i) Name of the Post & Post Codes: Supervisor [Assay & Refining] (Technical Control) at S-1 Level [Post Code.1] and Laboratory Assistant at B-3 Level [Post Code.2]

An online exam with the under-mentioned Scheme will be conducted.

Sr. No.	Test Name	No. of Questions	Max. Marks	Duration of Exam for each Part	Total Duration of the Exam
PART-A				30 Minutes	**90 Minutes**
1	General Awareness and Basic Computer Knowledge	10	10		
2	Arithmetic Ability	10	10		
3	Basic English Language and Comprehension skills	10	10		
4	General Intelligence and Reasoning	10	10		
PART-B				60 Minutes	
5	Technical Subject (Subject Pertaining to Specific Stream)	60	120		
		Total Marks	160		

The Minimum Qualifying marks required to be scored by the candidates in the online examination to be eligible for further selection process for different categories is as under:

S.No	Category of Candidate	Minimum Qualifying Marks
1.	General/EWS	55%
2.	OBC	50%
3.	SC/ST	45%

- **Important Note: There shall be no separate Qualifying Marks for PART-A & PART-B of the online Examination, however, each candidate will have to secure a minimum overall score as detailed above.**
- Mere qualifying the online examination does not entail any candidate to be eligible for his/her appointment. He/She must rank sufficiently high in the order of merit for his/her final selection.
- Roll No. of the candidates shortlisted for Document Verification will be published on IGMH web-site, after Online examination.

ii) Name of the Post & Post Codes: Engraver (Sculpture) (Post Code.3), Engraver (Metal Works) [Post Code.4] & Engraver (Painting)[Post Code.5]

a) Selection to the posts Engraver (Sculpture), Engraver (Metal Works) & Engraver (painting) at B-4 Level will be done In 02 phases#

Phase-I:

An online exam with the under-mentioned Scheme will be conducted.

Sr. No.	Test Name	No. of Questions	Max. Marks	Duration of Exam for each Part	Total Duration of the Exam
PART-A				30 Minutes	**90 Minutes**
1	General Ability Test (General Awareness, Basic English Language skills, Basic Computer Knowledge, Basic Arithmetic Ability)	20	20		
PART-B				60 Minutes	
2	Technical Subject (Subject Pertaining to Specific Stream)	40	80		
		Total Marks	100		

Annexure V

INDICATIVE SYLLABUS FOR THE POSTS OF SUPERVISOR [ASSAY & REFINING] at S-1 Level & Laboratory Assistant at B-3 Level

PART-A

1) **General Awareness and Basic Computer Knowledge**: Questions will be aimed at testing the candidate's general awareness around him and to test knowledge of current events and of such matters of day to day importance. Questions relating to India pertaining to sports, History, Culture, Geography, economy, Polity & Indian Constitution. These Questions will be such that they do not require a special study. Candidates' basic ability to work with Computers is tested in these questions.

2) **Arithmetic Ability**: Questions on problems relating to Number Systems, Computation of Whole Numbers, Decimals and Fractions and relationship between Numbers, Fundamental arithmetical operations, Percentages, Ratio and Proportion, Averages, Interest, Profit and Loss, Discount, Mensuration, Time and Distance, Ratio and Time, Time and Work, etc.

3) **Basic English Language Skills:** Candidates' ability to understand Basic English and his basic comprehension would be tested.

4) **General Intelligence and Reasoning:** Questions of both verbal and non-verbal type. The topics are, Semantic Analogy, Symbolic/ Number Analogy, Figural Analogy, Semantic Classification, Symbolic/ Number Classification, Figural Classification, Semantic Series, Number Series, Figural Series, Problem Solving, Word Building, Coding & de-coding, Numerical Operations, symbolic Operations, Trends, Space Orientation, Space Visualization, Venn Diagrams, Drawing inferences, Punched hole/ pattern- folding & un-folding, Figural Pattern-folding and completion, Indexing, Address matching, Date & city matching, Small & Capital letters/ numbers coding, decoding and classification, Embedded Figures, Critical thinking.

PART-B (TECHNICAL SUBJECT)
SUPERVISOR [ASSAY & REFINING] at S-1 Level

Physical chemistry

General topics
Concept of atoms and molecules; Dalton's atomic theory; Mole concept; Chemical formulae; Balanced chemical equations; Calculations (based on mole concept) involving common oxidation-reduction, neutralisation, and displacement reactions; Concentration in terms of mole fraction, molarity, molality and normality.

Gaseous and liquid states
Absolute scale of temperature, ideal gas equation; Deviation from ideality, van der Waals equation; Kinetic theory of gases, average, root mean square and most probable velocities and their relation with temperature; Law of partial pressures; Vapour pressure; Diffusion of gases.

