EngineeringRise

Elasticity: stress, strain and moduli

Formulas and units, JEE Main. Status: Reviewed on 2026-11-20.

Result	Formula	Units or note
Stress	stress = F/A Valid when: force perpendicular to area, spread uniformly over A	N/m^2 (Pa)
Longitudinal strain	strain = dL/L Valid when: small deformation; L is the original length	no unit
Young's modulus	Y = F L/(A dL) Valid when: wire within the elastic (Hooke) limit	N/m^2
Bulk modulus	B = - V dP/dV = - dP/(dV/V) Valid when: uniform pressure change, small volume change, elastic limit	N/m^2
Modulus of rigidity	n = shear stress/shear angle = (F/A)/theta Valid when: small shear angle in radians, within elastic limit	N/m^2
Spring constant of a wire	k = Y A/L Valid when: uniform wire within the elastic limit	N/m
Elastic energy	U = (1/2) F dL = F^2 L/(2 A Y) Valid when: wire stretched slowly from zero within the elastic limit	J
Energy density	u = (1/2) stress x strain = stress^2/(2Y) Valid when: elastic limit not crossed; per unit volume	J/m^3
Thermal stress (clamped rod)	stress = Y alpha dT Valid when: rod rigidly clamped, uniform temperature change, within elastic limit	N/m^2
Wire hanging under its own weight	dL = rho g L^2/(2Y) Valid when: uniform vertical rod hanging under its own weight	m

Full lesson with worked examples:
https://www.engineeringrise.in/learn/learn/jee-main/physics/properties-of-solids-and-liquids/elasticity-stress-strain-and-moduli

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