
Scope of the Mechanical Engineering exam

- Physics for mechanical engineering

Kinematics in one dimension, in two dimension
Newton's laws of motion, gravitation, contact forces
Dynamics of uniform circular motion, orbits, non uniform circular motion
Kepler laws
Work and energy, kinetics energy
Potential energy, work done by variable forces
Momentum and impulse, momentum conservation
Collisions
Rotational Kinetic energy, torque, work
Angular momentum, conservation
Rigid body dynamics
Fluids, pressure, Pascal's principle, buoyancy, fluid flow
Oscillations, simple harmonic motion, pendulum
Waves and sound
Linear superposition, interference, diffraction
Doppler effect
Temperature and Heat
The ideal gas law

- Maths: analysis (calculus !), linear algebra, differential equations

Ordinary differential equations
Vectors and linear algebra
Systems of differential equations
Vector analysis
Fourier analysis
Partial differential equations
Complex analysis

- Chemistry for mechanical engineering

General chemistry
Stoichiometry
Conservation of energy, mass
Elementary atomic theory
Periodic table
Gas laws



Nuclear chemistry
Chemical bonding
Chemical kinetics
Chemical equilibria
Physical chemistry
Equilibrium: properties of gases, first law, second law, changes of state
Structure: quantum theory, atomic structure and spectra, molecular structure, statistical thermodynamics introduction

- Thermodynamics / engineering thermodynamics

Energy and the first law
Properties and State
States of simple substances
Energy analysis
Entropy and the second law
Some consequences of the second law
The thermodynamics of State
Thermodynamic Systems
Thermodynamic of non reacting mixtures

- Fluid Mechanics

Fluid statics
Bernoulli and energy equation
Momentum analysis of flow structures
Flow in pipes
Flow over bodies: Drag and Lift
Boundary layer

- Heat Transfer

Introduction: Modes of Heat Transfer
Steady state conduction in one dimension
Heat Transfer coefficient
Forced convection
Free convection, introduction
Radiation Heat Transfer
Introduction to Heat Exchangers
Unsteady state and multidimensional Heat conduction



- **Material engineering (& science) basics**

Atomic structure, nanostructure, macrostructure,
crystallography, bonding thermodynamics

- **Strength of materials and solid mechanics**

Continuum mechanics

Stress and strain

Strain analysis

Mechanical behavior of solids: elastic, plastic, viscoelastic material behavior

Linear elastic solids; elastic solids

Finite element methods

Failure modes in solid mechanics