



NCEES

*advancing licensure for
engineers and surveyors*

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

Effective Beginning with October 2024 Examination

- 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, questions involving multiple types of materials, and questions related to specific materials. The approximate distribution of material-specific questions is as follows:

Ferrous 30–55%

Nonferrous 15–25%

Polymers and polymer composites 10–20%

Ceramics and ceramic composites 5–10%

	Number of Questions
1. Structure	11–17
A. Structures of metals, ceramics, and polymers (e.g., FCC/BCC, degree of cross-linking, imperfections or defects in solids)	
B. Diffusion and phase transformations	
C. Fractography	
D. Materials chemistry	
E. Microstructure/macrostructure	
F. Binary and ternary phase diagrams	
G. Non-equilibrium structures	
2. Performance	23–35
A. Environmental performance of metals (e.g., corrosion, hydrogen damage, SCC, LME)	
B. Environmental performance, weathering, and aging of nonmetals	
C. Mechanical performance (e.g., instantaneous and time-dependent response to static, dynamic, and cyclic loading)	
D. Thermal performance (e.g., heat transfer, microstructural stability, oxidation/sulfidation, interactions)	
E. Wear performance and tribology (e.g., erosion, fretting, abrasive, adhesive, galling, lubricant performance)	

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- F. Quality assurance (e.g., NDE, application of standards and specifications, inspection, statistical analysis)
 - G. Failure analysis
 - H. Fitness for service, life prediction and modelling, and life extension
 - I. Material selection (e.g., Ashby plots)
 - J. Lifecycle analysis (e.g., recyclability, CO₂ footprint, sustainability)

3. Processing

19–29

- A. Deformation processing (e.g., rolling, forging, extruding, stamping, drawing)
- B. Casting and molding (e.g., sand, die, investment, injection, blow, slip)
- C. Coating applications (e.g., thermal sprays, paints, vapor deposition, electroplating, galvanizing)
- D. Cold work, stress relief, and annealing
- E. Diffusion and thermal surface treatments
- F. Joining of metals/polymers (e.g., brazing, soldering, and welding)
- G. Heat treatment and other strengthening mechanisms (e.g., quenching, tempering, precipitation hardening, solid solution)
- H. Powder processing of metals and ceramics (e.g., pressing, sintering)
- I. Additive manufacturing/3D printing (metals, polymers, ceramics, and composites)
- J. Polymer and composite material processing (e.g., injection molding, extrusion of molten polymers, blow molding, autoclaving, hot isostatic pressing)

4. Characterization and Properties

17–26

- A. Structural analysis techniques (e.g., XRD, EBSD, TEM, SEM)
- B. Chemical analysis techniques (e.g., OES, EDS, mass spectroscopy, wet chemistry)
- C. Polymer characterization techniques (e.g., chemical, thermal, time-dependent mechanical analyses)
- D. Corrosion testing
- E. Characterization of metallic and nonmetallic coatings
- F. High-temperature behavior (e.g., thermal stability, creep, stress rupture)
- G. Low-temperature and cryogenic behavior (e.g., ductile-to-brittle transition, toughness)
- H. Mechanical property evaluation (e.g., tensile, impact, hardness, fatigue, fracture toughness, high temperature)
- I. Mechanical behavior of composites and heterogeneous material
- J. Physical properties (e.g., density, thermal conductivity, CTE, optical, magnetic, electrical, dielectric)