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AIRCRAFT ENGINES
LECTURE NOTES
(First Preliminary Edition)

Section A. Nomenclature Topics

Part II. Thermal Coefficients, Energy, and Work

Chapter 6. Internal Energy Characteristic of Thermodynamics

LECTURE 7. INTERNAL ENERGY

§ 1.8. Energy. Internal energy

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The relation by **A. Einstein** [113, pp. 22-23]

$$E = mc^2,$$

where E – **total energy of a body**, with the mass of m; c – the speed of light $\left(c = 3 \cdot 10^8 \text{ m/s}\right)$.

The mass of a body, moving with the velocity (speed) of w

$$m = \frac{m_0}{\sqrt{1 - \dfrac{w^2}{c^2}}},$$

where m_0 – the mass of the body in the rest (immovable state).

In thermodynamics, the **total energy of a macro-system** equals

$$E = E_k + E_p + U,$$

where E_k – **kinetic energy** of the system; E_p – **potential energy** of the system in the external forces fields; U – **internal energy**.

Kinetic energy

$$E_k = \frac{mw^2}{2}.$$

The change of the **potential energy** is equal to the **work**, done over the system at its displacement from one position (place) in the force field to another.

Internal energy it is the energy, enclosed in the system. It consists of the kinetic energy of translational, rotational, and oscillation movement (motion) of molecules, potential energy of the molecules interaction, energy of internal-atomic and internal-nucleus (nuclei) motions of particles and other.

Internal energy is the function of the internal parameters of state (state variables) (temperature, pressure) and the composition of a system. Due to being the function state, the change of the internal energy ΔU does not depend upon the shape (view, form) of the way of a process, but is determined by just the values in the final and initial states only instead, i.e. (that is)

$$\Delta U = U_2 - U_1.$$

Internal energy is an additive value. For a complex system it is determined as the sum of internal energies of component parts of the system, i.e. (that is) [113, pp. 22-23]

$$U = \sum U_i .$$

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