NCEES
advancing licensure for engineers and surveyors

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

Effective Beginning with the October 2015 Examinations

- The exam is an 8-hour open-book exam. It contains 40 multiple-choice questions in the 4-hour morning session, and 40 multiple-choice questions in the 4-hour afternoon session. Examinee works all questions.
- The exam uses both the International System of Units (SI) and the US 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 numbers of material-specific questions are distributed as follows:

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

		Approximate Number of Questions
I.	**Structure**	**12**
	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	
II.	**Properties**	**16**
	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	

III. Processing 24

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

IV. Performance 28

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)