



WIKIPEDIA
The Free Encyclopedia

Dynamics (mechanics)

Dynamics is the branch of classical mechanics that is concerned with the study of forces and their effects on motion. Isaac Newton was the first to formulate the fundamental physical laws that govern dynamics in classical non-relativistic physics, especially his second law of motion.

Principles

Generally speaking, researchers involved in dynamics study how a physical system might develop or alter over time and study the causes of those changes. In addition, Newton established the fundamental physical laws which govern dynamics in physics. By studying his system of mechanics, dynamics can be understood. In particular, dynamics is mostly related to Newton's second law of motion. However, all three laws of motion are taken into account because these are interrelated in any given observation or experiment.

Linear and rotational dynamics

The study of dynamics falls under two categories: linear and rotational. Linear dynamics pertains to objects moving in a line and involves such quantities as force, mass/inertia, displacement (in units of distance), velocity (distance per unit time), acceleration (distance per unit of time squared) and momentum (mass times unit of velocity). Rotational dynamics pertains to objects that are rotating or moving in a curved path and involves such quantities as torque, moment of inertia/rotational inertia, angular displacement (in radians or less often, degrees), angular velocity (radians per unit time), angular acceleration (radians per unit of time squared) and angular momentum (moment of inertia times unit of angular velocity). Very often, objects exhibit linear and rotational motion.

For classical electromagnetism, Maxwell's equations describe the kinematics. The dynamics of classical systems involving both mechanics and electromagnetism are described by the combination of Newton's laws, Maxwell's equations, and the Lorentz force.

Force

From Newton, force can be defined as an exertion or pressure which can cause an object to accelerate. The concept of force is used to describe an influence which causes a free body (object) to accelerate. It can be a push or a pull, which causes an object to change direction, have new velocity, or to deform temporarily or permanently. Generally speaking, force causes an object's state of motion to change.^[1]

Newton's laws

Newton described force as the ability to cause a mass to accelerate. His three laws can be summarized as follows:

- First law** If there is no net force on an object, then its velocity is constant either the object is at rest (if its velocity is equal to zero), or it moves with constant speed in a single direction.^{[2][3]}

- 2 **Second law** The rate of change of linear momentum $\mathbf{P}$ of an object is equal to the net force $\mathbf{F}_{\text{net}}$, i.e., $d\mathbf{P}/dt = \mathbf{F}_{\text{net}}$.
3. **Third law**: When a first body exerts a force $\mathbf{F}_1$ on a second body, the second body simultaneously exerts a force $\mathbf{F}_2 = -\mathbf{F}_1$ on the first body. This means that $\mathbf{F}_1$ and $\mathbf{F}_2$ are equal in magnitude and opposite in direction

Newton's laws of motion are valid only in an inertial frame of reference.

See also

- Statics
- Multibody dynamics
- Rigid body dynamics
- Analytical dynamics

References

1. Goc R (2005). "Force in Physics" (https://web.archive.org/web/20100222050455/http://www.staff.amu.edu.pl/~romangoc/M3_1_force_physics.html) Archived from the original (<http://www.staff.amu.edu.pl/~romangoc/M3-1-force-physics.html>) (Physics tutorial) on 2010-02-22. Retrieved 2010-02-18.
- 2 Browne ME (1999) *Schaum's outline of theory and problems of physics for engineering and science* (<https://archive.org/details/schaumsoutlineof00brow>) (Series: Schaum's Outline Series). New York: McGraw-Hill. pp. 58 (<https://archive.org/details/schaumsoutlineof00brow/page/58>). ISBN 978 0 07 008498 8 "Newton's first law of motion "
3. Holzner S (2005). *Physics for Dummies* (<https://archive.org/details/physicsfordummie00holz>). Hoboken: Wiley. pp. 64 (<https://archive.org/details/physicsfordummie00holz/page/64>). ISBN 978-0 7645 5433 9 "Newton's laws of motion"

Further reading

- Attenborough K, Postema M (2008). *A pocket-sized introduction to dynamics* (<https://hal.archives-ouvertes.fr/hal-03188303/document>) Kingston upon Hull University of Hull doi:10.5281/zenodo.7504154 (<https://doi.org/10.5281%2Fzenodo.7504154>). ISBN 978-90-812588 3 8
- Swagatam (25 March 2010). "Calculating Engineering Dynamics Using Newton's Laws" (<https://web.archive.org/web/20110412013636/http://www.brighthub.com/engineering/mechanical/articles/111610.aspx>). *Bright Hub*. Archived from the original (<http://www.brighthub.com/engineering/mechanical/articles/111610.aspx>) on April 12, 2011 Retrieved 2010 04 10
- Wilson CE (2003). *Kinematics and dynamics of machinery*. London: Pearson. ISBN 978-0-201-35099 9
- Dresig HD, Holzweißig F (2010). *Dynamics of Machinery: Theory and Applications*. Heidelberg: Springer ISBN 978 3 540 89939 6

Retrieved from "[http://en.wikipedia.org/w/index.php?title=Dynamics_\(mechanics\)&oldid=1131552599](http://en.wikipedia.org/w/index.php?title=Dynamics_(mechanics)&oldid=1131552599)"

▪