</b>	Chemistry.....	75 Marks
<b>Unit– II</b>	Biochemistry.....	75 Marks

**TECHNICAL PAPER – II (MCQ/Objective Type) (150 MARKS)**

<b>Unit – I</b>	Forensic Chemistry & Toxicology.....	100 Marks
<b>Unit- II</b>	Computer knowledge (Certificate Level).....	30 Marks
<b>Unit- III</b>	Aptitude Test .....	20 Marks

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**TECHNICAL PAPER – I**

**Unit – I : Chemistry  
(75 Marks)**

**(i) Atomic Structure and Periodic property:** Dual character of matter; Uncertainty Principle; Schrodinger wave equation; quantum numbers; radial and angular wave function; atomic-orbitals (*s*, *p* and *d*-orbitals); Aufbau principle; Pauli's exclusion principle; Hund's rule; Effective nuclear charge, shielding or screening effect. periodic properties of *s* & *p*-block elements with reference to: Atomic/Ionic radii, Ionization Energy, Electron Affinity, Electronegativity, polarisability, metallic character; Concept of hybridization; VSEPR; hydrogen bonding. MOT for homonuclear & heteronuclear species; VBT; CFT (octahedral, tetrahedral & square planar), CFSE in weak and strong ligands. Ionic bond, Covalent bond, Coordinate bond, Metallic bond, Hydrogen bond, Structures of solids- Types of crystals, Packing, Radius ratio, Crystal structures, Lattice energy, Lattice defects.

**(ii) Experimental analysis:** Significant figures, rounding off of numerical expressions; types of errors; minimizing of errors, accuracy and precision, rejection of data, confidence limits and intervals, test of significance (the F-test and t-test); Correlation Coefficient and Coefficient of determination; Volumetric titrimetry: primary/secondary standard, expressing concentrations of standard solutions, acid base titrations, redox titrations, theory of indicators; Qualitative analysis of organic and inorganic compound; Solubility product, common ion effect and interfering ions; UV-Vis, IR, NMR, AAS, AES (Basic principle and Instrumentation); Solvent extraction- Principle and efficiency of the technique.

Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and non-aqueous media; Chromatography- Classification, principle and efficiency of the technique; Analysis of milk products: Theory of the analysis of milk, butter and other dairy items. Analysis of fats and oils. Characterization of fats and oils; Iodine value, iodine-bromine value and saponification value, and their significances; Quality control.

**(iii) Reaction mechanism:**  $S_N1$ ,  $S_N2$ ,  $S_{Ni}$ , E1 and E2 mechanism; Thermodynamic and kinetic control reaction; Reactive intermediates and their stability; Friedel Crafts alkylation and acylation, Knoevenagel, Michael, Wittig, Reformatsky, Claisen-Schmidt, Baeyer-Villiger, Hunsdiecker, Dieckmann, Darzens, Arndt-eistert, Mannich reaction, Favorskii, pinacol-pinacolone, Wagner-Meerwein, dienone-phenol, Beckmann, Wolff, Hofmann, Benzil-Benzilic acid, Fries and Claisen-rearrangements. Pericyclic reactions: Electrocyclic and cycloaddition reactions.

**(iv) Chemical kinetics, electrochemistry, colloids and surface chemistry:**

Rate, Order and Molecularity of a reaction; Pseudo-unimolecular reaction; Differential & Integrated Rate Expressions for Zero, first and Second Order;  $t_{1/2}$  for  $n^{\text{th}}$  order; Effect of Temperature on Reaction Rate; Specific/Molar conductance, Transport number and its relation to ionic conductance and ionic mobility; conductometric titrations; pH scale; electrolytic and electrochemical cells. Standard EMF, electrode potential; Calculation of  $\Delta G$ ,  $\Delta H$ ,  $\Delta S$  and equilibrium constant from EMF data; Potentiometric determination of pH, Potentiometric titrations; Colloids- Classification, purification, properties- Tyndall effect, Brownian movement, electrophoresis and electro-osmosis; protective colloids and gold number; Sols (reversible and irreversible); emulsions and emulsifiers, association colloids (micelles), Gels; Physisorption, chemisorption, molar enthalpy of adsorption. Langmuir and Freundlich adsorption isotherm. Specific Surface area determination (BET method).