Atomic structure and chemical bonding
Bohr model, spectrum of hydrogen atom, quantum numbers; Wave-particle duality, de Broglie hypothesis; Uncertainty principle; Qualitative quantum mechanical picture of hydrogen atom, shapes of s, *p* and *d* orbitals; Electronic configurations of elements (up to atomic number 36); Aufbau principle; Pauli's exclusion principle and Hund's rule; Orbital overlap and covalent bond; Hybridisation involving *s, p* and *d* orbitals only; Orbital energy diagrams for homonuclear diatomic species; Hydrogen bond; Polarity in molecules, dipole moment (qualitative aspects only);

Energetics
First law of thermodynamics; Internal energy, work and heat, pressure-volume work; Enthalpy, Hess's law; Heat of reaction, fusion and vapourization; Second law of thermodynamics; Entropy; Free energy; Criterion of spontaneity.

Chemical equilibrium
Law of mass action; Equilibrium constant, Le Chatelier's principle (effect of concentration, temperature and pressure); Significance of AG and AG^0 in chemical equilibrium; Solubility product, common ion effect, pH and buffer solutions; Acids and bases (Bronsted and Lewis concepts); Hydrolysis of salts.

Electrochemistry
Electrochemical cells and cell reactions; Standard electrode potentials; Nernst equation and its relation to AG; Electrochemical series, emf of galvanic cells; Faraday's laws of electrolysis; Electrolytic conductance, specific, equivalent and molar conductivity, Kohlrausch's law; Concentration cells.

Chemical kinetics
Rates of chemical reactions; Order of reactions; Rate constant; First order reactions; Temperature dependence of rate constant (Arrhenius equation).

Solid state
Classification of solids, crystalline state, seven crystal systems (cell parameters *a, b, c,* a, P, Y), close packed structure of solids (cubic), packing in fcc, bcc and hcp lattices; Nearest neighbours, ionic radii, simple ionic compounds, point defects.

Surface chemistry
Elementary concepts of adsorption (excluding adsorption isotherms); Colloids: types, methods of preparation and general properties; Elementary ideas of emulsions, surfactants and micelles (only definitions and examples).

Classification of Elements: Classification – periodic law – periodicity and periodic properties classification of elements into s, p, d, f blocks.

“s” block elements: (Alkali metals and Alkaline earth metals) Elements of group IA – General properties, physical and chemical properties of compounds of I group i.e. NaOH, Na2CO3 – preparations, properties and uses. **“p” block elements:** (III, IV, V, VI, VII group elements) A. III Group: General Properties – Physical properties, chemical properties and uses. **“d” block elements:** (Transition Elements) General properties of transition elements – some general characterstics – werner’s theory of complex compounds – effective atomic number.

Solutions: Concentration methods, problems – buffer solutions – colligative properties - solubility

Acids-bases: Arrhenius acid base theory – Lowry Bronsted concept – Lewis concept – pH Problems-theory of indicators.

Oxidation-Reduction: definition - rules determining – calculation of oxidation numbers.

Bonding Group Theory and its Applications, Molecular Orbital Theory of Metal Complexes, Mono, Di and Tri hapto Complexes, Tetra, Penta,Hexa,Hepta and Octahapto Complexes, Catalytic Role of OTMC-I & II.

Analysis of non- Ferrous alloys: Analysis of Tin, Zinc and Copper in Brass, Bronze. Analysis of Tin and lead in Solder.

Ethyl Chloride, Chloroform, Alcohols, Aldehydes, Ketones, Carboxylic acids, Ethers. Polymerization-Addition and Condensation polymerization.Preparation, properties and uses of – Benzene, Nitro benzene, Aniline. Electrolytes, non-electrolytes, Arrhenius theory- Faraday’s laws of electrolysis.

Chemical equilibrium – Law of mass action – Effect of concentration, pressure, temperature and catalyst on chemical equilibrium – Lechatelier’s principle – Applications.

Industrial acids and gases: Hydrochloric acid and synthesis process - Nitric acid by ammonia oxidation process –Extraction of sulphur - Sulphuric acid by Contact process & DCDA process. HydrogenElectrolytic method – steam hydrocarbon reforming process.

Miscellaneous Inorganic Chemicals: Potassium permanganate -Potassium chloride, NPK fertilizers – Alum form Bauxite – silicon carbide by electric arc furnace – calcium carbide by quick lime process.

