

National Council of Examiners for Engineering and Surveying
Principles and Practice of Engineering
METALLURGICAL AND MATERIALS ENGINEERING Exam Specifications
Effective Beginning with the October 2008 Examinations

	<u>Approximate Percentage of Examination</u>
I. Foundation Topics	33%
A. Statistics	5%
1. Confidence intervals	
2. Data analysis	
3. Application to quality control	
4. Process quality control	
B. Physical/engineering sciences	11%
1. Physical chemistry	
2. Phase equilibria	
3. Thermodynamics	
4. Heat transfer	
5. Reaction kinetics	
C. Mechanics of materials	5%
1. Statics	
2. Dynamics	
D. Process fundamentals	12%
1. Mass balances	
2. Heat balances	
3. Thermodynamics	
4. Kinetics	
5. Heat transfer	
6. Electrochemistry	
II. Structure and Properties	30%
A. Structure/phase/transformations	10%
1. Crystal structure	
2. Phase diagrams	
3. Solidification	
4. Phase transformations	
5. Diffusion	
6. Chemistry	

B. Mechanical properties of metals and materials	10%
1. States of stress	
2. Strengthening mechanisms	
3. Cold work and annealing	
4. Elastic/plastic deformation	
5. Fracture mechanics	
6. Fatigue analysis and life prediction	
7. High-temperature behavior (creep and stress-rupture)	
8. Mechanical behavior of composites	
C. Applications and specifications of metal and materials selection	10%
1. Mechanical performance	
2. Chemical resistance	
3. Thermal stability	
4. Corrosion/environmental compatibility	
5. Temperature/radiation or other environmental compatibilities	
III. Processing	21%
A. Heat treatments	7%
1. Ferrous alloys (e.g., hardenability, hardening, tempering)	
2. Nonferrous alloys (e.g., annealing, precipitation hardening, age hardening)	
3. Polymers, ceramics and glasses	
B. Surface modification	5%
1. Diffusion treatment (e.g., carburization)	
2. Coatings (e.g., thermal sprays, paints, vapor)	
3. Thermal treatments (e.g., flame or induction hardening)	
C. Forming and fabrication	9%
1. Joining (e.g., welding, brazing, and soldering)	
2. Casting (e.g., sand, die, investment)	
3. Bulk forming (e.g., rolling, forging, extruding)	
4. Powder processing (e.g., pressing, sintering)	
5. Material removal processes (e.g., machining)	
IV. Performance	16%
A. Material testing	8%
1. Mechanical testing (e.g., hardness, tensile, impact)	
2. Mechanical testing (e.g., fatigue, fracture, toughness)	
3. Nondestructive testing (NDT) (e.g., radiography, ultrasonic, penetrant)	
4. Chemical analysis techniques (e.g., OES, EDS)	
5. Metallography (microstructure/macrostructure)	
6. Electron microscopy	
7. X-ray diffraction application/analysis	
8. Environmental test methods (e.g., corrosion testing)	

B. Material degradation	7%
1. Corrosion and wear mechanisms (e.g., crevice, galvanic, pitting)	
2. High-temperature oxidation	
3. Embrittlement (e.g., hydrogen, DBTT)	
C. Waste process control and environmental impact	1%
1. Recycling and alternative materials to reduce and manage hazardous waste (e.g., Cr, Cd)	
Total	100%

Notes

1. The examination will include questions that are independent of the type of material and questions that are related to specific materials. The materials-specific questions will be distributed in the following three groups:
 - a. Approximately 50% of the material-specific questions address ferrous materials, defined as stainless steel, cast iron, carbon steel, and alloyed steel.
 - b. Approximately 30% of the material-specific questions address light and nonferrous materials, defined as titanium and titanium alloys, aluminum and aluminum alloys, copper and copper alloys, intermetallic alloys, precious metals, refractory alloys, superalloys, and other nonferrous metals.
 - c. The remaining 20% of the material-specific questions address ceramics, polymers, composites, and electronic materials, including glasses, functional ceramics, engineering ceramics, elastomers, thermoset, thermoplastic, composites, silicon, and other semiconductor materials.
2. The knowledge areas specified as A, B, C, etc., are examples of kinds of knowledge, but they are not exclusive or exhaustive categories.
3. This exam contains 80 multiple-choice questions. Examinee works all questions.