NCEES
advancing licensure for engineers and surveyors

NCEES Principles and Practice of Engineering Examination
METALLURGICAL AND MATERIALS CBT Exam Specifications

Effective Beginning October 1, 2022

- The exam topics have not changed since October 2015 when they were originally published.
- The PE Metallurgical and Materials exam is computer-based. It is closed book with an electronic reference handbook.
- Examinees have 9.5 hours to complete the exam, which contains 85 questions. The 9.5-hour time includes a tutorial and an optional scheduled break. Examinee works all questions.
- The exam uses both the International System of Units (SI) and the U.S. Customary System (USCS).
- The exam is developed with questions that require a variety of approaches and methodologies, including design, analysis, and application.
- The knowledge areas specified as examples of kinds of knowledge are not exclusive or exhaustive categories.
- The exam includes questions independent of the type of material as well as questions related to specific materials. The number of material-specific questions are distributed as follows:

Ferrous 30–50	Ceramics and ceramic composites 5–10
Nonferrous 15–25	Other materials 1–3
Polymers and polymer composites 5–10	

	Number of Questions
1. Structure	**11–17**
A. Crystal structures of metals, ceramics, and polymers, including imperfections or defects in solids (e.g., vacancies, interstitials, substitutional atoms, dislocations, twins, stacking faults, phase boundaries)	
B. Diffusion	
C. Fractography	
D. Materials chemistry	
E. Metallography (microstructure/macrostructure), including microstructural standards and specifications	
F. Phase diagrams	
2. Properties	**14–21**
A. Chemical analysis techniques (e.g., OES, EDS)	
B. Metallic and nonmetallic coatings	
C. High-temperature behavior (thermal stability, creep, and stress rupture)	
D. Low-temperature and cryogenic behavior	
E. Materials standards and specifications	
F. Mechanical behavior of composites and heterogeneous material	
G. Physical properties (e.g., density, thermal conductivity, CTE)	
H. Routine (e.g., hardness, tensile, impact) and specialized (e.g., fatigue, fracture toughness, high temperature) mechanical testing	

3. Processing **21–32**

A. Elastic/plastic deformation and bulk forming (e.g., rolling, forging, extruding)
B. Casting (e.g., sand, die, investment)
C. Coating applications (e.g., thermal sprays, paints, vapor, electroplating, galvanizing)
D. Cold work and annealing
E. Diffusion treatment (e.g., carburization)
F. Heat transfer
G. Heat treatment and thermal treatments (e.g., flame or induction hardening)
H. Joining—brazing and soldering
I. Joining—welding
J. Phase transformations and other strengthening mechanisms for metals
K. Powder processing (e.g., pressing, sintering)
L. Standards and specifications for processing
M. Toughening mechanisms for ceramics
N. Strengthening mechanisms for polymers and reinforced polymers
O. Industrial safety practices

4. Performance **24–36**

A. Corrosion mechanisms (e.g., crevice, galvanic, pitting, MIC)
B. Corrosion/environmental compatibility
C. Electrochemistry
D. Environmental test methods (e.g., corrosion testing, aging testing)
E. Environmentally assisted cracking (e.g., hydrogen, SCC, LME)
F. Failure analysis
G. Fatigue analysis
H. Fitness for service, life prediction and modeling, and life extension
I. Fracture mechanics
J. High-temperature degradation (e.g., oxidation, creep, corrosion, microstructure alterations, metal dusting) and temperature, radiation, and other environmental compatibilities
K. Mechanical performance
L. Nondestructive testing (NDT) (e.g., radiography, ultrasonic, penetrant)
M. Performance standards and specifications
N. Statistical quality control methods
O. States of stress (e.g., tensile, compressive, bending, shear, biaxial, plane strain)
P. Wear mechanisms (e.g., erosion, fretting, abrasive, adhesive, galling)