

THE NATIONAL COUNCIL OF EXAMINERS FOR ENGINEERING AND SURVEYING

Principles and Practice of Engineering Examination
Mechanical Engineering—MECHANICAL SYSTEMS and MATERIALS Depth Examination

EFFECTIVE October 2008

The mechanical engineering examination is a breadth and depth examination. This means that **all** examinees work the breadth (AM) exam and **one** of the three depth (PM) exams. The three areas covered in the mechanical engineering examination are HVAC and Refrigeration; Mechanical Systems and Materials; and Thermal and Fluids Systems. The breadth exam contains questions from these three areas of mechanical engineering. The depth exams focus more closely on a single area of practice in mechanical engineering.

	Approximate Percentage of Examination
Mechanical Systems and Materials Depth Module (PM)	
I. Principles	60%
A. Statics (e.g., free body diagrams, friction, centroids, inertia)	15%
B. Kinematics (e.g., linear/rotational motion, velocity, acceleration)	7%
C. Dynamics (e.g., particle and rigid body)	10%
D. Materials Properties (e.g., physical, chemical, mechanical)	10%
E. Strength of Materials (e.g., stress/strain, shear, bending, buckling, torsion)	18%
II. Applications	40%
A. Mechanical Components	10%
1. Pressure vessels (e.g., thick/thin wall)	
2. Bearings (e.g., journal, ball, roller, lubrication, life-load relationships)	
3. Gears (e.g., spur, bevel, helical, planetary, speed and torque ratios)	
4. Springs (e.g., helical, torsion, leaf, stiffness, deflection)	
5. Belts, pulleys, and chains (e.g., flat/V, wire rope, roller chain, sprockets)	
6. Clutches and brakes (e.g., disc/drum brake, flat plate/cone clutch)	
7. Power screws (e.g., lifting and lowering torque, locking conditions)	
8. Shafts and keys (e.g., torsion, bending, static/fatigue failure, stress risers)	
9. Mechanisms (e.g., linkages, slider cranks, levers, mechanical advantage)	
10. Mechatronics (e.g., electro-mechanical interfaces, control, robotics)	
B. Joints and Fasteners	10%
1. Welding and brazing (e.g., butt, fillet, groove, eccentric, symbols)	
2. Bolts, screws, and rivets (e.g., load capacity, grade, bolt patterns, pretension)	
3. Adhesives and soldering (e.g., butt, lap, glue, epoxy)	
4. Others (e.g., pipe threads, snap rings, interference fit)	
C. Vibration/Dynamic Analysis	10%
1. Natural frequencies (e.g., for linear, bending and torsional)	
2. Damping (e.g., frequency, damping ratio, critical damping)	
3. Forced vibrations (e.g., magnification factor, transmissibility, unbalance)	
4. Vibration isolation	
5. Dynamic analysis (e.g., balancing, vehicle dynamics)	

D. Materials and Process

10%

1. Materials selection (e.g., impact of physical, chemical and mechanical properties)
2. Manufacturing processes (e.g., machining, molding, heat treatment)
3. Fits and tolerances
4. Economic analysis and project management
5. Quality control

Notes

1. The examination is developed with questions that will require a variety of approaches and methodologies including design, analysis, and application. Some questions may require knowledge of engineering economics.
2. Questions in this module will be in *either* USCS or SI units.
3. The knowledge areas specified under 1, 2, 3, etc., are examples of kinds of knowledge, but they are not exclusive or exhaustive categories.
4. Each depth (PM) exam contains 40 multiple-choice questions. Examinee chooses one depth examination and works all questions in the depth examination chosen.
5. Score results are combined with breadth exam results for final score.