

Board of Metallurgical Engineering

The Metallurgical Engineer Licensure Examination Syllabus

METALLURGY I

Scope: The conceptual knowledge and understanding of the scientific, engineering and economic terminologies, theories and principles underlying the preparation, separation, recovery and concentration of metals and mineral values from their ores and such other secondary sources as may be feasible, and, as well as the extraction and purification of the former into their primary usable forms. It shall, likewise, include adequate knowledge and appreciation of commercially available and generally applied unit metallurgical process and operations which are of immediate and significant relevance to the intelligent, economic, competent and practical applications of the above theories, principles, unit operations and processes to metallurgical problems and situations as most likely to be encountered in practice.

1.0 Mineral Processing

1.1 Ores and Other Sources of Metals and Minerals

1.2 Principles and Theories Involved in the following:

- Liberation
- Comminution
- Separation and Concentration
- Dewatering and Filtration
- Other relevant miscellaneous processes and operations

1.3 Sampling, Testing and Milling Calculations

1.4 Plant Operations and Flow sheets including waste handling and treatment recovery and/ or disposal in mineral processing

1.5 Applications

2.0 Extractive Metallurgy

2.1 Pyrometallurgy

General Concepts

Stoichiometry and Charge Calculations

Heat, Heat Flow and Heat Balance Calculations

Combustion and Heat Utilization

Chemical Equilibria in Pyrometallurgy

Phases in Pyrometallurgical Systems

High Temperature Kinetics

Unit Pyrometallurgical Processes and Operations

2.2 Hydrometallurgy

General Concepts

Equilibria in Solutions

Thermodynamics and Kinetics of Leaching Reactions

Practical Leaching Systems

Solid-Liquid Separation

Aqueous Purification

Metals winning from Solutions

Hydrometallurgy of Common Metals

2.3 Electrometallurgy

General Concepts
Electrolysis, Partition Theory, Ion Exchange, etc.
Electrochemical Aspects of Leaching and Corrosion
Electrometallurgical Extraction Processes

3.0 Ore Microscopy

- 3.1 General concepts and Principles of Microscopy
- 3.2 Microscopic Techniques in Mineral Identification, Sizing and Determination of Degree of Liberation
- 3.3 Applications

4.0 Fire Assaying

- 4.1 Definitions and Terminologies
- 4.2 General Concepts and Principles
- 4.3 Equipment and Tools
- 4.4 Sampling and Measurements
- 4.5 Balances and Weights
- 4.6 Cupellation
- 4.7 Parting
- 4.8 Assay Techniques and Procedures
- 4.9 Calculations and Applications for Ores and Bullions

5.0 Metallurgical Physical Chemistry

- 5.1 General Concepts and Principles
- 5.2 Concept of State and Systems, Attributes and Basic Relationships
- 5.3 Laws of Thermodynamics
- 5.4 Auxiliary Thermodynamics Functions
- 5.5 Phases and Phase Equilibria
- 5.6 Gases and their Behaviors
- 5.7 Solutions and its Thermodynamics
- 5.8 Kinetics, Order of Reaction, Theory of Reactions Rates, Temperatures
- 5.9 Electrochemistry

6.0 Inorganic Qualitative and Quantitative Chemistry

- 6.1 Atomic Structure of Elements
- 6.2 Properties of Solids, Liquids and Solutions
- 6.3 Bonding and Periodicity
- 6.4 Chemical Equations (Oxidation and Reduction)
- 6.5 Equilibrium Principles and its Applications to Ionic Equilibria in Aqueous Solutions
 - Reactions Rates
 - Weak Acids and Bases
 - Ion Product, pH, Buffers, etc.
 - Heterogenous Equilibrium and Solubility Products
 - Hydrolysis
 - Polybasic Acids
 - Complex Ions
 - Amphoteric Substances
 - Oxidation-Reduction Equilibrium
 - Other principles relevant to above metallurgical engineering fields
- 6.6 Positive Ions, Behavior and Determination
- 6.7 Volumetric and Gravimetric Analysis
- 6.8 Analysis for Positive Ions, Metals and Alloys
- 6.9 Units and Measurements

THE METALLURGICAL ENGINEER LICENSURE EXAMINATION SYLLABUS

METALLURGY II

1.0 Physical Metallurgy

This subject deals with the study of metal structure, their behavior and properties, including the interpretation of phase equilibrium diagrams of metals and alloys and kinetics of transformation

- 1.1 Binary Systems/Equilibrium Diagrams
- 1.2 Heat Treatment of Metals and Alloys
- 1.3 Kinds of Metal bonding
- 1.4 Cooling Curves
- 1.5 Phase Transformation
- 1.6 Properties of Metals
- 1.7 Solidification of Metals
- 1.8 Hardenability
- 1.9 Diffusion

2.0 Mechanical Metallurgy

This involves the mechanical factors in metal forming and build-up processes as well as the metallurgical and mechanical factors which cause defects and problems in metal forming and processing