Second law of thermodynamics, Chemical reaction equilibria : Application of equilibrium criteria to chemical reactions – The standard Gibbs energy change and the equilibrium constant – Effect of temperature on the equilibrium constant – Evaluation of equilibrium constants – Relation between equilibrium constants and composition.

Chemical kinetics and ideal reactors: Chemical kinetics – Classification of reactions – Variables affecting the rate of reaction – Reaction rate- Concentration – Dependent term of a rate equation – Single and multiple reactors, elementary and non-elementary reactions– Rate constant K – Representation of a rate equation – Constant volume batch reactor .

Catalysis and Industrial Reactors : Types of catalysis – Characteristics of catalytic reactions – Auto catalysis – Accelerators, Promoters, inhibitors, poisons- some important catalysts- industrial catalytic processes-Important industrial reactors.

Inorganic chemistry

Isolation/preparation and properties of the following non-metals
Boron, silicon, nitrogen, phosphorus, oxygen, sulphur and halogens; Properties of allotropes of carbon (only diamond and graphite), phosphorus and sulphur.

Preparation and properties of the following compounds
Oxides, peroxides, hydroxides, carbonates, bicarbonates, chlorides and sulphates of sodium, potassium, magnesium and calcium; Boron: diborane, boric acid and borax; Aluminium: alumina, aluminium chloride and alums; Carbon: oxides and oxyacid (carbonic acid); Silicon: silicones, silicates and silicon carbide; Nitrogen: oxides, oxyacids and ammonia; Phosphorus: oxides, oxyacids (phosphorus acid, phosphoric acid) and phosphine; Oxygen: ozone and hydrogen peroxide; Sulphur: hydrogen sulphide, oxides, sulphurous acid, sulphuric acid and sodium thiosulphate; Halogens: hydrohalic acids, oxides and oxyacids of chlorine, bleaching powder; Xenon fluorides.

Transition elements (3d series)
Definition, general characteristics, oxidation states and their stabilities, colour (excluding the details of electronic transitions) and calculation of spin-only magnetic moment; Coordination compounds: nomenclature of mononuclear coordination compounds, cis-trans and ionisation isomerisms, hybridization and geometries of mononuclear coordination compounds (linear, tetrahedral, square planar and octahedral).

Preparation and properties of the following compounds
Oxides and chlorides of tin and lead; Oxides, chlorides and sulphates of Fe^{2}+, Cu^{2}+ and Zn^{2}+; Potassium permanganate, potassium dichromate, silver oxide, silver nitrate, silver thiosulphate.

Ores and minerals
Commonly occurring ores and minerals of iron, copper, tin, lead, magnesium, aluminium, zinc and silver.

Extractive metallurgy
Chemical principles and reactions only (industrial details excluded); Carbon reduction method (iron and tin); Self reduction method (copper and lead); Electrolytic reduction method (magnesium and aluminium); Cyanide process (silver and gold).

Others for Gold and Silver processing:
- Chemistry and Metallurgy (gold / silver alloy properties) and purity measurement for Precious Metals
- Methods of calculating required quantities of alloys
- Malleability of the metal and Allegation
- The chemical compositions, structure, and properties of substances used in the refining process
- The chemical processes and transformations that they undergo in the refining process
- Uses of different processes for different purposes and end results
- Potential work hazards while handling molten metal and chemicals

Principles of qualitative analysis
Groups I to V (only Ag+, Hg^{2}+, Cu^{2}+, Pb^{2}+, Bi^{3}+, Fe^{3}+, Cr^{3}+, Al^{3}+, Ca^{2}+, Ba^{2}+, Zn^{2}+, Mn^{2}+ and Mg^{2}+); Nitrate, halides (excluding fluoride), sulphate and sulphide.

Standards
Knowledge of Assaying Process as per IS1417:2016, IS: 1418 – 2009 for Gold and IS 2113: 2016 for Silver, Hall Marking as per IS 15820:2009

PART-B (TECHNICAL SUBJECT)

Laboratory Assistant at B-3 Level

1) Atomic structure and elementary quantum mechanics : Black body radiation, heat capacities of solids, Rayleigh Jeans law, Planck's radiation law, photoelectric effect, , Compton effect, De Broglie's hypothesis. Heisenberg's uncertainty principle, Schrodinger's wave equation and its importance.

2) Gaseous State: Deviation of real gases from ideal behavior. van der Waals equation of state. Critical phenomenon. PV isotherms of real gases, continuity of state. Andrew's isotherms of CO2. The van der Waal's equation and critical state. Joule Thomson effect and inversion temperature of a gas.

3) Liquid State: Intermolecular forces, structure of liquids. Structural differences between solids, liquids and gases. Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer.