**(v) Nuclear Chemistry:** Radioactivity; group displacement law; Radioactive disintegration; disintegration constant; half-life and average-life period; radioactive equilibrium; artificial radioactivity; artificial transmutation of elements; Neutron-proton ratio and its implications; packing fraction; mass defect; Nuclear binding energy; magic number: Fission, fusion, controlled fission reactions and atomic energy.

**Green chemistry:** Principle, Microwave assisted reactions in water: Mannich reaction, Hofmann elimination; Sonication reaction: Butyraldehyde, 2-chloro-N-aryl anthranilic acid; Biocatalysts: Biochemical (Microbial) Oxidation and reduction.

**Stereochemistry of organic molecules:** Isomerism: E-Z, R-S nomenclature; Elements of symmetry, molecular chirality, enantiomers, optical activity, diastereomers, meso compounds, resolution, inversion and retention of configurations, Racemization, Relative and absolute configuration; chemoselectivity, regeoselectivity, stereoselectivity; conformational isomerism in cyclohexane, mono- and di- substituted cyclohexane.

## Unit – II : BIOCHEMISTRY

( 75 Marks)

**I. BIOMOLECULES:- Carbohydrates-**Classification, biological role of carbohydrates; chemistry of mono-, di- and polysachharides; stereochemistry of sugars: chiral carbon, epimers, anomers, mutarotation, chair and boat forms, glycoside, glucopyranose and fructopyranose. **Proteins** - Amino acids, classification, chemical structure and general properties; peptide bond; forces stabilizing protein structure; primary structure of proteins; secondary structure ; tertiary structure and quaternary structure. **Lipids** - Classifications and biological role, fatty acid: nomenclature; structure and properties of saturated and unsaturated fatty acids. Triacylglycerols: nomenclature; physical properties;chemical properties and characterization of fats- hydrolysis; saponification value; rancidity of fats. **Nucleic acids:** Nature of genetic material; evidence that DNA is the genetic material; composition of RNA and DNA; Watson and Crick model of DNA structure; structure and roles of different types of RNA. .... (15 Marks)

**II. BIOCHEMICAL TECHNIQUES :- Chromatography-** General principles and applications of: adsorption chromatography; ion-exchange chromatography; molecular-sieve chromatography; thin-layer chromatography; affinity chromatography; paper chromatography. **Electrophoresis** – Basic principles of agarose electrophoresis; PAGE and SDS-PAGE. **Spectroscopic techniques-** Beer-Lambert's law; application of visible and UV spectroscopic techniques. **Measurement of pH-**principles of glass and reference electrodes; types of electrodes. .... (10 Marks)

**III. PHYSIOLOGICAL CHEMISTRY:-** Biochemistry of blood; blood clotting; blood cell types; hemoglobin- oxygen and carbon dioxide transport. Structure and function of kidney; mechanism of urine formation; water and electrolyte balance . Neurons; nerve impulse; neurotransmitters and synaptic transmission; muscle protein; mechanism of muscle contraction(smooth and skeletal). General classifications of hormones; hormones of hypothalamus, pituitary, thyroid, pancreas, adrenal and gonads. .... (15 Marks)

**IV. INTERMEDIARY METABOLISM:-** General features of metabolism; reactions and energetic of glycolysis; alcoholic and lactic acid fermentation; reactions and energetic of TCA cycle; gluconeogenesis; glycogenesis and glycogenolysis; pentose phosphate pathway. Electron transport chain and oxidative phosphorylation. Transport of fatty acids into mitochondria;  $\beta$ -oxidation of fatty acids; biosynthesis of fatty acids. Urea cycle and its regulation; biosynthesis and degradation of amino acids; inborn errors of amino acid metabolism – alkaptonuria, phenylketonuria, albinism. Biosynthesis and degradation of purines and pyrimidines; diseases related to nucleotide metabolism- hyperuricemia and gout. .... (10 Marks)

**V. ENZYMOLOGY:-** Nomenclature and IUB classification of enzymes; definition with examples of holoenzyme, apoenzyme, coenzymes, cofactors, activators, inhibitors, active site; metallo-enzymes; Units of enzyme activity –definition of IU and katal; transition state theory; activation energy. Factors affecting enzyme activity; Michaelis-Menten equation for uni-substrate reactions; significance of  $K_m$  and  $V_{max}$ ; Line Weaver-Burk plot; reversible and irreversible inhibition; competitive, non-competitive and uncompetitive inhibition; allosteric enzymes. (10 Marks)

**VI. CELL & MOLECULAR BIOLOGY:-** Cell; Eukaryotes & Prokaryotes ; Cell organelles- Nucleus, nucleolus, mitochondria, golgi complex, ribosomes, endoplasmic reticulum, lysosomes; cell membrane; active and passive transport .