- 2.1 Fracture, Creep, Stress, Strain
- 2.2 Metal Forming
 - Forging
 - Rolling
 - Drawing
 - Extrusion
 - Machining
 - Welding
 - Brazing and Soldering
- 2.3 Von-Mises Criterion
- 2.4 Elasticity
- 2.5 Shrinkage
- 2.6 Hot Working/Cold Working

3.0 Crystallography/Metallography

The subject deals with the arrangement of atoms within the structures of metals and alloys and the relationships of this atomic arrangement to the behavior of metals and their properties

- 3.1 Space lattice, the fourteen possible space lattices, unit cell
- 3.2 Crystallographic notation, reference axes
- 3.3 Seven crystal systems
- 3.4 Miller Indices
- 3.5 Structure of metallic crystals, close packed, hexagonal, face centered, cubic, body centered cubic and other crystal structure

4.0 Iron and Steel Metallurgy

This subject deals with the production of ferrous metals from ores to refined metals with emphasis given on Iron and Steels. Principles of various production processes and operations with the use of flowsheets are given high importance. Direct iron reduction is also taken into account. Topics undertaken are the following:

- 4.1 Fe-C equilibrium diagram
- 4.2 Heat treatment of steel
- 4.3 Chemistry of Ironmaking
- 4.4 Iron blast furnace
- 4.5 Direct reduction process
- 4.6 Steelmaking
- 4.7 Alloying elements
- 4.8 Metallography of steel

5.0 Non-Ferrous Metallurgy

This involves the different operation and production processes of non-ferrous metals.

- 5.1 Aluminum and aluminum alloys
- 5.2 Copper and copper alloys
- 5.3 Nickel and nickel alloys
- 5.4 Lead and lead alloys

6.0 Foundry

This subject gives emphasis on the principles and processes of metal casting production. It considers the production of common cast metal products and the common molding sand tests. Also, this specifies quality control measures in foundry works and identification of common casting defects and its causes.

- 6.1 Foundry sand testing/molding/casting
- 6.2 Metal casting
- 6.3 Patterns and pattern making
- 6.4 Solidification of castings
- 6.5 Riser
- 6.6 Gating
- 6.7 Cleaning and inspection
- 6.8 Foundry equipment tools and lay-out
- 6.9 Core and coremaking
- 6.10 Manufacture of cast products

THE METALLURGICAL ENGINEER LICENSURE EXAMINATION SYLLABUS

METALLURGY III

Scope: Conceptual knowledge, understanding and applications of the concepts terminology and principles of Basic Computer Science, Refractory Science, Fuel Technology, Metallurgical Law, Ethics, Statistics, Engineering Management, Mechanics and Hydraulics.

1.0 Basic Computer Science

- 1.1 Important parts/functions of computer hardware
- 1.2 Basic computer language/program
- 1.3 Forming and organizing spreadsheet or database

2.0 Refractory Science

- 2.1 Types of refractories
- 2.2 Properties of refractories
- 2.3 Manufacture of refractories
- 2.4 Application of refractories on metallurgical processes/ furnaces
- 2.5 Design of refractory systems/ computation of refractories required for specific applications

3.0 Fuel Technology

- 3.1 Types of fuels
- 3.2 Properties of fuels
- 3.3 Processing of solid fuels
- 3.4 Combustion of fuels in metallurgical furnaces
- 3.5 Heat transfer in metallurgical furnaces/processes

4.0 Metallurgical Law, Jurisprudence

- 4.1 P.D. 1536 - The Metallurgical Engineering Law
- 4.2 Implementing rules of P.D. 1536
- 4.3 Application of the law and implementing rules in actual professional practice
- 4.4 The Professional Regulations Commission: Powers and Functions, rules and regulations related to Met E. practice

5.0 Ethics

- 5.1 The code of Ethics for Metallurgical Engineers
- 5.2 Application of the code of ethics in actual professional practice

6.0 Statistics

- 6.1 Statistical Concepts
- 6.2 Normal distribution
- 6.3 Correlation
- 6.4 Sampling theory and practice
- 6.5 Statistical quality control

7.0 Engineering Management

- 7.1 Selection of alternatives
- 7.2 Simple investment/ engineering economy studies
- 7.3 Feasibility studies

8.0 Mechanics

- 8.1 Stress, strength, torque
- 8.2 Strength of materials
- 8.3 Forces acting on members/ simple machines
- 8.4 Dynamics of simple bodies/ machines
- 8.5 Solutions of simple problems

9.0 Hydraulics

- 9.1 Properties of fluids
- 9.2 Flow of fluids
- 9.3 Floating and submerged bodies
- 9.4 Movement of particles in fluids
- 9.5 Fluid handling equipment
- 9.6 Solution of simple problems

10.0 Design

- 10.1 Design of simple metallurgical processes/operation/ plants or facilities