4) Chemical Bonding: Ionic solids- lattice and solvation energy, solubility of ionic solids, Fajan's rule, polarity and polarizability of ions, covalent nature of ionic bond, covalent bond, Molecular orbital theory.

5) Volumetric Analysis: Standard solutions, indicators, end point, titration curves, Types of titrations: i)neutralization titration- principle, theory of acid base indicators, titration curves and selection of indicators- strong acid - strong base, strong acid –weak base, weak acid- strong base and weak acid –weak base.

6) Gravimetric analysis- Introduction, nucleation, precipitation, growth of precipitate, filtration and washing, drying and incineration of precipitate, co-precipitation and post precipitation. Determination of Ni2+ S3-G-2:

7) Theories of bonding in metals: Valence bond theory, Free electron theory, thermal and electrical conductivity of metals, Band theory, formation of bands. Classification of materials- classification as metals. The property of super conductivity of materials, Meisener effect and thermal properties. Composites, advanced composites and their classification .

8) s-block elements: General Characteristics of groups I and II elements, Diagonal relationship between Li and Mg, Be and Al.

9) p-block elements: Group–13, 14 & 15: Synthesis, structure , Classification, reactivity and Industrial application.

10) Oxides: Types of oxides, Structure of oxides of C, N, P, S and Cl - reactivity, thermal stability, hydrolysis. Oxy acids: Structure and acidic nature of oxyacids of B, C, N, P, S and Cl.

12) Anion analysis, Cation Analysis, separation and identification of group II (Hg2+, Pb2+, Bi3+, Cd2+, Sb2+), III (Al3+, Fe3+), IV ((Mn2+, Zn2+) . Application of concept of hydrolysis in group V cation analysis. Separation and identification of group V individual cations (Ba2+, Sr2+, Ca2+). Theory of flame test. Identification of Group VI cations (Mg2+, NH4 +).

13) Zero group elements: General preparation, structure, bonding and reactivity of Xenon compounds – Oxides, Halides and Oxy-halides

14) Chemistry of d-block elements: Characteristics of d-block elements with special reference to electronic configuration variable valence, ability to form complexes, magnetic properties &catalytic properties.

INDICATIVE SYLLABUS FOR THE POSTS OF ENGRAVER(SCULPTURE/METAL WORKS/PAINTING)

PART-A
(GENERAL ABILITY TEST)

General Awareness: Questions will be aimed at testing the candidate's general awareness around him and to test knowledge of current events and of such matters of day to day importance. Questions relating to India pertaining to sports, History, Culture, Geography, economy, Polity & Indian Constitution. These Questions will be such that they do not require a special study.

Basic English Language Skills: Candidates' ability to understand Basic English and his basic comprehension would be tested.

Basic Computer Knowledge: Candidates' basic ability to work with Computers is tested in these questions.

Basic Arithmetic Ability: Questions on problems relating to Number Systems, Computation of Whole Numbers, Decimals and Fractions and relationship between Numbers, Fundamental arithmetical operations, Percentages, Ratio and Proportion, Averages, Interest, Profit and Loss, Discount, Mensuration, Time and Distance, Ratio and Time, Time and Work, etc.

SYLLABUS FOR THE POST OF ENGRAVER(SCULPTURE/METAL WORKS)
PART-B(TECHNICAL SUBJECT)

History of Indian and Western Art

- History Of Art
- Fundamental of Art

A) Indian Art: Ajanta Murals, Ellora Cave Temples, Buddhist & Jain Manuscript Painting, Rajput, Kalighat Patachitras, Indus Valley Civilization-Sculpture, Terracotta & Pottery, Mauryan Sculpture, Shunga Sculpture – Sanchi, Bharahut and Bodhgaya, Amaravati Sculpture, Kushan Period – Gandhara and Mathura Sculpture, Origin of the Buddha Image, Gupta Sculpture-Hindu, Pala-Sena Sculpture, Pallava Sculpture, Khajuraho, Bhuvaneshwar and Konarak, Chola Sculpture, Pallava Sculpture

B) Metal Sculptures of North India.

C) Metal Sculptures of Western India.

D) Metal Sculptures of East India.

E) Metal Sculptures of South India

F) Western Art: Realism –Gustave Courbet & Mille, Impressionism—Manet, Monet ,Renoir, Degas, Post Impressionism—Gauguin, Van Gogh, Seurat, Cezanne, Fauvism-Matisse, German Expressionism, Edward Munch, Modigliani, Influence of Cubism on later Modern Art, Modern Sculpture-Rodin, Brancusi, Giacometti, Henry Moore, Futurism-A brief Introduction, Dadaism-Marcel Duchamp, Egyptian Sculpture, Greek Sculpture and Painting, Roman Sculpture.