DNA replication in prokaryotes and experimental evidence for semiconservative DNA replication; mechanism of replication- DNA polymerases, other enzymes involved in replication. Transcription in prokaryotes; RNA polymerases; Promoters; Initiation, elongation and termination of RNA synthesis; Reverse transcriptase. Genetic code: basic features of genetic code, biological significance of degeneracy. Wobble hypothesis. Mechanisms of translation: Ribosome structure, A and P sites, charged tRNA, f-met-tRNA, Shine-Dalgarno consensus sequence (AGGA), formation of 70S initiation complex. Genetic engineering: Vectors; Plasmids; Gene cloning; Restriction endonucleases; Application of recombinant DNA technology. .... (15 Marks)

## **TECHNICAL PAPER-II**

### **Unit-I : Forensic Chemistry & Toxicology (100 Marks)**

#### **Section-A (20marks)**

Definition of Forensic Science, physical evidence, Locard's principle of Exchange, definition of drugs, designer drugs, types of physical evidences, characteristics of drugs (depressant, Stimulant, Hallucinogens), Narcotics drugs and Psychotropic substances, alcohols, types of liquor, illicit liquor, proof spirit, arson.

#### **Section-B ( 25 marks )**

Identification, presumptive test( colour/spot test) and confirmatory tests, elemental analysis(organic and inorganic), collection and sampling of forensic evidences, analysis of alcoholic beverages, chemistry of fire, scientific investigation and evaluation of clue materials, trap related evidence materials, qualitative and quantitative forensic analysis of organic and inorganic industrial products, chemical fertilizers.

#### **Section-C ( 20marks )**

Definition of Forensic toxicology, definition of poison, types of poisoning, signs and symptoms of poisoning, insecticides, classification of poisons on the basis of chemical properties and method of isolation, factors affecting the intensity of poisoning,

#### **Section-D ( 25marks )**

Matrices in forensic toxicology, classical and modern methods of extraction, Stass-Otto method of extraction, definition of Distribution co-efficient in solvent extraction technique, choice of preservatives, interpretation of forensic results.

#### **Section-E (10 marks )**

#### **Laws relating to Forensic Chemistry & Toxicology:**

Assam Drugs Controll Act 1950, Drugs & Cosmetics Act 1940, MLPC Act, 2014, ND& PS Act' 1985, Indian Penal Code, Criminal Procedure Code, Indian Evidence Act.

#### **Suggested readings**

- 1.S.N. Tiwari; Analytical Toxicology, Gov't of India publications, New delhi, 1987
- 2.Saferstein.R : Forensic Science Handbook, Vol I, II, III, Prentice Hall, NL, 1982
3. Saferstein, R: Criminalistics, 2002.
- 4.Modi's Medical jurisprudence & Toxicology, M.M Tripathi Press Ltd, Allahabad, 1988
- 5.Laboratory Procedure Manual of Forensic Chemistry. DFS, MHA. GOI
- 6.Laboratory Procedure Manual of Forensic Toxicology. DFS, MHA. GOI
- 7.B.S. Nabar: Forensic Science in criminal investigation. Asia Law House, Hyderabad

## **Unit – II : Computer Knowledge (Certificate Level)** **( 30 Marks )**

### **1. Fundamental of Computers (5 Marks )**

**Introduction :** Characteristics of Computers, The Evolution of Computers, The Computer Generations (First Generation(1942-1955), Second Generation (1955 – 1964), Third Generation (1964 – 1975), Fourth Generation (1975 – 1989), Fifth Generation (1989 – Present).

**Basic Computer Organization :** Input Unit. Output Unit. Storage Unit. Arithmetic Logic Unit. Control Unit. Central Processing Unit.

**Processor and Memory :** The Central Processing Unit, The Main Memory.

**Secondary Storage Devices :** Magnetic Tape. Optical Disk. Mass Storage Devices. Storage Hierarchy.

**Input/Output Devices :** Input Devices (Keyboard Devices, Data Scanning Devices, Electronic Card Reader), Output Devices (Monitors, Printers, Screen Image Projector).

