NCEES
advancing licensure for engineers and surveyors

Principles and Practice of Engineering Examination
MECHANICAL—MACHINE DESIGN AND MATERIALS CBT Exam Specifications
Effective Beginning April 2020

- The exam topics have not changed since April 2017 when they were originally published.
- The exam is computer-based. It is closed book with an electronic reference.
- Examinees have 9 hours to complete the exam, which contains 80 questions. The 9-hour time includes a tutorial and an optional scheduled break. Examinees work 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.

	Number of Questions
I. Principles	**35–55**
A. Basic Engineering Practice	7–11
1. Engineering terms, symbols	
2. Interpretation of technical drawings	
3. Quality assurance/quality control (QA/QC)	
4. Project management and economic analysis	
5. Units and conversions	
6. Design methodology (e.g., identifying requirements, risk assessment, verification/validation)	
B. Engineering Science and Mechanics	9–14
1. Statics	
2. Kinematics	
3. Dynamics	
C. Material Properties	7–11
1. Physical (e.g., density, melting point, optical)	
2. Chemical (e.g., corrosion, alloys, oxidation)	
3. Mechanical	
a. Time-independent behavior (e.g., modulus, hardness, thermal expansion)	
b. Time-dependent behavior (e.g., creep, viscoelastic, thermal conductivity)	

		Number of Questions
D.	Strength of Materials	9–14
	1. Stress/strain (e.g., tension, compression)	
	2. Shear	
	3. Bending	
	4. Buckling	
	5. Torsion	
	6. Fatigue	
	7. Failure theories (e.g., Von Mises, maximum shear stress)	
E.	Vibration	3–5
	1. Natural frequencies (e.g., linear, bending, torsional) and acoustics	
	2. Damping (e.g., frequency, damping ratio, critical damping)	
	3. Forced vibrations (e.g., magnification factor, transmissibility, balancing, isolation)	
II.	**Applications**	**35–55**
A.	Mechanical Components	16–25
	1. Pressure vessels and piping (e.g., thick/thin wall)	
	2. Bearings (e.g., types, lubrication analysis, life-load analysis)	
	3. Gears (e.g., types, speed analysis, force analysis)	
	4. Springs (e.g., types, force analysis, fatigue analysis)	
	5. Dampers (e.g., types, selection)	
	6. Belt, pulley and chain drives (e.g., types, force analysis)	
	7. Clutches and brakes (e.g., types, torque/force analysis)	
	8. Power screws (e.g., types, lifting and lowering torque, locking conditions)	
	9. Shafts and keys (e.g., torsion, bending, static/fatigue failure, stress risers)	
	10. Mechanisms (e.g., linkages, cams, slider crank, levers, force analysis, kinetic analysis)	
	11. Basic mechatronics (e.g., electromechanical interfaces, sensors, basic circuits, basic controls)	
	12. Hydraulic and pneumatic components (e.g., pumps, cylinders, presses)	
	13. Motors and engines (e.g., energy conservation, efficiency)	
B.	Joints and Fasteners	10–16
	1. Welding and brazing (e.g., types, symbols, stress analysis)	
	2. Bolts, screws, rivets (e.g., grade/class selection, preload, fastener group force analysis)	
	3. Adhesives (e.g., types, analysis)	
C.	Supportive Knowledge	9–14
	1. Manufacturing processes (e.g., machining, molding, heat treatment)	
	2. Fits and tolerances	
	3. Codes and standards	
	4. Computational methods and their limitations (e.g., FEA, CAE)	
	5. Testing and instrumentation	