MODELLING FROM LIFE

1) Study of human figures structures with reference to anatomy of full figure and portrait study n classy½, ¾ size clay modelling from life model I various poses as well as nude, semi-nude and draped.
2) Simplifications of human figure – various textural qualities to be obtained the application of the clay modelling to get various light effect, moulding an casting of ½, 3/4 size full figure model in plaster and small sketches in bronze.
3) Torso study in drawing and making torso in clay

SCULPTURAL DESIGN

1) Study of the development of sculptural organization observed from objective and non-objective forms in order to explore the expressive possibilities.
2) A segment in round and relief in clay and plaster creating structural forms through various mixed medias and various medium such as bronze, lead wax etc.

Wood Sculpture & Wood Carving

1) Study of different woods which are permanently used in wood carving such as teak, Rose,Wood, Yellow wood and similar to that study of various possibilities of wood carving methods.
2) Study of wood carving methods also methods of joining wood treatment & wood seasoning etc. Assignment based on carving on wood block and assembling the wooden various colored pieces.

Ceramic Sculpture

1) Preparing various bodies of clay and selecting three out of these bodies from sculptures.
2) Soft Body –Earthen wears, Semi stone wear, also executing sculpture cithor by, slip, slab, and hand built method. Making piece slip casting & surface made with various methods used in ceramics. To utilize the methods of Hand Building process and process for constructing the sculpture.
3) Terracotta relief & round sculpture relief & round sculpture decorated with the following methods-1.Engobing, 2.Incising 3 Perfortation, 4. Applique, 5. Coiling & 6. Impression.

Metal Sculpture (Welded Sculpture & Bronze Casting)

1) Copper, Brass, Lead and their use in response in round and in relief,
2) Possibilities and limitations of metals sculptors by casting Exercise in all stages of Bronze casting taking mold casting, Finishing & Platination .
3) Hammering & Casting Techniques
4) Embossing & Repousse Techniques
5) Chasing Techniques
6) Engraving Techniques
7) Inlaying Techniques
8) Drawing From Cast and Figure
9) Enamel Design
10) Repousse Design
11) Visualization Enamel Design
12) Visualization Repousse Design

SYLLABUS FOR THE POST OF ENGRAVER (Painting)
PART-B(TECHNICAL SUBJECT)

History of Arts:

A) Indian Art: Indus Valley Civilization, Mauryan Art, Shunga Art, Andhra Art, Kushan Art , Gupta Art, Pallava Period. Study of Indian Miniatures Painting, Jain, Rajasthani, Pahari and Mughal Schools

B) Western Art: Egyptian Art, Mesopotamian Art, Greek Art, Roman Art, Byzantine Art, Gothic Art, Renaissance

Painting:

1) Drawing (Manmade & Nature)

2) Head Study.

3) Drawing From Life

4) Painting: Study of Visual Elements, Point, Line, Planes and Shapes. Study of Design Principles, Organization in space (positive and negative).Basic and free shapes- Line, Colour, Tone, Texture, Form and Space.

5) Colour: Perception of colour, Light and Pigment theory, Understanding of Primary and Secondary colours. Number of secondary colours that can be made from basic colours. Colour Wheel and various Colour Schemes derived from it. Complementary Scheme, Analogous Colour. Split and Double Split Complementary Colour Scheme. Gray Scale, Keys and Contrast.

6) PRINT MAKING: Fundamentals of various methods of taking prints. Rubbing. Mono-print in single or two colours with various types of materials and their combinations, viz. paper, card board, cloth etc. Various categories of print making into the surface of a printing block ciz. Plano-graph, relief process, intaglio and stencil. The method and materials used in various processes of print making viz. Lino cut, Wood cut, knowledge of terminology and mounting a print.

7) Painting In water colour, coloured pencils or coloured inks. Extension of Painting: Arrangements of figures and forms in pictorial space, expression of specific mood and emotions.

8) Drawings & Paintings from life: Drawing from life (Human forms), Painting of full human figure in various colours media (water, Pastel, Oil), Portrait painting, Half-length studies of human figure, Bust of male and female in different age groups.

9) Pictorial Design: Study of composition (Principals), Placement of the elements on the surface, compositional problems of each type of painting.

10) PRINT MAKING: Introduction of materials and tools, it's use for making a design for relief print. Making relief print from wooden blocks. Knowledge of registration, designing prints with more than two colours, Use of overlapping of colours, Possibilities of the textural values of various types of materials like wood, linoleum, zinc plate etc.