**Classification of Computers :** Notebook Computers. Personal Computers (PCs). Workstation. Mainframe Systems. Supercomputers. Clients and Servers

### **2. Operating System (5 Marks)**

**Basic DOS Commands :** Comparison of DOS and Windows. Switching between DOS and Windows. Basic DOS Commands. Copying of Files and Disks. Delete/Undelete

**The User Interface :** Using Mouse and Moving Icons on the Screen. The My Computer Icon. The Recycle Bin. Status Bar, Start and Menu & Menu selection. Running an Application. Windows Explorer Viewing of Files, Folders and Directories. Creating and Renaming of Files and Folders. Opening and Closing of different Windows.

**Windows Setting :**Control Panels. Wall Paper and Screen Savers. Setting the Data and Sound. Concept of menu Using Help.

**Advanced Windows :** Using right Button of the Mouse. Creating Short Cuts. Basics of Window Setup. Notepad. Installing/ Uninstalling application.

### **3. Office Automation software (15 Marks)**

#### **3.1. MS WORD**

**Word Processing Basic:** An Introduction to Word Processing. Opening Word Processing Package. The Menu Bar. Using the Help. Using the Icons below menu bar

**Opening Documents and Closing documents:** Opening Documents. Save and Save As. Page Setup. Printing of Documents. Display/Hiding of Paragraph Marks and Inter Word Space

**Moving Around in a Document:** Scrolling the Document. Scrolling by line/paragraph. Fast Scrolling and Moving Pages

**Text Creation and Manipulation:** Paragraph and Tab Setting. Text Selection. Cut, copy and paste. Font and Size selection. Bold ,Italic and Underline. Alignment of Text: Center, Left, right and Justify

**Formatting the Text:** Changing font, Size and Color. Paragraph indenting. Bullets and Numbering. Use of Tab and Tab setting. Changing case

**Handling Multiple Documents:** Opening and closing of Multiple documents. Cut, Copy and Paste across the documents. Saving of Clip boards

**Table Manipulation:** Concept of table: Rows Columns and Cells. Draw Table. Changing cell Width and Height. Alignment of Text in Cell. Copying of cell Delete/insertion of row and columns. Borders for Table

**Printing:** Printing. Print Preview. Print a selected page

### 3.2. MS EXCEL

**Elements of Electronics Spread Sheet:** Application/usage of Electronic Spread Sheet. Opening of Spread Sheet. The menu bar. Creation of cells and addressing of cells. Cell inputting

**Manipulation of cells:** Enter texts numbers and dates. Creation of tables Cell Height and Widths. Copying of cells

**Providing Formulas:** Using basic functions/formalism a cell. Sum() function Average. Percentage. Other basic functions

### 3.3. MS POWERPOINT

**Basic:** Difference between presentation and document. Using Power Point. Opening a Power Point Presentation. Using Wizard for creating a presentation

**Creation of Presentation:** Title. Text Creation. Fonts and Sizes. Bullets and indenting. Moving to Next Slide

**Preparation of Slides:** Selection of type of Slides. Importing text from word documents. Moving to next Slide. The Slide manager

**Providing aesthetics:** Slide Designs. Background and Text colors. Making your own slide format. Footnotes and slide numbering

**Presentation of the Slides:** Using the Slide Show. Printing the Slides and Handouts. Slide sorter. Title sorter.

## 4. Internet Technologies (5 Marks)

**Introduction:** Growth and Owners of the Internet. History of World Wide Web. Basic Internet terminologies. Commerce on the Internet. Governance on the Internet. Impact of Internet on Society

**Internet Technology and Protocols:** Internet Protocols. TCP/IP. Network architecture. Local area networks. Wide Area Network. Domains

**World Wide Web:** What is World Wide web. Evolution of World Wide web. HTTP and URL's. Search Engines. Hypertext

**Browsers** : Basic features. Bookmarks, History and Progress Indication. Different Web Browser. Customization of Web Browser. Saving and printing web pages. The Internet Explorer. Searching and downloading on the internet

**Electronic Mail** : What is an Electronic Mail. Email Addressing. Using E-mails. Mailbox: Inbox and Outbox. Creating and Sending a new E-mail. Replying to an E-mail message. Forwarding an E-mail message. Sorting and Searching emails. Sending document by E-mail. Sending Softcopy as attachment

### **Unit – III : 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.